The Fragility of Government Funding Advantage*

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Abstract

US federal debt plays a special financial role giving the US government a funding advantage compared to the private sector. Is this an immutable feature of US treasuries or a fragile equilibrium outcome? To answer this, we build a model where government funding advantage emerges endogenously from the financial sector's ability to use treasuries to hedge risk. Financial regulation can amplify the hedging properties of US treasuries by creating captive demand in bad times but only if the government runs stable fiscal policy to protect long-run treasury prices. Ultimately, the government cannot simultaneously choose: (i) high funding advantage, (ii) financial sector stability, and (iii) monetary-fiscal policy that destabilizes treasury prices. Balancing these tradeoffs has far-reaching macroeconomic and welfare implications.

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

Key words: Convenience Yields, Government Debt, Financial Repression, Safe Assets

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"When the public is assured that the rate will not rise [and so the price will not fall], prospective investors will realize that there is nothing to be gained by waiting, and a flow [of funds] into Government securities . . . may be confidently expected."

Emanuel Goldenweiser (Fed Board, R&S)

1 Introduction

US federal debt plays a special role in the economy and so has given 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 non-pecuniary 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. Historically, US policy makers have argued the reality is more complicated and US funding advantage emerged as part of a complicated collection of financial-monetary policies that have shaped financial sector demand for US treasuries. When viewed in this way, generating and exploiting a funding advantage is closely interconnected with government policy, fragile in execution, 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 associated with how government polices influence demand for government debt.

When studying US funding advantage, the macro-finance literature has been strongly influenced by historical asset pricing data appearing to show a relatively stable, downward sloping equilibrium relationship between funding advantage and government Debt-to-GDP for the period 1920-2007 (e.g. Krishnamurthy and Vissing-Jorgensen (2012)). This has led to many papers that model government funding advantage using a time-invariant bond-in-the-utility function that is calibrated to match the histroical data. However, in Lehner, Payne, Shurtleff and Szőke (2025), we show that this apparently stable relationship comes from mismeasurement because the most commonly used measure of funding advantage effectively compares the difference between yields on nominal corporate bonds and the yields on government bonds with a put option on inflation and favorable tax treatment. Once we correct for tax and option issues we find that there is little equilibrium connection between spreads and quantities. Instead, there are low-frequency changes to the level and curvature of the equilibrium relationships that correlate with historical policy regime changes. US funding advantage appeared in the late 1860s, well before Bretton-Woods, and fell to zero during the high inflation of the 1970s, despite the emergence of US dollar denominated debt as the international reserve asset. This suggests that the dominant models in the literature are missing key connections between policy and the government budget constraint.

We build a general equilibrium structural model that endogenizes the connections between financial sector regulation, fiscal policy, the return process on government debt, and government funding advantage.

[1] This spread is sometimes referred to as the "convenience yield", "convenience spread", or "box spread" in the literature. However, there are also other measures of the convenience yield. So, to avoid confusion we instead use the term high-grade corporate to treasury spread to refer to the measure in our data and government funding advantage or public-private borrowing cost spread to refer to theoretical spread in our model that we are trying to approximate. We choose this terminology to emphasize that we are measuring how much more cheaply the government can raise funds than the private sector.

Our environment is a stochastic neoclassical growth model extended to include a morning sub-period where households need liquidity services provided by a risky banking sector (referred to as the "secondary" asset market) and an afternoon subperiod where there are no frictions (referred to as the "primary" asset market). The economy is populated by households who need bank deposits to be able to trade and produce in the morning sub-period. Banks issue deposits and equity to households and invest in government and corporate bonds. The main friction is that banks cannot issue uncollateralized IOUs with each other to settle withdrawals (and redeposits) in the morning market. Instead, they must rely on bond sales and costly equity raising from the households, both of which become more costly in the crisis states of the world when the banking sector faces systemic liquidity shocks. So this a model of interbank settlement frictions (in the tradition of Freeman (1996a,b)) as opposed to a model of self-fulfilling bank runs (e.g. Diamond and Dybvig (1983)) or leverage cycles (e.g. Gertler and Kiyotaki (2010)). The frictions make our environment a "second-best" world with two interconnected asset pricing distortions: a "liquidity spread" on financial sector liabilities and a "hedging spread" on assets that can help banks to self-insure against high withdrawal shocks. Absent financial regulation, additional financial frictions, or government debt devaluation, this is an economy where government debt and productive capital are equally useful/useless for hedging risks in the secondary market. That is, government debt does not have an immutable, special role in the economy.

