The Fragility of Government Funding Advantage*

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Abstract

US federal debt plays a special role in the US economy and so gives the US government a funding advantage, often summarized by the spread between the yield on high-grade US corporate bonds and comparable US treasuries. Why? One reason is that government regulation (and/or repression) of the financial sector influences asset pricing and helps make long term US federal debt a "safe-asset". We study the mechanics, limitations, and macroeconomic trade-offs involved with generating a government funding advantage through restrictions on the financial sector. We show the government cannot choose all three of: (i) high funding advantage, (ii) a well-functioning financial sector, and (iii) fiscal policy that leads to systematic debt devaluation. We then test our theories using new US historical yield curve data from 1860-2024 and data from the Eurozone sovereign debt crisis.

JEL CLASSIFICATION: E31, E43, G12, N21, N41

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1 Introduction

US federal debt plays a special role in the economy and so gives the US government a funding advantage, often summarized by the spread between the yield on high-grade US corporate bonds and comparable US treasuries.[1] Macro-finance models have frequently treated US funding advantage as an immutable feature of the economic environment and encoded the "benefits" of holding US debt into agent preferences or the market structure. This means the government can easily "exploit" the funding advantage to increase spending. By contrast, historical studies suggest that the funding advantage emerged as part of a complicated collection of financial-monetary policies that have shaped financial sector demand for US treasuries. As documented in Lehner, Payne and Szőke (2024), this led to a funding advantage appearing in the late 1860s, well before Bretton-Woods, and falling to zero during the high inflation of the 1970s, despite the emergence of US dollar denominated debt as the international reserve asset. When viewed in this way, generating and exploiting a funding advantage is closely interconnected with government policy, difficult to execute, and imposes far reaching impacts on the macroeconomy. It links the stability of the financial sector to the stability of the government budget constraint. It distorts the portfolio of the financial sector, potentially increasing default and crowding out private liquidity creation and productive investment. In this paper, we study the mechanics, limitations, and trade-offs involved with creating financial sector demand for government debt and relate our analysis to historical eras.

We build a stochastic neoclassical growth model extended to include a morning sub-period where households need liquidity services provided by a risky banking sector. Absent regulation, there is no special role for government debt. The economy is populated by households who need bank deposits to be able to consume in the morning sub-period. Banks issue on-demand deposits and equity to households and invest in short assets, capital, and government bonds. In this sense, banks provide both liquidity and intermediation services to households. In the morning sub-period, banks get idiosyncratic deposit withdrawal shocks, which potentially cause them to default because their resource-drawing capacity is constrained and the inter-bank asset markets are characterized by "fire-sale pricing". The combination of households' need for deposits and the possibility of costly default are the "frictions" in the economy that break Modigliani and Miller (1958) by driving a wedge between the stochastic discount factors of the household and banks. The government in our model cares about spending and household welfare but faces a constraint that taxation is determined by an exogenous political process. Instead, the government can place restrictions on the portfolios of the banks that potentially increase the price of government debt

[1] This spread is sometimes referred to as the "convenience yield", "convenience spread", or "treasury premium" in the literature. However, there are also many other measures of the convenience yield so we instead use the term funding advantage to emphasize that we are measuring how much more cheaply the government can raise funds than the private sector.

and expand their spending. We focus on restrictions that require the banks to maintain a particular ratio of weighted average assets to deposits. We interpret equal weighting on government debt and capital to be neutral regulation and a higher weighting on government debt to be financial "repression".

We characterize how repression can generate a government funding advantage both directly through forced portfolio choice and also indirectly by making government debt an endogenously "safe-asset" in the economy. We show that the government can choose constraints on holdings of government debt that bind more for banks in the bad state of the world and so create counter-cyclical "captive demand". This can lead to an appreciation of the price of government debt in the secondary market in bad states. Ultimately, this makes government debt a good "hedge" against both aggregate shocks and idiosyncratic withdrawal risk, which also inflates the price of government debt in the primary market because banks voluntarily hold it to hedge their default risk. We interpret the inflated debt price as an embedded "funding advantage", defined to be the difference between the yield on government debt and the yield on an asset issued by the private sector with the same risk profile. In our model, the funding advantage decomposes into two components: a term reflecting the direct effect of regulatory demand and a second term reflecting the hedging role of government debt. The tractability of our model allows us to characterize how these terms depend explicitly on both regulatory parameters and fiscal policy.

We use our model to show that government "fiscal irresponsibility" erodes the funding advantage, where we interpret fiscal irresponsibility to mean the (explicit or implicit) default on government debt in bad times. Once government debt carries default risk, it is important to calculate funding advantage by subtracting the risk premium to remove the direct compensation for default risk (following Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2020b)). However, we show that doing so does not make the funding advantage independent of government default. In fact, both components of the convenience yield change. On the one hand, fiscal irresponsibility increases the convenience yield from direct regulatory demand because it makes the real value of government debt scarce and so the regulatory constraint harder to satisfy. On the other hand, it decreases the hedging role of government debt because it forces losses onto banks that respond by exiting the banking sector, which erodes the price of government debt in the secondary market in bad times. That is, financial repression ties the solvency of the banking sector to the solvency of the government and so government default makes government debt a worse hedge at the same time that it makes banks less solvent and more concerned about finding a good hedge. Ultimately, the result of this feedback is that fiscal irresponsibility decreases the government's funding advantage. This is in sharp contrast to models with bond-in-the-utility or bond-in-advance where the role of government debt is exogenous and its marginal usefulness increases as the market value of government debt declines. This means that as the government starts to

default, the government funding advantage increases. Or put another way, in these models the agents get utility from giving resources to the government so when the government starts to default, then they want more government debt. In this sense, the bond-in-utility and bond-in-advance models only capture the first component of the funding advantage in our model and miss the impact of the diminishing hedging role of government debt as the government starts to default. This highlights the importance of starting from a model where government is not exogenously important when we study fiscal policy.

Our model leaves the government with complicated trade-offs, which we summarize as a "trilemma" that the government cannot choose all three of: (i) high funding advantage, (ii) a well-functioning financial sector (profitable and stable), and (iii) fiscal policy that leads to systematic debt devaluation (e.g. "default", "counter-cyclical" issuance, "inflation"). For example, if the US government wants to run high inflation (a real devaluation of its debt), then according to the trilemma it must choose between maintaining its funding advantage by forcing the financial sector to hold more government debt and maintaining financial stability by allowing the financial sector to substitute away from government debt and and so lose its funding advantage. Alternatively, if the US government wants to generate a high funding advantage through heavy repression of the financial sector, then it must choose between a profitable financial sector and fiscal-monetary policy that would lead to the systematic devaluation of its debt.

Our theoretical model provides sharp predictions about how government regulation and fiscal policy influence the government funding advantage. In Section 5 we consider whether these predictions are consistent with empirical evidence. We focus on two datasets: a new estimation of US funding advantage for the period 1860-2024 (from our companion paper Lehner et al. (2024)) and "risk-adjusted convenience yields" across the Eurozone during the sovereign debt crisis covering the period 2003-2022 (following Jiang et al. (2020b)).

We use the historical US data to show that changes to financial and monetary policy correlates with changes in the relationship between debt issuance and US funding advantage. First, we find there are low frequency movements in the average funding advantage. On average, the US funding advantage peaked during the National Banking Era (1862-1913) and generally stayed high during the gold standard, as predicted by our model. Its long-run mean dropped sharply after World War I and followed a trend decline after the Great Depression before reaching its lowest levels during the high inflation of the 1970s and 1980s. Second, we find that the relationship between the US funding advantage and the US debt-to-GDP ratio varies with monetary and financial policy. The relationship appears mostly flat (with period specific intercepts) during the National Banking Era (1865-1913), during the era of yield curve control (1942-1951), and the quantitative easing period (post 2008). The overall period from 1920-2007 is downward sloping but during the high inflation period in the 1970s and 1980s, the funding advantage drops to zero and the relationship significantly changes. This

is consistent with our model, which suggests that the historical relationship between funding advantage and the debt-to-GDP does not reflect a stable exploitable demand function but instead reflects particular regulations and government policies. Similar to the Phillips curve, the relationship breaks down as governments tries to exploit it.

We also study the Eurozone during the sovereign debt crisis because it offers a unique opportunity to "test" a second key prediction of our model: that increases in the likelihood of government default (implicit or explicit) erode the risk-adjusted convenience yield, even when government debt is privileged by regulation. For this period, unlike for the historical US period, we can use data from credit default swaps (CDS) to approximate the default risk premium and calculate risk-adjusted convenience yields (following the approach in Jiang et al. (2020b)). We find that countries facing fiscal crises and high CDS spreads (e.g. Ireland, Portugal, Spain, and Italy) experienced much larger decreases in risk-adjusted convenience yields than countries in relative strong positions (e.g. Germany, Netherlands, Finland, and France). This pattern holds true even after the ECB issued wavers for Greek debt (April 2010), Irish debt (March 2011), and Portuguese debt (July 2011) that allowed banks to continue to use debt from those countries as collateral at the ECB despite their low credit ratings. So, the decrease in the funding advantage for Ireland, Portugal, Spain, and Italy cannot entirely be explained by risk premia and changes in their collateral value. This is consistent with our model, which suggests that the hedging role of these assets also changed leading to an erosion of the risk-adjusted convenience yield.

1.1 Related Literature

Our paper is part of a large literature studying financial and fiscal policies in non-Ricardian macroeconomic models. A recent branch of this literature studies the "fiscal-sustainability" of government debt taking fiscal policy and private sector pricing kernels as given (e.g. Jiang, Lustig, Stanford, Van Nieuwerburgh and Xiaolan (2022a); Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2022b); Chen, Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2022)) or deriving private sector pricing kernels from a model with incomplete markets that generate a premium on government debt (e.g. Reis (2021b), Reis (2021a), Brunnermeier, Merkel and Sannikov (2022)). Our paper studies the feasibility and costs of using financial regulation as a means to "choose" private sector pricing kernels that increase government fiscal capacity. Another branch of this literature studies fiscal-monetary connections (e.g. Sargent and Wallace (1981) and the "fiscal theory of the price level" papers such as Leeper (1991), Sims (1994), Woodford (1994), Cochrane (2023), Bianchi, Faccini and Melosi (2023)). Unlike in these papers, government debt in our model is in part backed by financial regulation by creating captive demand within the financial sector and endogenously making government debt a safe asset. Ultimately, this means that fiscal policy not only backs government debt through the surplus process but also through its effectiveness as a safe asset.

Our government design problem is related to the literature studying optimal policy in economies with financial frictions and tax distortions (e.g. Calvo (1978), Bhandari, Evans, Golosov and Sargent (2017a), Bhandari, Evans, Golosov, Sargent et al. (2017b), Chari, Dovis and Kehoe (2020), Bassetto and Cui (2021), Sims (2019), Brunnermeier et al. (2022)). In this paper we take the stand that the government follows a fiscal policy rule governed by unmodeled political constraints but has flexibility in how it wants to restrict the financial sector. We believe this reflects the historical experience of many governments. We use this model to focus on microfounding the "costs" of using financial regulation to increase government fiscal capacity.

We are also part of a long literature attempting to understand how the financial sector and government can create safe assets (e.g. Holmstrom and Tirole (1997), Holmström and Tirole (1998), Gorton and Ordonez (2013), Gorton (2017), He, Krishnamurthy and Milbradt (2016), He, Krishnamurthy and Milbradt (2019), Choi, Kirpalani and Perez (2022)) and the macroeconomic implications of safe asset creation (e.g. Caballero, Farhi and Gourinchas (2008), Caballero, Farhi and Gourinchas (2017), Caballero and Farhi (2018)). Our contribution to this literature is to connect an endogenous safe asset model to a general equilibrium macroeconomy with a government that faces fiscal constraints.

Our historical comparisons extend existing studies on the convenience yield (e.g. Krishnamurthy and Vissing-Jorgensen (2012), Choi et al. (2022)) back to the mid nineteenth century. This makes us part of a literature attempting to connect historical time series for asset prices to government financing costs (e.g. Payne, Szőke, Hall and Sargent (2023b), Payne, Szőke, Hall and Sargent (2023a), Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2021b), Jiang, Krishnamurthy, Lustig and Sun (2021a), Jiang, Lustig, Van Nieuwerburgh and Xiaolan (2020a)). Our Eurozone example adopts the approach in Jiang et al. (2020b). Our focus on modeling the hedging properties of government debt is complementary to the empirical work of Acharya and Laarits (2023).

2 A Model of Policy-Invariant Funding Advantage

This section outlines a simple two period model highlighting how convenience yields are often generated in the macroeconomic literature. We show this model gives the government extensive power to "exploit" its funding advantage and increase borrowing capacity through debt devaluation.

Environment: Time lasts for two periods: $t \in \{0, 1\}$. There is one type of consumption good. The economy is populated by a representative household and contains a government. The household is endowed with 1 good at $t = 0$ and has two saving options. One is a production technology that transforms 1 good at $t = 0$ into z goods at $t = 1$. The other is

a bond, issued by the government, that trades in a competitive market at $t = 0$ for price q_0^b and repays x_1^b at time $t = 1$. The household gets utility $u(c_1) = \frac{1}{1-\gamma} c_1^{1-\gamma}$ from consuming c_1 goods at $t = 1$ and utility $\nu(q_0^b b_0) = \frac{\bar{\nu}}{1-\gamma} \left(q_0^b b_0\right)^{1-\gamma}$ from purchasing b_0 bonds.

The government finances spending G_0 at $t = 0$ by issuing debt B_0 and repays $x_1^b B_0$ by raising lump sum taxes τ_1 at $t = 1$. So, their budget constraints are:

$$G_0 = q_0^b B_0, \qquad \tau_1 = x_1^b B_0 \tag{2.1}$$

We interpret $1 - x_1^b$ as the real devaluation or default on government debt. We refer to a government choice of $(B_0, x_1^b, \tau_1, G_0)$ satisfying (2.1) as their budget feasible fiscal policy.

Equilibrium: The household chooses consumption, c_1, bond holdings, b_0, and capital, k_0, to solve problem (2.2) below:

$$\max_{c_1, b_0, k_0} \left\{\beta u(c_1) + \nu(q_0^b b_0)\right\} \quad s.t. \quad q_0 b_0 + k_0 \leq 1, \quad c_1 \leq z k_0 + \delta_1^b b_0 - \tau_1 \tag{2.2}$$

Substituting in the $t = 1$ constraint leads to the household first order conditions:

$$[b_0]: \qquad q_0^b = \xi \left(\frac{1}{1 - \nu'(q_0^b b_0)/\mu_0^c}\right) \delta_1^b$$

$$[k_0]: \qquad 1 = \xi z$$

where $\xi := \beta u'(z k_0 + x_1^b - \tau_1)/\mu_0^c = 1/z$ is the household discount factor across periods, μ_0^c is the Lagrange multiplier on the time 0 budget constraint, and $1/(1 - \nu'(q_0^b b_0)/\mu_0^c)$ is the "wedge" in the FOC representing the non-pecuniary benefit from holding government debt. Given budget feasible government policies $(B_0, x_1^b, \tau_1, G_0)$, an equilibrium is a collection of (q_0^b, b_0, k_0, c_1) such that households solve (2.2) and the government bond market clears: $b_0 = B_0$.

Convenience yields and the government budget constraint: We define the government's "funding advantage" to be the spread between the yield on an asset with the same payoff as government debt and the yield on government debt, which in equilibrium is given by:

$$\chi = -\log\left(\xi x_1^b\right) - \left(-\log(q_0^b)\right) = \log\left(\frac{1}{1 - \nu'(q_0^b b_0)/\mu_0^c}\right) \tag{2.3}$$

The literature sometimes refers to this spread as the "convenience yield", "risk-adjusted convenience yield", or "treasury premium". To emphasize its role in generating government borrowing capacity, we will use the term "government funding advantage" throughout this

paper. For the special case that $\gamma = 1$, the funding advantage is given explicitly by:

$$\chi = -\log\left(1 + \frac{1 + 1/\bar{\nu}}{z/(x_1^b B_0) - 1}\right)$$

Combining the government budget constraints shows that the equilibrium ratio of government spending to taxation is given by:

$$\frac{G_0}{\tau_1} = \xi(1 + \chi)$$

From these expressions, we can see that a decrease in $x_1^b B_0$ leads to an increase in χ and an increase in the G_0/τ_1 ratio regardless of whether it is x_1^b or B_0 that decreases.

Exploiting funding advantage: Our simple model exposes an important implication of the modeling approaches used in the macro-finance literature: the government has a lot of freedom to "exploit" the relationship (2.3) to expand its budget constraint. First, a devaluation of government debt through a decreasing x_1^b leads to an increase in its funding advantage by moving the government along the household's debt demand curve. We can see this in Figure 1. This is because the "special role" of treasuries in the bond-in-the-utility models is policy-invariant and in particular, it is unrelated to the treasury price process. Second, the convenience yield appears without any government financial restrictions. This implies that the model underestimates the full "cost" of generating convenience yields.

In section 3, we build a model where regulation generates a convenience yield indirectly through the way it changes the price process for government debt and the ability of the financial sector to use government debt as a "safe-asset". This will prevent the government from moving along the government debt demand curve through devaluation because devaluation policy changes demand for government debt and so shifts the debt demand curve. Ultimately, this will mean that the government faces a trade-off between counter cyclical debt issuance, high convenience yields, and the profitability of the banking sector.

3 A Model of Policy-Variant Funding Advantage

Our model is a stochastic neoclassical growth model extended to include a morning sub-period where households need liquidity services. Financial intermediaries provide these services but this exposes them to frictions in the secondary asset markets (in the morning sub-period) that may force asset sales and/or costly default in bad states of the world. This generates two interconnected asset pricing distortions: a "liquidity spread" on financial sector liabilities and a "hedging spread" on assets that help the financial intermediaries

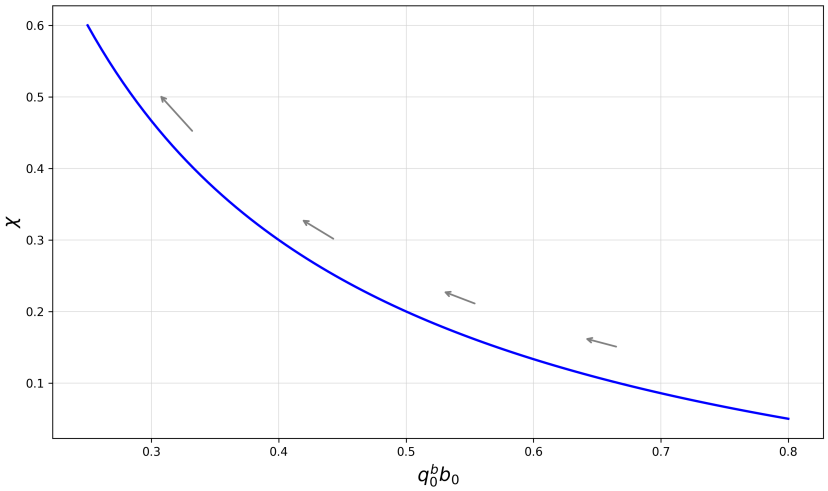


Figure 1: Exploiting the convenience yield

Left plot: Devaluing government debt by decreasing x_1^b leads to a decrease in $q_0^b b_0$ and an increase in χ. This is a movement from right to left along the curve.

to self insure risks in the secondary asset markets. Both of these spreads are higher in bad states of the world, reflecting counter-cyclical household demand for liquid assets and counter-cyclical financial sector demand for hedging assets. Absent financial regulation and government default, government debt and productive capital are equally useful for hedging risks in the secondary market. That is, government debt does not have an immutable, special role in the economy.

We study a government that imposes restrictions on financial sector portfolios. This introduces additional asset-specific regulatory pricing distortions, which change the equilibrium co-movement between government debt prices and aggregate shocks. In particular, the regulatory restrictions can induce crowding into the secondary government debt market in bad times. This can make government debt a good hedging asset, which in turn generates a government funding advantage. In this sense, the funding advantage emerges endogenously through counter-cyclical captive demand rather than through an immutable, exogenous preference, as in Section 2. This means that our endogenous funding advantage becomes policy variant. In particular, systematic devaluation of government debt erodes financial sector profitability, which leads to exit from the financial sector. This limits the government's ability to create regulatory captive demand and so, in turn, erodes its funding advantage.

3.1 Environment

Setting: The economy is in discrete time with infinite horizon: $t = 0, 1, 2, \ldots$. Each period has morning and afternoon sub-periods. We interpret the afternoon sub-period as a primary asset market and the morning sub-period as a secondary (inter-bank) asset market. We denote variables in the morning market with a breve, $\breve{v}$, and in the afternoon market without a breve, v. There is one consumption good. There is a family of households and a continuum of islands, each with a representative competitive bank. There is a government that issues debt, b_t, in the primary asset market at price q_t^b and raises taxes τ_t from the family in the afternoon.

Production technologies: There is a linear "afternoon" production technology that transforms k_t units of capital into $z(\mathsf{s}_t)k_t$ units of consumption goods in the afternoon, where s_t is the aggregate state that has distribution $\Pi(\mathsf{s}_t)$ and is realized at the beginning of period t. Afternoon consumption goods can be transformed one-to-one into units of capital next period and capital depreciates at rate $\delta > 0$ so the evolution of an agent's capital holdings follows:

$$k_t = (1 - \delta)k_{t-1} + i_t \tag{3.1}$$

where i_t is investment. There is also a "morning" short term production technology that transforms m_t goods in the afternoon market at time t into $\breve{z}(\mathsf{s})m_t$ goods in the morning market at time $t + 1$.

Households: We model intra-period heterogeneity using a family of households in the spirit of Lucas (1990). In each afternoon, taking after-tax unspent wealth, $a_t - \tau_t$, as given, the family chooses consumption, and a portfolio of bank deposits and equity evenly across the islands. At the start of each morning, the members of the family are separated evenly across the continuum of islands. During separation, households have access to the family's bank deposit on their own island and are excluded from financial markets on other islands. Households on each island are uncertain about their own preferences, in the manner of Diamond and Dybvig (1983) and Allen and Gale (1994). There are two "layers" of uncertainty: household- and island-specific, both of which are resolved immediately after the family is separated. First, on each island, a random fraction λ of households consume in the morning and then die. Second, λ is a random variable following the distribution $\lambda \sim F(\lambda)$ with mean Λ. In the afternoon, surviving members—of fraction $(1 - \Lambda)$—return to the family and a fraction Λ of new members is born keeping the afternoon size of the family unchanged.

Banks: In the afternoon of each period t, on each island, a one period lived representative

bank is set up and issues demand deposits, d_t, and equity, e_t, to the family at prices q_t^d and q_t^e, respectively.[2] Equity issued by bank λ pays $x_{t+1}^e(\lambda)$ in the afternoon of period $t+1$ and nothing in the morning. Households on island λ can withdraw deposits for resources $\breve{x}_{t+1}^d(\lambda) \leq 1$ either in the morning or in the afternoon of period $t+1$.

Three assets. In the morning, after the shocks are realized, banks can trade government bonds, at price $\breve{q}_t^b$, and claims on capital, at price $\breve{q}_t^k$, in the secondary asset markets. Post trade asset portfolios are restricted by a regulatory collateral constraint specified below.

In the afternoon, banks sell their remaining assets to the newly formed banks, pay out dividends, then die.