We use our environment to study how government policies can both create and destroy a special role for government debt in the financial sector. We focus on financial regulations that require the banks to maintain a particular ratio of weighted average assets to deposits. The functional regulatory form is designed to nest both the banknote backing conditions from the National Banking Era and the Basel III weighted leverage ratio restrictions in the modern period. It is also equivalent to an environment in which the central banks acts as a lender of last resort but imposes different haircuts when government bonds and corporate bonds are used as collateral. We show how these government portfolio restrictions in the secondary market determine which asset plays the role of a "hedging" asset for the financial system. If the regulations place more weight on holding government debt, which we refer to as regulatory privilege (although is also sometimes referred to as financial repression), then banks end up crowding into the government debt in the bad state of the world when the regulatory constraint binds more. In this sense, the government regulation can create "captive" counter-cyclical demand for it debt. This leads to an appreciation of the price of government debt in the morning market in bad states and so makes government debt a good "hedge" against both aggregate shocks and idiosyncratic withdrawal risk. Consequently, banks voluntarily increase their government debt in the afternoon market to self-insure against morning market shocks, which also leads to banks taking on higher leverage and so, in equilibrium, having more need for government bonds to hedge their risk. The end result is that the price of government debt is inflated in the primary asset market. We interpret the inflated debt price as an embedded "funding advantage", as measured by the difference between the yield on government debt and the yield on an asset issued by the private sector with the same cashflow process.

We then show how the combination of regulatory privilege and inflation risk erode the government's funding advantage. This is because regulatory privilege ties the solvency of the banking sector to the stability of the government debt prices while at the same time unstable fiscal policy destabilizes government debt prices. This means that the banks are left with a difficult trade-off: if they don't purchase government debt, then they violate the regulatory restrictions on backing deposits but if they purchase government debt, then the government's monetary-fiscal policy policy forces them to take losses and pay negative dividends. So the government's monetary-fiscal policy makes government debt a worse hedge at the same time that it makes banks less solvent and more concerned about finding a good hedge. Banks respond to this lose-lose situation by forcing losses onto deposit holders and effectively "exiting" the deposit market. This erodes the government's captive demand in the banking sector and so the government' funding advantage disappears. It is important to understand that this decrease in funding advantage is not coming from a simple inflation risk premium emerging on government debt (since inflation risk is differenced out in our definition of government funding advantage as the spread between corporate and government bond yields). Instead, it occurs because government debt no longer plays a special role in interbank market and so no longer provides a non-pecuniary benefit. 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 return volatility decreases the market value of government debt. In these models, as the government starts to run irresponsible fiscal policy, the government funding advantage increases. Or put another way, in these models the agents receive welfare from providing resources to the government so, when the government starts to devalue its debt, they feel they are providing the government too few resources and purchase more government debt. This highlights the importance of working with a model where government is endogenously important when we study fiscal policy.

We use our model of endogenous government funding advantage to study the macroeconomic economic tradeoffs for a government choosing restrictions on the financial sector to finance a fiscal rule. 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) monetary-fiscal policy that leads to systematic real debt devaluation (e.g. "default", "counter-cyclical" issuance, "inflation"). Intuitively, this Trilemma says that when a government uses the financial sector to generate funding advantage, then it intertwines the balances sheets of the banking sector and the government, which constrains the range of feasible government policies. If the government sets a high regulatory privilege to generate a high funding advantage (choosing part 1 of the trilemma), then it either needs to run monetary-fiscal policy that targets bond price stability (giving up part 3 of the trilemma) or it will put the financial sector into distress (giving up part 2 of the trilemma). In this sense, our model of endogenous funding advantage both gives the government more freedom to expand funding advantage but also highlights that this freedom rests on a stable monetary-fiscal environment.