Government: In the afternoon of period t, the government purchases consumption goods g_t, raises lump-sum taxes τ_t on the household, and issues bonds in the primary asset market at price q_t^b that pay $x_{t+1}^b \leq 1$ in the afternoon of period $t+1$. We interpret $x_{t+1}^b < 1$ as "partial default" or "dilution" because the government decreases the real value of the bond principal. The government's one-period budget constraint in the afternoon is:

$$g_t + x_t^b b_{t-1} \leq \tau_t + q_t^b b_t. \tag{3.2}$$

The government faces as exogenous stochastic surplus process $\tau_t - g_t$, which interpret as an exogenous fiscal rule coming from an unmodeled political arrangement. We consider a government setting (x_t^b, b_t) to satisfy 3.2.

The government can also manipulate the value of its bond, q_t^b, through financial regulation—by imposing restrictions on banks' portfolios after re-trading in the secondary asset markets:

$$\frac{\varrho}{2}\breve{x}_t^d(\lambda)\breve{d}_t(\lambda) \leq \kappa\ \breve{q}_t^b\breve{b}_t(\lambda) + (1-\kappa)\ \breve{q}_t^k\breve{k}_t(\lambda) \qquad \forall(\lambda, \mathsf{s})$$

where $\breve{d}_t(\lambda)$ is bank λ's remaining share of deposits at the end of the morning of period t, and $\breve{b}_t(\lambda)$ and $\breve{k}_t(\lambda)$ denote bank λ's post-trade holdings of government debt and claims on capital, respectively, *both* expressed relative to bank λ's initial deposits, d_{t-1}. The pair (ϱ, κ) is a set of regulatory parameters: $\varrho \in [0,1]$ is a leverage constraint that restricts the bank's ability to back its deposit with long term assets, while $\kappa \in [0,1]$ is the relative "weight" on government debt in the calculation of regulatory asset value, which we interpret as the extent of repression. We refer to $\kappa = 0.5$ as a "neutral" regulatory regime and $\kappa > 0.5$ as a "repression" regime.[3]

Markets: We use goods as the numeraire. All markets are competitive.

[2] The deposit and equity prices are the same on each island because islands are ex-ante identical.

[3] $\kappa = 0.5$ refers to a regulatory regime that treats government debt and capital symmetrically and just restricts bank risk taking through $\varrho > 0$. $\kappa > 0.5$ is a regime that incentivizes the holding of government debt over capital as regulatory collateral, while $\kappa < 0.5$ corresponds to the opposite case.

3.1.1 A Broader Interpretation

We have written the model to focus on how portfolio restrictions in the banking sector change the price process for government debt. However, the forces in the model generalize to other environments. Here we discuss two generalizations: alternative types of regulation and alternative types of financial intermediaries.

Alternative regulations: We have interpreted κ as the weight in explicit macroprudential regulation. One alternative is that it could reflect implicit pressure on the banking sector to purchase government debt. Another alternative is that it could reflect collateral requirements at a government discount window. For the latter case, the regulatory requirement is only faced by backs that are in trouble rather than by all banks in the economy.

Alternative financial intermediaries: At a more abstract level, the key features of the model that we require are: (i) there is a financial intermediary that provides a service to households that exposes the intermediary to risk, (ii) the financial intermediary faces frictions that generate a wedge $\breve{M}^e$ in the intermediary Euler (e.g. equity raising constraints), (iii) the government restricts the portfolio that the financial intermediary must maintain when they trade in secondary asset markets. In this sense, the forces in our model could also apply to insurance companies or pension funds.

3.2 Equilibrium

Household problem: Let $V(a)$ be the value of the household at the start of the afternoon with unspent wealth a. The recursive formulation of the household problem is (where dependence on the aggregate state s is left implicit):

$$\begin{aligned} V(a) = \max_{\{c,e,d,\breve{c}(\lambda')\}} \quad & u(c) + \beta \mathbb{E}_{\mathsf{s}'|\mathsf{s}} \left[\sum_{\lambda'} \lambda' u\Big(\breve{c}(\lambda')\Big) dF(\lambda') + V(a') \right] \\ s.t. \qquad & c + q^d d + q^e e \leq a - \tau \\ & \breve{c}(\lambda') \leq \breve{x}^d(\lambda') d, \qquad \forall (\lambda', \mathsf{s}') \\ & a' = \sum_{\lambda'} \Big(x^e(\lambda') e + (1-\lambda') \breve{x}^d(\lambda') d \Big) dF(\lambda') \end{aligned} \tag{3.3}$$

Bank problem: The bank problem is linearly homogeneous in deposit issuance d. For simplicity, we use the notation $\hat{v}$ to denote variables v normalized by bank deposit. Morning

asset holdings $(\breve{b}_t, \breve{k}_t)$ are normalized from the start. The representative bank maximizes:

$$\begin{aligned}
\max_{\substack{\hat{m},\hat{k},\hat{b},\\ \breve{x}^d(\lambda'),\hat{x}^e(\lambda'),\breve{b}(\lambda'),\breve{k}(\lambda')}} \quad & \mathbb{E}_{\mathsf{s}'|\mathsf{s}}\left[\xi \sum_{\lambda'} \max\{0;\ \hat{x}^e(\lambda')\} dF(\lambda')\right] + q^d - \hat{m} - \hat{k} - q^b\hat{b} \\
s.t. \qquad & \lambda'\breve{x}^d(\lambda') \leq \breve{z}(\mathsf{s}')\hat{m} + \breve{q}^b(\mathsf{s}')\Big(\hat{b} - \breve{b}(\lambda')\Big) + \breve{q}^k(\mathsf{s}')\Big(\hat{k} - \breve{k}(\lambda')\Big), \\
\hat{x}^e(\lambda') + (1-\lambda')\breve{x}^d(\lambda') & \leq \Big(z(\mathsf{s}') + (1-\delta)q^k(\mathsf{s}')\Big)\breve{k}(\lambda') + x^b(\mathsf{s}')\breve{b}(\lambda'), \\
\frac{\varrho}{2}\breve{x}^d(\lambda')(1-\lambda') & \leq \kappa\ \breve{q}^b(\mathsf{s}')\breve{b}(\lambda') + (1-\kappa)\ \breve{q}^k(\mathsf{s}')\breve{k}(\lambda'), \\
0 \leq \breve{b}(\lambda'),\ \breve{k}(\lambda'),\ & 1 - \breve{x}^d(\lambda'), \qquad \forall(\lambda', \mathsf{s}')
\end{aligned} \tag{3.4}$$

where ξ denotes the household's SDF.

Definition 1 (Budget-feasible government policy)**.** Given a fiscal rule $\{\tau_t - g_t\}_{t\geq 0}$ and bond price sequence $\{q_t^b\}_{t\geq 0}$, a budget-feasible government policy is a sequence $\{B_t, x_t^b\}_{t\geq -}$ s.t. (3.2) is satisfied for all $t \geq 0$.

Definition 2 (Competitive Equilibrium)**.** Given a fiscal rule $\{\tau_t - g_t\}_{t\geq 0}$, regulation parameters (ϱ, κ), and a budget-feasible government policy $\{B_t, x_t^b\}_{t\geq 0}$, a competitive equilibrium is a sequence of prices $\{q_t^d, q_t^e, q_t^b, \breve{q}_t^k, \breve{q}_t^b\}_{t\geq 0}$, payoffs $\{\breve{x}_t^d, x_t^e\}_{t\geq 0}$, household policies $\{d_t, e_t, c_t, \breve{c}_t\}_{t\geq 0}$, and bank policies $\{d_t, m_t, i_t, b_t, \breve{k}_t, \breve{b}_t\}_{t\geq 0}$, such that

- The family solves (3.3),
- Banks solve (3.4),
- Morning and afternoon goods markets clear

$$\sum_{\lambda} \breve{c}_t(\lambda) dF(\lambda) = \breve{z}_t m_{t-1}, \qquad\qquad c_t + m_t + i_t + g_t = z_t k_{t-1}$$

  and morning asset markets clear

$$\sum \breve{b}_t(\lambda) dF(\lambda) d_{t-1} = b_{t-1}, \qquad \sum \breve{k}_t(\lambda) dF(\lambda) d_{t-1} = k_{t-1}$$

  and afternoon asset markets clear:

$$d_t^h = d_t, \qquad\qquad e_t^h = 1, \qquad\qquad b_t = B_t.$$

4 Equilibrium Characterization

4.1 Primary Asset Markets

In the afternoon sub-period, households, banks, and the government trade assets in the primary asset markets. In particular, households choose their portfolios of bank deposits and equity according to the following Euler equations:

$$q_t^d = \mathbb{E}\Big[\xi_{t,t+1} \sum_{\lambda} \Big(\big(1 + \breve{\nu}_{t+1}(\lambda)\big)\, \breve{x}_{t+1}^d(\lambda)\Big) dF(\lambda)\Big] \tag{4.1}$$

$$q_t^e = \mathbb{E}\Big[\xi_{t,t+1} \sum_{\lambda} x_{t+1}^e(\lambda) dF(\lambda)\Big] \tag{4.2}$$

where the stochastic discount factor (SDF) and the "liquidity wedge" are defined by:

$$\xi_{t,t+1} := \beta \frac{u'(c_{t+1})}{u'(c_t)}, \qquad\qquad \breve{\nu}_{t+1}(\lambda) := \lambda \left(\frac{u'(\breve{c}_{t+1}(\lambda))}{u'(c_{t+1})} - 1 \right).$$

Demand deposits provide liquidity services to the households in the morning sub-period, which introduces a distortion, $\breve{\nu}(\lambda)$, into the pricing of bank deposits. The presence of this asset-specific wedge implies that households are willing to hold demand deposits at a discount, which leads to an exogenous "funding advantage"—similar to those discussed in section 2—to the providers of such assets.

Banks create these "special" demand deposits by holding a portfolio of reserve asset, capital, and government debt. In particular, newly formed banks invest in the reserve asset according to the Euler equation

$$1 = \mathbb{E}\Big[\xi_{t,t+1} \breve{M}_{t+1}^e \breve{z}_{t+1}\Big] \tag{4.3}$$

and purchase capital (from exiting banks) and debt (from the government) in the primary asset markets according to the Euler equations:

$$1 = \mathbb{E}\Big[\xi_{t,t+1} \breve{M}_{t+1}^e \breve{q}_{t+1}^k\Big] \tag{4.4}$$

$$q_t^b = \mathbb{E}\Big[\xi_{t,t+1} \breve{M}_{t+1}^e \breve{q}_{t+1}^b\Big] \tag{4.5}$$

so that the bank zero profit condition is satisfied:

$$q_t^d d_t + q_t^e = m_t + k_t + q_t^b b_t. \tag{4.6}$$

The bank Euler equations (4.3)-(4.5) all include an extra distortion, $\breve{M}_t^e(\lambda)$ defined as

$$\breve{M}_t^e(\mathsf{s}) := \sum_{\lambda} \breve{\mu}_t^e(\lambda, \mathsf{s}) dF(\lambda)$$

where $\breve{\mu}_t(\lambda)$ is the equilibrium value of the Lagrange multiplier on the morning budget constraint of bank λ, so $\breve{M}_t^e$ reflects a representative bank's expected marginal value of income in the morning of period t *conditional* on the aggregate state s. Because deposit contracts cannot be freely conditioned on states (λ, s), and there is no equity injection or short-selling of debt and capital in the morning sub-period, the equilibrium value of $\breve{M}_t^e$ tends to be higher than one and is counter-cyclical, i.e., the "default distortion" $\breve{\mu}_t^e(\lambda)$ makes the banking sector act as more "risk-averse" than the household sector even though banks use the household's SDF.

Conditional on state variables $(\mathsf{s}_t, k_{t-1}, b_{t-1})$ and decisions in the next morning, period-t afternoon variables $(c_t, i_t, k_t, m_t, b_t, d_t, q_t^b, q_t^e, q_t^d)$ are characterized by (4.1), (4.2), (4.3), (4.4), (4.5), and (4.6) along with capital accumulation (3.1), the government budget constraint (3.2), and the aggregate resource constraint:

$$c_t + m_t + i_t + g_t = z(\mathsf{s}_t) k_{t-1}.$$

In other words, conditional on the morning sub-period, our model mimics the familiar neoclassical growth model, with the exceptions that the "liquidity distortion" $\breve{\nu}_t \neq 0$ and "default distortion" $\breve{M}_t^e \neq 1$.

4.2 Inter-bank Asset Markets

We now turn to characterizing equilibrium in the inter-bank asset markets which ultimately determines distortions $\breve{\nu}_t(\lambda)$ and $\breve{M}_t^e$, prices $\breve{q}_t^k$ and $\breve{q}_t^b$, and payoffs $\breve{x}_t^d(\lambda)$ and $\breve{x}_t^e(\lambda)$ that featured prominently in Euler equations (4.1)-(4.5). At the beginning of the morning, the island-specific withdrawal shock, λ, leads to ex post heterogeneity among banks: those with low λ have excess resources, $\breve{z}_t \breve{m}_{t-1} > \lambda$, that they can use to purchase assets in the inter-bank markets, while those with λ such that $\breve{z}_t \hat{m}_{t-1} < \lambda$ face financial distress that may lead to forced asset sales or default $\breve{x}_t^d(\lambda) < 1$.

We need to characterize four variables $(\breve{x}_t^d, \breve{k}_t, \breve{b}_t, x_t^e)$ and three multipliers $(\breve{\mu}_t^e, \mu_t^e, \breve{\mu}_t^r)$ which are functions of both idiosyncratic and aggregate states, (λ, s), and two asset prices $(\breve{q}_t^k, \breve{q}_t^b)$ which are functions of the aggregate state s only. $\breve{\mu}_t^r(\lambda)$ and $\mu_t^e(\lambda)$ are Lagrange multipliers associated with the regulatory constraint and afternoon budget constraint of bank λ, respectively. Conditional on multipliers $(\breve{\mu}_t^e, \mu_t^e, \breve{\mu}_t^r)$ and prices $(\breve{q}_t^k, \breve{q}_t^b)$, asset payoffs

and bank portfolios $(\breve{x}_t^d, \breve{k}_t, \breve{b}_t, x_t^e)$ are determined by the the FOC with respect to $\breve{x}_t^d(\lambda)$:

$$\psi \geq \underbrace{\lambda \breve{\mu}_t^e(\lambda) + (1-\lambda)\Big(\mu_t^e(\lambda) + (\varrho/2)\breve{\mu}_t^r(\lambda)\Big)}_{\text{marginal benefit of reducing } \breve{x}_t^d} \quad \text{with } = \text{ if } \breve{x}_t^d(\lambda) < 1 \qquad \forall(\lambda, \mathsf{s})$$

the Euler equations with respect to capital $\breve{k}_t(\lambda)$ and debt $\breve{b}_t(\lambda)$:

$$\begin{aligned}
\breve{q}_t^k &\geq \left(\frac{\mu_t^e(\lambda)}{\breve{\mu}_t^e(\lambda) - (1-\kappa)\breve{\mu}_t^r(\lambda)}\right)\Big(z_t + (1-\delta)\Big) && \text{with } = \text{ if } \breve{k}_t(\lambda) > 0, \qquad \forall(\lambda, \mathsf{s}) \\
\breve{q}_t^b &\geq \left(\frac{\mu_t^e(\lambda)}{\breve{\mu}_t^e(\lambda) - \kappa\breve{\mu}_t^r(\lambda)}\right) x_t^b && \text{with } = \text{ if } \breve{b}_t(\lambda) > 0, \qquad \forall(\lambda, \mathsf{s})
\end{aligned}$$

and the bank afternoon budget constraint:

$$x_t^e(\lambda) = \Big(z_t + (1-\delta)\Big)\breve{k}_t(\lambda) + x_t^b \breve{b}_t(\lambda) - (1-\lambda)\breve{x}_t^d(\lambda) \qquad \forall(\lambda, \mathsf{s})$$

Conditional on prices $(\breve{q}_t^k, \breve{q}_t^b)$ and quantities $(\breve{x}_t^d, \breve{k}_t, \breve{b}_t, x_t^e)$, the three multipliers are pinned down by the bank morning budget constraint

$$\lambda\breve{x}_t^d(\lambda) + \psi(1 - \breve{x}_t^d(\lambda)) = \breve{z}_t m_{t-1} + \breve{q}_t^k\Big(k_{t-1} - \breve{k}_t\Big) + \breve{q}_t^b\Big(b_{t-1} - \breve{b}_t\Big) \qquad \forall(\lambda, \mathsf{s})$$

the regulatory constraint

$$0 = \breve{\mu}_t^r(\lambda)\Big((1-\kappa)\ \breve{q}_t^k \breve{k}_t(\lambda) + \kappa\ \breve{b}_t^k \breve{b}_t(\lambda) - \frac{\varrho}{2}\breve{x}_t^d(\lambda)(1-\lambda)\Big) \qquad \forall(\lambda, \mathsf{s})$$

and the complementary slackness condition of the limited liability constraint

$$0 = \Big(\mu_t^e(\lambda) - 1\Big)x_t^e(\lambda) \qquad \forall(\lambda, \mathsf{s})$$

Finally, asset prices $(\breve{q}_t^k, \breve{q}_t^b)$ are determined by the asset market clearing conditions

$$\begin{aligned}
\sum_\lambda \breve{k}_t(\lambda) &= \hat{k}_{t-1} \qquad \forall \mathsf{s} \\
\sum_\lambda \breve{b}_t(\lambda) &= \hat{b}_{t-1} \qquad \forall \mathsf{s}.
\end{aligned}$$

Evidently, two key features influence equilibrium in the inter-bank asset markets: the banking sector's inability to draw resources from the households (as characterized by the multiplier $\breve{\mu}^e(\lambda) > 1$) and the regulatory constraint (as characterized by the multiplier $\breve{\mu}_t^r(\lambda) > 0$). If neither of these features were present, then $\breve{\mu}_t^e(\lambda) = 1$, $\breve{\mu}_t^r(\lambda) = 0$ and $\mu_t^e(\lambda) = 1$ (dividend would be always positive). In this case, the all banks' marginal value of an additional unit of wealth is equal to the household's marginal value: $\breve{M}_t^e \equiv 1$ and prices

of bonds and capital would be $\breve{q}_t^b = x_t^b$ and $\breve{q}_t^k = z_t + 1 - \delta$. We refer to this as the assets being priced at their "fundamental value".

The bank's inability to raise equity in the morning introduces a link between the aggregate proceeds from bank reserve holdings, $\breve{z}_t \hat{m}_{t-1}$, and aggregate asset demand in the sense that resource scarcity puts downward pressure on asset prices in the inter-bank market. This shows up as a wedge, $\breve{\mu}_t^e(\lambda) > 0$, between the marginal value of income inside versus outside of bank λ. In equilibrium this wedge manifests itself as "fire sale pricing" in the inter-bank asset markets in the sense that, on average, $\breve{q}_t^b < x_t^b$ and $\breve{q}_t^k < z_t + 1 - \delta$, i.e., assets are traded below their "fundamental value" at all states of the word in which $\breve{M}_t^e > 1$.[4] Moreover, because the multiplier $\breve{M}_t^e$ increases when aggregate resources get relatively more scarce, the bank's marginal valuation of wealth goes up relatively more in bad times which makes the bank more "risk averse" than the household. As a result, banks will pay a premium (relative to households) for an asset that is a good hedge against aggregate risk. We show this visually in the left panel of Figure 2. Taking the household's and bank's SDFs as given we ask how much more the bank will pay, compared to the household, for an asset that has a mean price of $\bar{q}_t^b$ but which pays $\breve{q}_t^b(\mathsf{s}_L)$ in the bad state. The solid lines depict this premium, $\mathbb{E}[\xi \breve{M}^e \breve{q}_t^b] - \mathbb{E}[\xi \breve{q}_t^b]$, as a function of $\breve{q}_t^b(\mathsf{s}_L)$ while keeping the mean price $\bar{q}_t^b$ constant (dashed vertical line). As we move from left to right the asset becomes a better hedge against aggregate risk and in fact the premium the bank will pay for this asset increases.

Finally, when both equity raising frictions and regulation are present, both Lagrange multipliers are positive $\breve{\mu}_t^e > 1, \breve{\mu}_t^r > 0$ at least for some banks. Because the multipliers $\breve{\mu}_t^r$ appears with a negative sign in the pricing equations, indicating that the regulatory constraint dampens the higher effective risk aversion of the bank. Indeed, comparing the orange and black lines in the left panel of Figure 2, we can see that the bank's hedging premium under repression (orange line) is consistently lower than the premium without government restrictions on bank's balance sheets (black line). In the right panel, we can see that this is reflected in a decrease in the concavity of the bank's continuation value because they now have an effective hedge. If regulation is symmetric in its treatment of bonds and capital, then $\kappa = 1/2$ and the relative price ratio is simply the ratio of afternoon payoffs:

$$\frac{\breve{q}_t^b}{\breve{q}_t^k} = \frac{x_t^b}{z_t + 1 - \delta}, \qquad \forall \mathsf{s}$$

If regulation advantages government bonds, then $\kappa > 1/2$ and relative price of government

[4] The finance literature refers to this as "fire sale" Shleifer and Vishny (1992, 2011) or cash-in-the-market pricing Allen and Gale (1994, 1998). The monetary literature, starting with Lucas (1990), refers to this as "liquidity effect" which was taken up by the limited participation literature (Christiano and Eichenbaum, 1992, 1995).

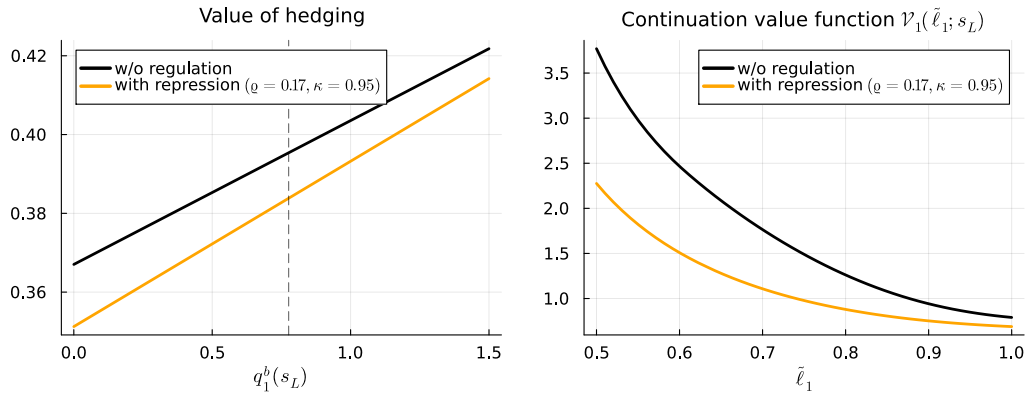


Figure 2: Financial regulation affects the banking sector's "risk aversion"

Left plot: solid lines depict how much more banks would pay for an asset that has a mean price of $\breve{q}_t^b$ (dashed line) but which pays $\breve{q}_t^b(\mathsf{s}_L)$ in the bad state (x-axis). Formally, we measure this via $\mathbb{E}[\xi(\mathsf{s})\breve{M}^e(\mathsf{s})\breve{q}_t^b(\mathsf{s})] - \mathbb{E}[\xi(\mathsf{s})\breve{q}_t^b(\mathsf{s})]$ (y-axis). *Right plot:* Continuation value function $\mathcal{V}_1$ (as a function of leverage $\tilde{\ell}_1$) conditional on the bad aggregate state s_L.

debt is higher and satisfies:

$$\frac{\breve{q}_t^b}{\breve{q}_t^k} = \frac{x_t^b}{z_t - \kappa \breve{\mu}_t^r \breve{q}_t^k}, \qquad \forall \mathsf{s}$$

In the bad state, s_L, there are fewer resources and so $\breve{\mu}_t^r(\mathsf{s}_L)$ increases, which in turn increases $\breve{q}_t^b(\mathsf{s}_L)/\breve{q}_t^k(\mathsf{s}_L)$. In this sense, regulation creates a counter-cyclical captive demand in the sense that it makes banks more "captive buyers" for government debt in bad times. Both cases are depicted graphically in Figure 3. Without repression, government debt prices fall in bad times. However, with repression, government debt prices increase in bad times because the banks crowd into the government debt market, making government debt a good hedge against aggregate risk.