Our trilemma can be interpreted as introducing a notion of financial dominance to complement existing notions of fiscal and monetary dominance. There are many macroeconomic theories and models of monetary-fiscal interactions. This papers often present a type of dichotomy between monetary dominance on the one hand and fiscal dominance on the other hand. In the former case, monetary policy is actively chosen by the government and fiscal policy has to accommodate to deliver the desired nominal interest rate path. In the later case, fiscal policy is chosen by the government and monetary policy accommodates to deliver the required monetary policy. However, very few of these papers consider the role of the financial sector in assessing government debt sustainability even though historically much US federal debt has been held by financial intermediaries. Our trilemma suggests that introducing a financial sector leads to the possibility of financial dominance. If the government chooses a high funding advantage and a stable financial sector, then it must run combined monetary-fiscal policy that stabilizes long-term debt prices and protects the balance sheet of the banking sector.

We close our model by studying counterfactual financing of large government spending shocks in a calibrated version of our model. The four major historical increases in the US Debt-to-GDP ratio are the Civil War, World War I, World War II, and the Global Financial Crisis. A striking feature of these episodes is that there only one example where the large increase in US Debt-to-GDP actually coincides with a decrease in government funding advantage: World War I. By contrast the very large increases in funding advantage during the Civil War and the Global Financial Crisis actually coincide with large increase the funding advantage. Through the lens of our model, this occurs because, during both the Civil War and the Global Financial Crisis, the financial system was reorganized to help finance the government. In both cases, this ended up leading to government debt becoming a better asset for hedging aggregate risk. In this sense, the government both increased the supply of government debt but also intervened in financial markets to increase demand. We perform a counterfactual experiment in which the US government finances World War I using a similar approach to the Civil War and the Global Financial Crisis. We find that the government is able to decrease taxation but at the cost of both lower investment and lower banking sector liquidity creation.

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 partially backed by financial regulation that creates captive demand within the financial sector and so makes 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. In this sense, we bring the fiscal cost of generating a funding cost spread onto the equilibrium path.

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, Lustig, Van Nieuwerburgh and Xiaolan (2020b). Our focus on modeling the hedging properties of government debt is complementary to the empirical work of Acharya and Laarits (2023).

Section 2 presents historical empirical evidence on the private-public borrowing cost spread. Section 3 describes and characterizes our baseline model of captive demand and funding advantage. Section 4 studies how government monetary-fiscal policies impact the government funding advantage. Section 5 discusses how other commonly used models cannot capture the loss of funding advantage in the 1970s. Section 6 explores implications for macroeconomic policy.

2 Empirical Equilibrium Relationships Between US Government Funding Advantage

In this section, we define government advantage, discuss the mis-measured stylized historical facts that have motivated the macro-finance literature, and show how our new historical data series change our understanding the equilibrium relationships that macro-finance modeling should be targeting.

2.1 Defining Government Funding Advantage

To fix notation, suppose both the government and the corporate sector issue long-term bonds that pay a fraction ω of the remaining outstanding balance each period, so their average maturity is $1/\omega$. The bonds trade at prices q_t^b and q_t^h respectively. We say that the government has a funding advantage if it can sell its debt at a higher price than the private sector, $q_t^b > q_t^h$, even though the bonds promise the same cash flow stream. This is often equivalently expressed by saying that the spread between the yield on private sector bonds and the yield on government bonds is positive:

$$\chi_t := \Big(-\omega \log(q_t^h)\Big) - \Big(-\omega \log(q_t^b)\Big) > 0.$$

so the government can borrow at a cheaper rate than the private sector. The spread χ_t is sometimes referred to as a treasury "box spread" compared to a synthetic government bond without the non-pecuniary benefits of actual government debt (e.g. van Binsbergen, Diamond and Grotteria (2022)) or a "convenience yield", although many papers reserve the term convenience yield to refer to the spread between expectation of the household's stochastic discount factor (SDF) and the yield on treasuries (e.g. Krishnamurthy and Vissing-Jorgensen (2012)). We do not take a stand on the most appropriate name from the literature and instead refer to the yield spread χ_t as the *"private-public borrowing cost spread"* and the price difference $q_t^b - q_t^h$ as the *"treasury premium"*. We consider both to be measures of the government *"funding advantage"* compared to the private sector but not measures of the special role of all debt compared to non-debt assets.