4.3 Government Funding Advantage

We close this section by characterizing the government funding advantage. As before, this is defined as

$$\widetilde{\chi}_t := \log(q_t^b) - \log(\mathbb{E}[\xi x_{t+1}^b])$$

that is, the log difference between the price of government debt and the price of an asset with the same cash flows as government debt but without the special role of government

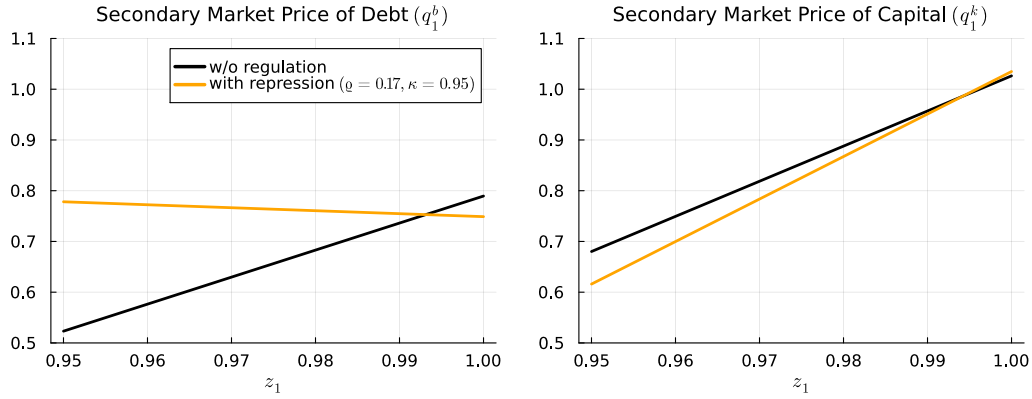


Figure 3: Financial regulation makes government debt a good hedge against aggregate risk

debt.[5] We can decompose the funding advantage further into:

$$\widetilde{\chi} = \underbrace{\log\left(\mathbb{E}\left[\xi \breve{M}_{t+1}\left(\frac{\breve{q}^b_{t+1}}{x^b_{t+1}}\right)x^b_{t+1}\right]\right) - \log\left(\mathbb{E}\left[\xi \breve{M}_{t+1} x^b_{t+1}\right]\right)}_{\text{direct effect of regulation} =: \widetilde{\chi}_r}$$
$$+ \underbrace{\log\left(\mathbb{E}\left[\xi \breve{M}_{t+1} x^b_{t+1}\right]\right) - \log\left(\mathbb{E}\left[\xi x^b_{t+1}\right]\right)}_{\text{indirect hedging premium} =: \widetilde{\chi}_h}$$

From this expression we can see that the funding advantage comes from both the direct impact of forcing the banks to purchase government debt and an indirect impact that creating a safe asset helps the banks to hedge risk. The importance of the second term has been explored empirically in Acharya and Laarits (2023) who argue that the key source of the convenience yield on US treasuries is its hedging role. Expanding the first term gives:

$$\widetilde{\chi}_r \approx \log\left(\mathbb{E}\left[\frac{\breve{q}^b_{t+1}}{x^b_{t+1}}\right]\right) + \text{Cov}\left(\frac{\xi \breve{M}^e x^b}{\mathbb{E}[\xi \breve{M}^e x^b]}, \frac{\breve{q}^b / x^b}{\mathbb{E}\left[\breve{q}^b / x^b\right]}\right)$$

Expanding the second term gives:

$$\widetilde{\chi}_h \approx \log\left(\mathbb{E}\left[\breve{M}^e\right]\right) + \text{Cov}\left(\frac{\xi x^b}{\mathbb{E}[\xi x^b]}, \frac{\breve{M}^e}{\mathbb{E}\left[\breve{M}^e\right]}\right)$$

In both cases, we can see that the covariance between the wedges in the bank Euler equation and the devaluation of government debt ($x^b < 1$ in some states of the world) are key components of the funding advantage. A goal of our paper is to show explicitly how these

[5] We interpret the "risk-adjusted" convenience yield as the value that households place on the special role that government debt plays.

covariance terms are related to government regulation and fiscal policies.

4.4 Government Default

We now use our model to explore how government fiscal irresponsibility impacts the government funding advantage. In Figure 4, we plot the decomposition of the risk-adjusted convenience yield (and other prices) in our repression model as the government defaults more in the bad state, i.e., $x^b(s_L)$ decreases. The plots are constructed so that moving from left to right increases the risk on government debt. Evidently, the risk penalty becomes more negative as government debt becomes riskier. However, what's more interesting is that the funding advantage (or risk-adjusted convenience yield) decreases as well as government debt becomes more risky.

We can see that the direct effect of regulation on the risk-adjusted convenience yield, $\widetilde{\chi}_r$, is increasing as government debt becomes riskier and so plays a very similar role to the terms in the BIU models discussed in section 2. That is, it reflects captive demand within the banking sector for holding government debt, which increases as the market value of government drops. In our model, this force is dampened by allowing the banks to default on their deposit and effectively escape the financial regulation. The higher the cost of doing so, the stronger the direct impact of repression and more this term behaves like the BIU model. The large difference in our model relative to the BIU model is that our risk adjusted convenience yield also contains the hedging term, $\widetilde{\chi}_h$, and this term decreases as government debt becomes riskier. Why? Agents in our model want an asset to hedge the idiosyncratic and aggregate risk but the effectiveness of government debt as a hedge against either shock depends on whether the government repression can actually make government debt a safe asset. As the government defaults more in the bad state, the hedging property of government debt erodes, as depicted in the top row of Figure 4. Ultimately, this decreases the covariance between ξx^b and $\breve{M}^e$, which decreases the risk-adjusted convenience yield. That is, by modeling how financial regulation makes government debt a safe asset, we can show how fiscal irresponsibility erodes that role. This highlights the importance of micro-founding government debt demand when it comes to questions about the government budget constraint and fiscal capacity.

4.5 Policy Trade-offs: A Financing Trilemma

Our model with an endogenous, policy-variant government funding advantage leaves the government with complicated trade-offs. Figure 5 shows the average default rate in the financial sector (left subplot) and the convenience yield (right subplot) as a function of two government policy choices: the level of financial repression on the x-axis and the devaluation of government debt on the y-axis. Evidently, increasing financial repression can increase US

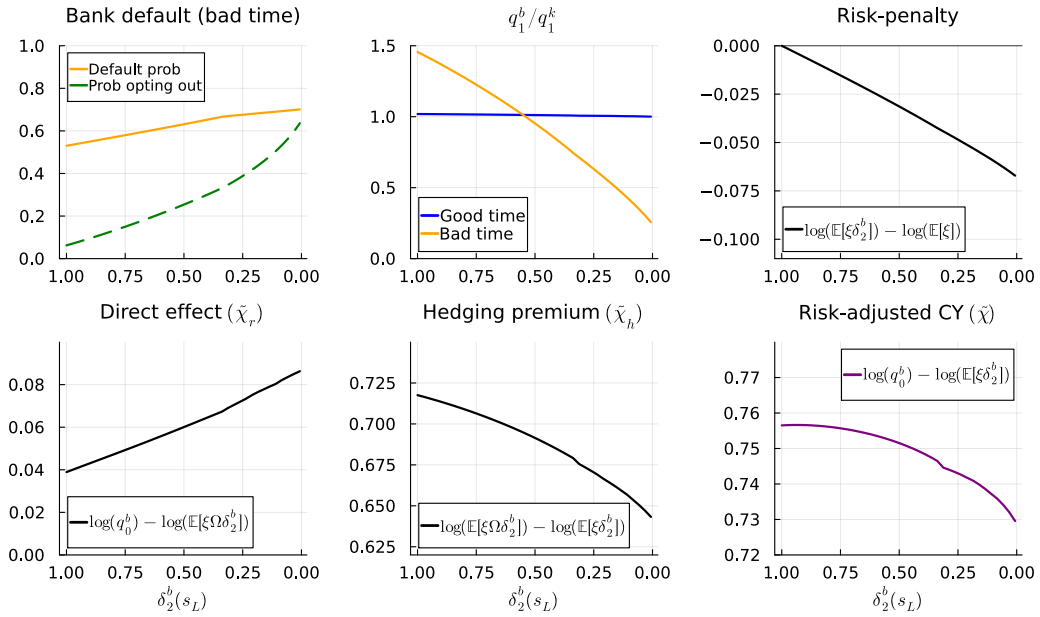


Figure 4: Decomposition of Equilibrium Pricing in the Repression Model

funding advantage ("Risk-adjusted CY"). However, when is accompanied by a devaluation of US, increasing financial repression also leads to higher default rates in the financial sector, which partially offsets the high funding advantage.

We summarize our results as a "trilemma" for the government. Ultimately, the government cannot choose all three of:

1. High funding advantage,
2. A well-functioning financial sector (profitable and stable), and
3. Irresponsible fiscal policy that leads to systematic debt devaluation (e.g. "default", "counter-cyclical" issuance, "inflation").

We can interpret some historical periods through the lens our trilemma. During the 1970s, the US government ran high inflation leading to the real devaluation of US debt. According to the trilemma, this meant it had to choose between maintaining its funding advantage by forcing the financial sector hold more government debt and maintaining financial stability by allowing the financial sector to substitute away from government debt and and so lose the funding advantage. Ultimately, as documented in the next section, the government chose to lose the funding advantage from 1975 to 1990.

Another period of interest in the National Banking Era (1865-1913). During this time, the government placed heavy financial repression on the banking sector to generate a high government funding advantage. According to the trilemma, this meant it had to choose

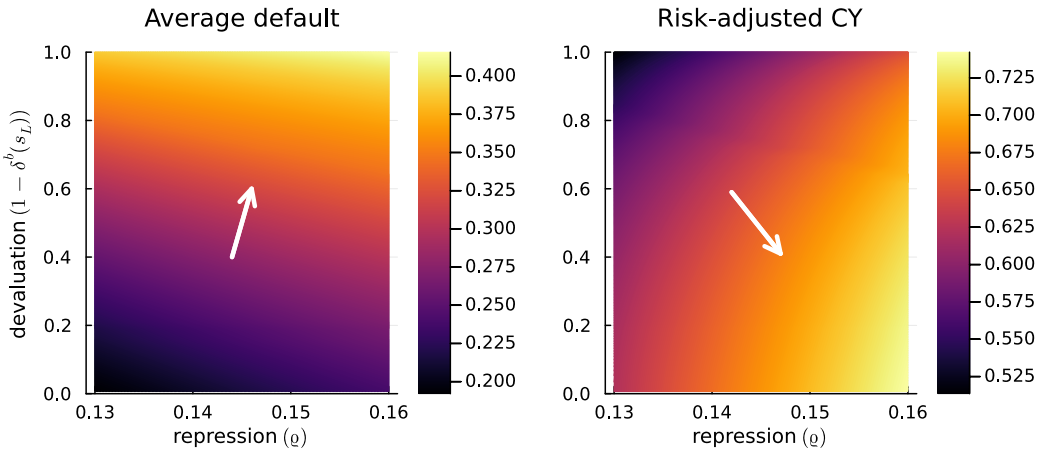


Figure 5: Government Financing Trade-offs

The left subplot shows a heat map with level of government repression on the x-axis, the devaluation of government debt on y-axis, and average default rate in the financial sector as the color. The right subplot shows a heat map with the same x and y-axes but with the convenience yield as the color.

between a profitable financial sector and fiscal-monetary policy that would lead to the systematic devaluation of its debt. Ultimately, as documented in the next section, the government chose to maintain stable bond prices (through the return to the gold standard after the Civil War) and ensure banking sector profitability.

4.6 Connection to Different Fiscal Literatures:

Our paper is connected to a number of very large literatures studying fiscal and financial policies in general equilibrium models. Here, we provide some thoughts on how our analysis is distinct but complementary to these literatures:

(i) *Ramsey and constrained planner models:*[6] Our environment has two key frictions: an incomplete secondary interbank market at $t = 1$ and a default cost externality. From the constrained planner point of view, the first friction leads to fire-sale asset pricing and bank default at $t = 1$ and the second friction potentially means the banks take on too much risk when they choose portfolios at $t = 0$. Both frictions manifest as wedges in the private sector Euler equations. Consequently, the constrained planner would respond by reallocating resources across islands to liquidity constrained banks at $t = 1$ and across states by restricting the leverage of the banking sector at $t = 0$. In principle, a Ramsey planner could implement this without any "financial regulation" if it had a sufficiently large set of tax and transfer tools at $t = 0$ and $t = 1$. By

[6] Chari et al. (2020), Bassetto and Cui (2021)

contrast, our paper considers a government facing political restrictions that limit its policy choice set to financial regulation. This allows us to focus on the "costs" of using financial regulation to increase government fiscal capacity. We show that these costs involve subtle covariances between the different wedges on the private sector Euler equations and so the government faces a trade-off between expanding fiscal capacity and the stability of the financial sector. We view our work as microfounding the (implicit) cost of "taxing" the financial sector. Future work could consider how a Ramsey planner might balance this cost against the distortionary costs of other taxes.

(ii) *Macroeconomic safe asset models:*[7] In our model, the household need for deposits and the frictions on the banking sector create bank demand for a safe-asset that allows them to hedge default risk and the associated costs. In this sense, we have a similar argument to the "safe-asset" literature, which suggests government debt can earn a "convenience yield" by playing the role of the "liquid" or "safe" asset in the economy. However, this literature typically models the special role of government debt using an exogenous bond-in-utility or bond-in-advance formulation, which allows the government to easily increase fiscal capacity by exploiting the convenience yield. We believe this makes these models less suitable for studying fiscal policy. By contrast, we generate the convenience yield through government financial regulations that create a captive market for government debt in bad times, which endogenously makes government debt a good hedge against both aggregate and idiosyncratic risk. One benefit of endogenizing the convenience yield in this way is that we can show how irresponsible fiscal policy erodes the safe-asset role of government debt. Another benefit is that we can see that the full cost of making government debt a safe asset involves financial instability and the crowding out of real investment and private liquidity creation.

(iii) *Non-Ricardian macro-fiscal models:*[8] Similar to this literature, we are very interested in the trade-offs about how the government backs its liabilities. In our model with aggregate risk, government debt is partially backed by an exogenous surplus process but also by restrictions that create captive demand within the financial sector in bad times and so change the price process of government debt. We believe this makes the following important contributions to this literature: (i) we provide a model of an endogenous convenience yield that, unlike other papers in the literature, is intimately related to government fiscal policy, and (ii) we relate the convenience yield to frictions within the financial sector that reflect some overlooked features of financial history. Ultimately, this means that, in our model, exploiting the convenience yield is hard

[7] Caballero et al. (2008), Caballero et al. (2017), Choi et al. (2022), Kekre and Lenel (2024).

[8] This includes (but is not limited to) Sargent and Wallace (1981) and the "fiscal theory of the price level" literature, e.g., Leeper (1991), Sims (1994), Woodford (1994), Cochrane (2023), Bianchi et al. (2023), and the recent literature on fiscal backing, e.g., Jiang et al. (2022a,b); Chen et al. (2022).

work that depends very tightly on the fiscal rule, and doesn't invalidate the key trade-offs involved in backing government debt with taxation. In this sense, we show that convenience yields are not an alternative backing for all government debt. There is no free lunch. Overall, we believe we show how to introduce convenience yields while maintaining the importance of fiscal policy for determining the role of government debt.

5 Empirical Connections

Our model in Section 3 provides sharp predictions about how government regulation and fiscal policy influence the government's funding advantage. We now consider whether these predictions are consistent with empirical evidence. We focus on two datasets: a new collection of historical convenience yields in the US covering the period 1860-2024 (from our companion paper Lehner et al. (2024)) and convenience yields across the Eurozone during the sovereign debt crisis covering the period 2003-2022.

5.1 Historical Funding Advantage in the US

An important prediction of our model is that restrictions on the financial sector change the funding advantage at which the government can issue debt. The US is a particularly interesting country for studying this prediction because different policy makers have organized very different financial systems. The challenge is that we need to work with historical data, which requires us to construct and analyze new estimates for historical convenience yields. We have taken up these challenges in our paper Lehner et al. (2024) where we estimate the yield curve on high grade US corporate bonds and the yield curve on US treasuries from 1860-2024. In both cases we make adjustments so we the yields curves reflect bonds with the same risk, tax treatment, and callability features. We interpret the spread between our estimate of the US corporate yield curve and the US treasury yield curve to be a historical estimate for the US government's funding advantage.

5.1.1 Context on Historical Financial Sector Regulation

To help interpret the historical data, we outline some key historical changes in monetary, financial, and fiscal policy. We provide a summary in Table 1 and a more comprehensive time-line in Appendix **??**.

1791-1862: Banks of The US and State Banks. Between April 1792 and February 1862, the federal government minted gold and silver coins but not paper notes. Instead, state legislatures charted state banks, which could issue their own bank notes. Initially, the First

	Regulation Parameters	Discussion
1791-1862	$\varrho \approx 0$, $\kappa = 0.5$	*Pre-Civil War:* bank regulation was typically at the state level, and regulation was 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:* has implicit advantages for government debt through the acceptance of US debt at the FED discount window and the Bretton Woods reserve requirements (from 1944-1971).
2008-2024	ϱ = leverage ratio, κ = risk weight on US debt	*Basel III and Dodd-Frank Act:* led to increased regulation of the financial sector, with asset requirements based on their risk weights.

Table 1: Summary of Financial Eras

(1791-1811) and Second (1816-1836) Banks of the United States operated at the national level and indirectly regulated state bank bank note creation but Andrew Jackson (1829-1837) allowed the Bank's charter to expire (1836). In the subsequent decades (1837-1862), states expanded their banking sectors by allowing the automatic chartering of banks without requiring explicit approval from the state legislature. This period is often referred to as the "free banking era" and was perceived to be characterized by weak enforcement of bank portfolio restrictions, high bank risk taking, and discounted state bank notes. From the point of view of our model, we interpret this as a period with a low effective leverage requirement (low ϱ) and no particular weight on US federal debt ($\kappa = 0.5$).

1862-1913: National Banking System. The outbreak of the Civil War in 1861 put significant strain on the monetary and financial systems, leading to major policy changes. On February 25, 1862, Congress passed a Legal Tender Act that authorized the Treasury to issue 150 million dollars of a paper currency known as greenbacks that the government did not promise immediately to exchange for gold dollars. In addition, between 1863-6, Congress passed a collection of National Banking Acts, which established a system of nationally charted banks and the Office of the Comptroller of the Currency. National banks faced restrictions on what loans they could make[9] and were allowed to issue bank notes up to 90% of the

[9]National banks could only operate one branch. They were restricted from making mortgages unless they were operating in rural areas, where they could make a limited range of loans collateralized by agricultural land.

minimum of par and market value of qualifying US federal bonds.[10] These national bank notes were intended to replace the state bank notes as a standardised currency that could be used across the country. In order to achieve this, Congress imposed a 10% annual tax on state bank notes, which was significantly greater than the 1% annual tax on national bank notes.[11] From the point of view of our model, the National Banking Era is a period of explicit financial repression with $\varrho = 0.9$ and $\kappa = 1$ when bonds trade below par (and $\kappa = q_t^b$ when bonds traded above par).

1915-1971: Establishment of the Federal Reserve Bank, Deposit Insurance, and Bretton Woods. Bank runs and stock market crashes were a common feature of all different monetary and banking policy arrangements during the 19th century. There were country wide bank panics in 1819, 1827, 1857, 1873, 1893, and 1907 as well as many other local bank panics in New York and other financial hubs. In response, The Federal Reserve System Act was passed in 1913 to create a Federal Reserve Bank (FRB) to act as a reserve money creator of last resort to prevent bank runs. The Bank started operations in late 1914. The inability to prevent bank failures during the depression prompted Franklin D. Roosevelt to introduce a further reorganization of the financial sector. The 1933 Banking act introduced deposit insurance for retail banks, established the Federal Deposit Insurance Corporation (FDIC), and separated commercial and investment banking. The 1934 and 1938 household acts established the Federal National Mortgage Association (commonly known as Fannie Mae) to insure long term mortgages. These reforms ultimately relaxed the explicit financial repression from the National Banking Era. However, the FRB started to privilege government debt as collateral for discount window lending, which acted as an implicit advantage to government debt.

The difficulties of financing World War II led to the government "fixing" the yield curve from 1942-1951, with yields on long term bonds set at 2.5% (see Garbade (2020)). The policy was implemented through coordination between the Treasury and the Federal Reserve, with the Fed agreeing to absorb excess bond supply at the fixed price, and implicit coordination with the banking system, which ended up predominately holding government debt. This coordination ended in 1951 with the Treasury-Fed Accord that establishes official Fed independence from fiscal policy. At the international level, the 1944 Bretton Woods Agreement set up an international system of fixed exchange rate with US dollar convertable to gold.

[10] Technically, national banks could issue bank notes for circulation according to the following rules. Banks had to deposit certain classes of US Treasury bonds as collateral for note issuance. Permissible bonds were US federal registered bonds bearing coupons of 5% or more. Deposited bonds had to be at least one-third of the bank's capital (not less than $30,000). Banks could issue bank notes up to an amount of 90% of the maximum of the market value of the bonds and the par value of the bonds. The 90% value was changed to 100% in 1900.

[11] Before 1900, the banks had to pay 1.0% tax on the notes they had issued. After 1900, they had to pay a 0.5% tax.

1972-2007: Financial Deregulation. Internationally, the US effectively terminated the Bretton Woods systems in 1971 by ending convertibility to gold. Domestically, the government embarked on a program of financial deregulation. In 1994, the Riegle-Neal Interstate Banking and Branching Efficiency Act allowed banks to operate across states. In 1999, the Gramm-Leach-Bliley Act repealed the provisions of the Glass-Steagall Act that prohibited banks from holding other financial companies. In our model, we would interpret this as a decrease in the effective ϱ.

2008-2024: Financial Crisis, Basel-III, and Dodd-Frank Act. The 2007-9 financial crisis led to extensive new regulation on the banking sector and the Dodd-Frank Wall Street Reform and Consumer Protection Act. In addition, the Basel-III regulation introduces restrictions so that ϱ reflects the bank leverage requirement and κ is the "risk" weight on government debt for calculating risk weighted asset ratios.

5.1.2 Times Series For US Funding Advantage

Figure 6 shows the 10-year nominal yields on US Treasuries and high-grade corporate bonds (top panel), the spread between the two yields (middle panel), and the scatter plot between spreads and the market value of government debt to GDP (bottom panel). The labeling on the middle panel of Figure 6 indicates major banking regulations and monetary eras. Evidently, the spread exhibits large low frequency variations with its long-run mean value ranging between 0-2 % over the last 160 years. On average, the US funding advantage peaked during the National Banking Era (1862-1913) and generally stayed high during the gold standard. Its long-run mean dropped sharply after World War I and followed a trend decline after the Great Depression before reaching its lowest levels during the high inflation of the 1970s and 1980s.

The scatter plot in the bottom panel of Figure 6 looks somewhat different to the plot documented by Krishnamurthy and Vissing-Jorgensen (2012) for two main reasons: we use our estimates of the term structure of zero-coupon yields to consistently calculate the US funding advantage at the 10 year horizon (with adjustment for tax treatment and other features) and we extend the sample back to 1860. The longer sample highlights some new patterns in the relationship between the US funding advantage and the US debt-to-GDP ratio. In particular, the relationship appears mostly flat (with period specific intercepts) during the National Banking Era (1865-1913), during the era of yield curve control (1942-1951), and the quantitative easing period (post 2008). In this paper, we focus on the spread between corporate bond yields and treasuries because that is a convenience yield measure that can be viewed as a proxy of the US government's long-term funding advantage and at the same time, can be extended back in time to get a sense of its variation across different

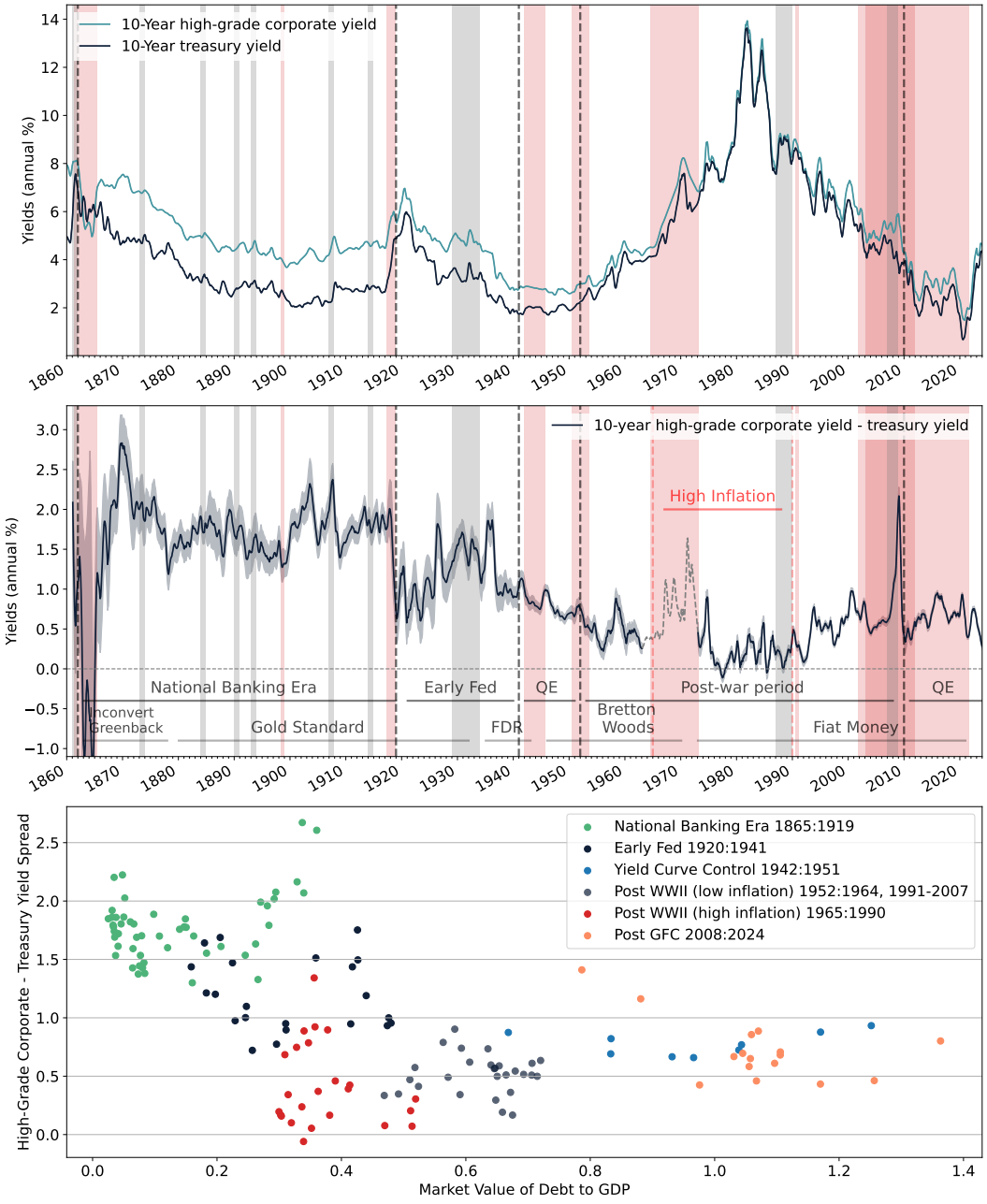


Figure 6: *Top panel:* The black line is the posterior median estimate of the 10-year nominal zero-coupon yield on US treasuries. The blue line is the posterior median estimate of the 10-year nominal zero-coupon yield on high grade corporate bonds. *Middle panel:* The black line is the posterior median estimate of the spread between the 10 year high-grade corporate and treasury yields. The shaded bands around the line is 95% posterior intervals. The gray shaded time intervals are financial crisis from Reinhart and Rogoff (2009). The red shaded time intervals are wars. *Bottom panel:* Scatter plot of the spread between the 10-year high-grade corporate and treasury yields against the market value of US debt to GDP.

regulatory eras. There exist other high-quality estimates of the convenience yield on US government debt for the modern period, e.g., see van Binsbergen, Diamond and Grotteria (2022), Nagel (2016), Koijen and Yogo (2020), however, data limitations render them less appropriate for the time horizon we are interested in.

5.1.3 Relationship Between Funding Advantage and Government Debt Supply

An important prediction of our model is that the ability of the US government to issue government debt at low cost depends upon the restrictions on the financial sector. This implies that the relationship between the funding advantage and the debt-to-GDP ratio should vary across the different eras of financial sector regulation. We can now use our historical series to look for evidence that this took place.

The scatter plot in the bottom panel of Figure 6 offers descriptive support for our hypothesis. Evidently, within the National Banking Era (1868-1914) and around WWII (1940-1965), the elasticity of the US funding advantage to government debt issuance is very low. These are the periods when the government intervened most aggressively in financial markets to try and create demand for government debt. The period with the much studied downward sloping "demand curve is largely the interwar period and the last third of the 20th century (excluding the high inflation during the 1970s). These are both periods, where the government relaxed pressure on the financial sector. Ultimately, we interpret this plot as suggestive evidence that the equilibrium relationship between government debt supply and the convenience yield has very different properties under different financial regulation regimes.

To study this more systematically, in Table 2 we rerun the regression from Krishnamurthy and Vissing-Jorgensen (2012) using different sub-samples from our extended dataset. The regressions confirm what can be seen visually in Figure 6:

1. For 1868-1914 the debt/GDP ratio is not significant and has a coefficient close to zero. We run the regression with and without the average corporate default rate during the period but find it makes little difference, which suggests it is not changes in the likelihood of corporate default that is driving the result.

2. For the overall period from 1915-2007, we find a significant downward sloping relationship between the convenience yield and government debt supply, with similar values to Krishnamurthy and Vissing-Jorgensen (2012).[12] However, within this period there is a lot of variation in the relationship. The coefficient on $\log(Debt/GDP)$ is close to zero for the period of yield curve control and implicit financial repression. It also has different negative values for the periods 1920-41 and 1952-2007.

[12] Krishnamurthy and Vissing-Jorgensen (2012) uses a different range and finds the coefficient to be in the range of -0.55 to -1.66 depending upon the exact time period and bond yield chosen.

	1868-1919 (NBE)		1920-2007 (FED, Macroprudential Regulation)						Dodd-Frank
	no EDF	with EDF	1920-41	1942-1951	1952-1964 1991-2007	1965-1990	1952-2007	All 1920-2007	2010-2024
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$ln(B/Y)$	0.071	0.061	-0.774^{***}	0.1148	-0.255^{***}	-0.366^{**}	-0.0461	-0.184^{*}	0.064
	(0.065)	(0.073)	(0.206)	(0.172)	(0.091)	(0.168)	(0.070)	(0.099)	(0.306)
Vol	-0.237	-0.327	0.1835	0.1871	2.064^{***}	-1.335	-0.008	1.765^{***}	2.213^{***}
	(0.434)	(0.497)	(0.559)	(1.685)	(1.784)	(1.358)	(0.781)	(0.547)	(0.611)
$Slope$	-0.039	-0.035	0.176^{**}	0.1403	-0.0277^{*}	-0.0124	-0.032	-0.031	-0.015
	(0.041)	(0.043)	(0.066)	(0.085)	(0.050)	(0.037)	(0.020)	(0.040)	(0.029)
EDF		0.007							
		(0.019)							
constant	1.99^{***}	1.970^{***}	-0.0917	0.5092	0.1865^{**}	-0.0187	0.448^{***}	0.302^{***}	0.536^{***}
	(0.235)	(0.247)	(0.341)	(0.279)	(0.090)	(0.280)	(0.098)	(0.113)	(0.130)
Adj R^2	-0.03	-0.05	0.35	0.082	0.19	0.052	0.05	2.1e-4	0.193
F-test	0.666	0.425	0.013	0.367	8.39e-06	0.0428	0.262	5.91e-13	0.003
AIC	36.60	38.44	3.038	-14.89	-78.06	99.88	109.1	74.75	-33.43
N	51 (A)	51 (A)	22 (A)	10 (A)	114 (Q)	97 (Q)	221 (Q)	88 (A)	56 (Q)

Nota: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table 2: Relationship Between Treasury Supply and Bond Spreads

5.1.4 Relationship Between Funding Advantage and Inflation

The 1970's US high inflation period provides a particularly laboratory to test whether the scatter plot in the bottom panel of Figure 6 can be viewed as a stable exploitable relationship. From the perspective of the 1940's and 1950's the persistently high inflation rates of the 1970's can reasonably be considered as unexpected and as such, they devalued the outstanding stock of long-term nominal debt. Under the assumption of a stable exploitable relationship between government debt supply and the US funding advantage, this reduction in the value of debt would have led to an increase in the convenience spread. As the "special asset" becomes scarcer in the economy, the private sector is willing to pay a higher premium for holding the remaining stock of it. Indeed, as we saw in section 2, this is exactly what happened illustrative model in Section 2.

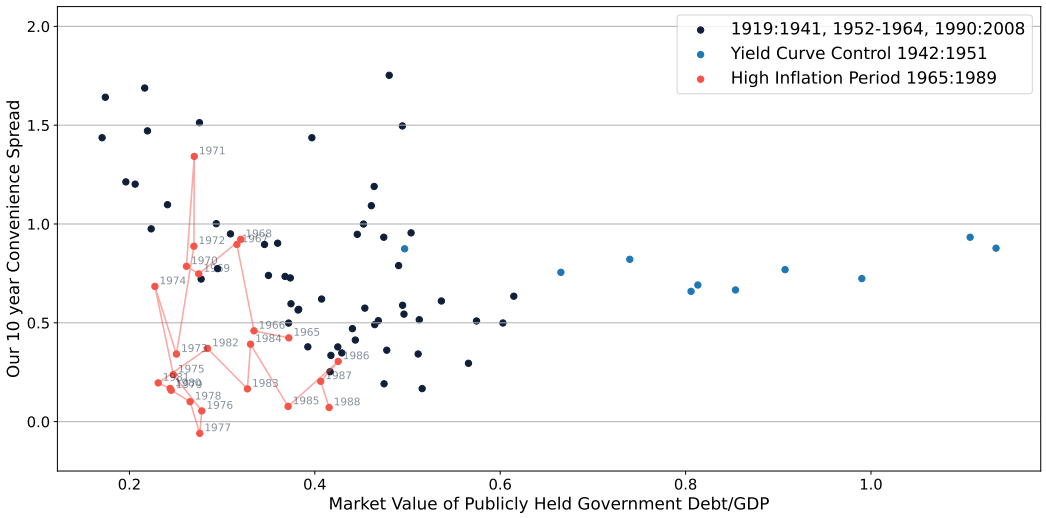


Figure 7: Convenience Spread vs Debt/GDP: 1919-2008, Annual

Top panel depicts a scatter plot of the KVJ convenience spread proxy against the market value of publicly held government debt to GDP ratio. The bottom panel depicts a scatter plot of our 10-year convenience spread estimate against the time series of debt-to-GDP ratio used in the top panel. Red dots highlight the High Inflation period.

Figure 7 tells a drastically different story.[13] Although for the first few years, between 1965-1971, the funding advantage went up, the relationship eventually broke down and for most of the 1970's and early 1980's the funding advantage remained close to zero. That is, after adjusting to match maturities, tax treatment, and other features, the scatter plot tells a very different story to many macro-finance models. Instead of reaching its highest levels

[13]The light blue dots represent the yield curve control period. As we saw before, Fed QE pushed the medium term convenience yield up (relative to the 20-year).

since WWI, losing the nominal anchor during the 1970's coincided with an almost complete erosion of the funding advantage on US treasuries.

The scatter plot in Figure 6 and the whole sample regression in Table 2 have been interpreted as reflecting an exploitable stable demand function. Many macro models capture this using bond-in-the-utility or some other exogenous bond demand function. However, our illustrative model, our sub-sample regressions, and 7 suggest that researchers should be very cautious about this exercise because attempts to exploit the relationship in Figure 6 are very vulnerable to the Lucas critique. Financial regulation and government fiscal policy change the bond demand function, which ends up being reflected in the relationship between government debt supply and the funding advantage. In this sense, the funding advantage in macro-public finance is very similar to the Phillips curve relationship in macro-labor—neither are stable to changes in government policy.

5.2 Funding Advantage Across the Eurozone

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, which we consider an empirical proxy to our notion of funding advantage. In this subsection, we follow Jiang et al. (2020b) 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 (implicit or explicit) erode the risk-adjusted convenience yield.

5.2.1 Regulatory Context

In the Eurozone context, there are a number of components of regulation that are particularly important to our analysis and are well captured by our model. The first is the treatment of government debt from European countries as collateral by the European Central Bank (ECB). Before 2005, the ECB decided collateral terms using a private discretionary rating system that could deviate from those of private credit agencies. 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. In principle, this meant that the government debt of a number of European countries (particularly Greece and Cyprus) should have become ineligible as collateral during the Eurozone crisis (2009-2015). However, the ECB repeatedly relaxed the criteria. In 2008, they lowered the minimum market credit rating requirement and then announced wavers for Greek debt (April 2010), Irish debt (March 2011), and Portugese debt (July 2011). From May 2010, the ECB started to purchase Greek, Portugese, and Irish bonds as part of its "Security Markets Programme" (SMP), which was extended to Spanish and Italian bonds in 2011. We interpret the April 2010 announcement as resolving

uncertainty that European government debt could lose its collateral status. Ultimately, the ECB treatment of Greek, Irish, Portugese, Spanish, and Italian debt as collateral allowed the European banks to take low interest loans from the ECB and purchase high yielding government assets without increasing their risk-weighted assets or their TIER 1 capital ratio.

In addition, the deposit insurance system in Europe does not have the same backing as in the US. All European Union member states are required to maintain a minimum government deposit guarantee. However, this guarantee is not backed by the ECB or the European Union but instead by the independent member state. So, for countries in the Eurozone, they cannot easily create money to recapitalize their banking sectors. In this sense, as in our model, the Eurozone deposits are not necessarily risk free, particularly when the government is unable to access debt markets. We saw this risk materialize in Iceland, Cyprus, and Greece during the Eurozone crisis.

5.2.2 Risk Adjusted Convenience Yields

We can express the yield on a government bond from Eurozone country i with maturity h and price $q_t^{i,h}$ as:

$$y_t^{i,h} = r_t^h - \chi_t^{i,h}$$

where $y_t^{i,h} = -\frac{1}{h}\log(q_t^{i,h})$ is the yield on the bond, $r_t^h = -\frac{1}{h}\log\mathbb{E}[\Xi_{t,t+h}]$ is the expectation of the h period (nominal) SDF pricing government debt, and $\chi_t^{i,h}$ is the convenience yield on the bond. In analogous manner to Section 4.3, we breakup the convenience yield into:

$$\chi_t^{i,h} = \widetilde{\chi}_t^{i,h} - s_t^{i,h}$$

where $s_t^{i,h} = -\frac{1}{h}\log\mathbb{E}_t\left[\Xi_{t,t+h}\prod_{j=1}^h(1-\mathfrak{d}_{t+j}^i)\right] + \frac{1}{h}\log\mathbb{E}[\Xi_{t,t+h}]$ is market rate for default risk insurance, $\mathfrak{d}_{t+j}^i$ is the probability of government default, and $\widetilde{\chi}_t^{i,h}$ is the risk-adjusted convenience yield on the bond. Following the approach in Jiang et al. (2020b), we proxy $s_t^{i,h}$ by the credit default spread and, instead of estimating r_t, we focus on the difference between the convenience yield in country i and Germany. Assuming that there is a common SDF across the Eurozone, we have that:

$$\widetilde{\chi}_t^{i,h} - \widetilde{\chi}_t^{DE} = s_t^{i,h} - s_t^{DE,h} - (y_t^{i,h} - y_t^{DE,h})$$

We plot the risk-adjusted convenience yield differentials in Figure 8 for key Eurozone countries over the period from 2004 to 2024 which includes the European Sovereign Debt Crisis. The top row are countries that maintained relatively strong fiscal positions during the Eurozone crisis while the bottom row are countries that faced ratings downgrades and speculation about their fiscal sustainability. For calculations, we use Euro denominated 5

year CDS spreads from Markit and 5 year sovereign yields from Global Financial Data. Evidently, risk-adjusted convenience yields decreased significantly more in the countries on the bottom row. In Figure 9 we plot the risk-adjusted convenience yield against the CDS spread and show that the negative relationship we saw in the cross-section is also true in the time series. These plots suggest that, even after controlling for the different risk characteristics of the sovereign bonds, there was a higher erosion of sovereign debt premia in the countries facing fiscal challenges during the crisis. As we saw in Subsection 4.4, this is a puzzle for workhorse macroeconomic models that use BIU or BIA formulations to generate convenience yields because those models predict the risk-adjusted convenience yield increases when the market value of government debt falls. By contrast, our model suggests a potential resolution: that an increase in the probability of government default lead to a decrease in the risk adjusted convenience yield because the hedging role of Irish, Italian, Portuguese, and Spanish debt diminished ($\widetilde{\chi}_h$ decreased) even though their collateral role at the ECB stayed the same ($\widetilde{\chi}_r$ stayed the same). A complementary explanation is proposed by Jiang et al. (2020b), which suggests that the heterogeneous decreases in the risk-adjusted convenience yields reflect how different fiscal policies during the crisis lead to different expectations about post-crisis debt issuance. We nest both explanations in our macroeconomic model.

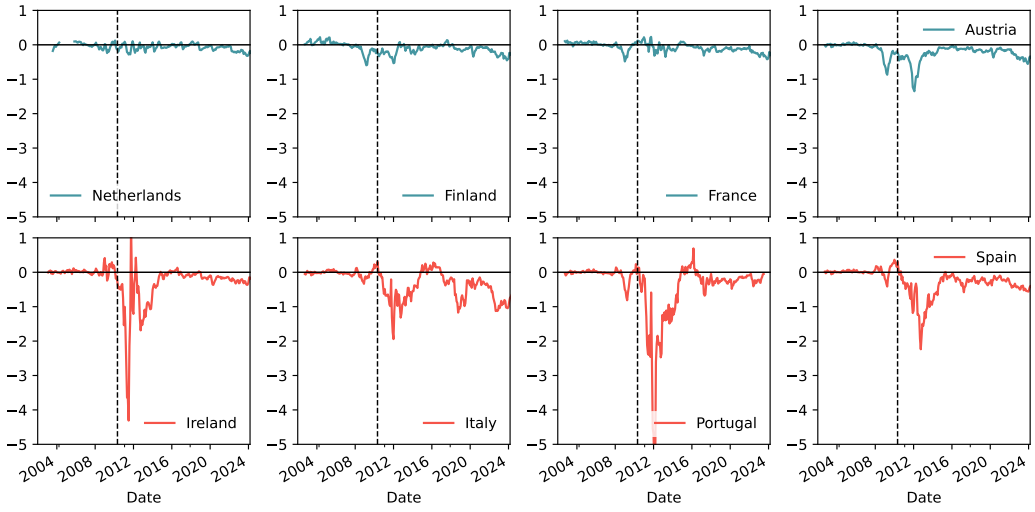


Figure 8: Difference in Risk Adjusted Convenience Yields to Germany.

The dashed line is at April 2010, the date at which the ECB announced the waver for Greek debt.

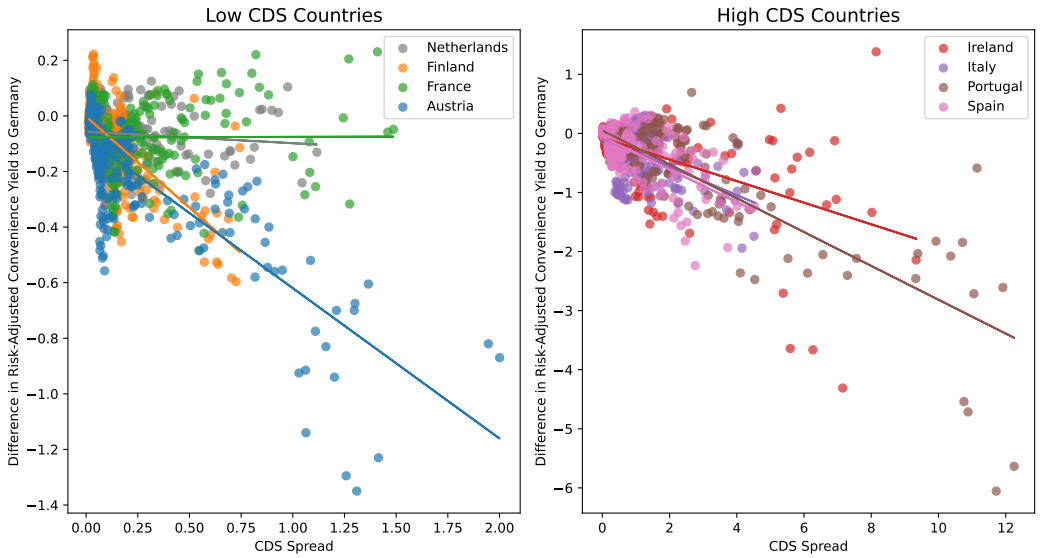


Figure 9: Difference in Risk Adjusted Convenience Yields to Germany vs CDS Spreads.

The left plot show countries that maintained low CDS spreads during the Eurozone crisis while the right plots shows countries that had high CDS spreads. The dots represent monthly observations and the lines represent linear regressions for each country.

6 Conclusion

In this paper, we show how the government can generate a funding advantage through restrictions on the financial sector that make government debt a "safe-asset" for the economy. Endogenizing government funding advantage in this way allows us to characterize how it is related to financial and fiscal policy. We show that government default erodes its funding advantage because it changes the role that government debt plays in the financial sector and so changes the debt demand function. This is very different to bond-in-utility and bond-in-advance models where bond demand is exogenous and the fundinga advantage increases when the government starts to default (because the real value of government debt becomes scarce). Our results suggest that macroeconomists should be very cautious about modeling government funding advantage using exogenous, immutable demand functions that fit empirical "safe-asset" curves. Like for the Phillips Curve, these relationships break down once the government attempts to exploit them.

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