The funding advantage χ_t plays an important and much studied role in macro-finance. This is because macroeconomists need to understand the equilibrium cost of government borrowing in order to model the government budget constraint. In particular, the size of the government's funding advantage determines the extent to which the government can issue debt unbacked by future tax revenue. Formally, suppose that, each period t, the government raises taxes τ_t, spends G_t, and issues long-term debt B_t. The period t government budget constraint is given by:

$$\omega B_{t-1} + G_t = \tau_t + q_t^b \left(B_t - (1-\omega)B_{t-1}\right).$$

If we assume that there exists a stochastic discount factor, $\widetilde{\xi}_{t,t+1}$, that prices private sector bonds, then iterating the budget constraint forward gives the lifetime budget constraint (e.g. see Jiang et al. (2022b)):

$$\begin{aligned}\left(\omega + (1-\omega)q_t^b\right)B_{t-1} &= \underbrace{\mathbb{E}_t\left[\sum_{s=0}^{\infty}\widetilde{\xi}_{t,t+s}\left(\tau_{t+s} - G_{t+s}\right)\right]}_{(i)} \\ &+ \underbrace{\left(q_t^b - q_t^h\right)B_t + \mathbb{E}_t\left[\sum_{s=1}^{\infty}\widetilde{\xi}_{t,t+s}\left(q_{t+s}^b - q_{t+s}^h\right)\left(B_{t+s} - (1-\omega)B_{t+s-1}\right)\right]}_{(ii)}.\end{aligned}$$

This equation implies that the value of outstanding debt, $(\omega + (1-\omega)q_t^b)B_{t-1}$, is the present discounted value of future surpluses, $\{\tau_{t+s} - G_{t+s}\}_{s\geq 0}$ (term (i)), and the present discounted value of the *"convenience revenue"* the government earns from being able to issue debt more cheaply than the private sector, $\{(q_{t+s}^b - q_{t+s}^h)B_{t+s}\}_{s\geq 0}$ (term (ii)). Following Sargent and Wallace (1981), we can express the convenience revenue from the current debt as a fraction of output y_t by:

$$(q_t^b - q_t^h)\frac{B_t}{Y_t} = \frac{q_t^b B_t}{Y_t}(1 - \exp(-\chi_t/\omega))$$

which can be interpreted as the market value of government debt $q_t^b B_t$ multiplied by the implicit "tax" from the government's funding advantage $1 - \exp(-\chi_t/\omega)$. This means that to understand the government budget constraint and choice set, it is essential for macro-finance to understand how government policies affect the government's funding advantage.

2.2 Revisiting Equilibrium Macroeconomic Empirical Targets

US policy makers have long been preoccupied by attempts to understand and control US Federal government funding advantage, which has spawned a wide range of potential explanations for its origins. National Banking Era (1862-1913) policy makers argued that they successfully lowered government borrowing costs by forcing banks to back money creation with long-term treasuries and so created a captive market for treasuries. The US Treasury secretary during World War I, William McAdoo, argued that stabilizing the return on treasuries was necessary to maintaining funding advantage (and the reason the government lost its funding advantage during World War I). Federal Reserve Board member Emanuel Goldenweiser returned to this argument when advocating for yield curve control during World War II. Financial commentators during the 1970s argued that the loss of the nominal anchor eroded government funding advantage. More recently, researchers have argued that the Basel III and Dodd-Frank macroprudential regulations have created demand for government debt. A common feature of these historical and contemporary theories is that government funding advantage is intimately connected to government policy interventions and, in particular, the way that the financial sector is constrained to interact with the treasury market.

By contrast, when studying US funding advantage, the macro-finance literature has been strongly influenced by historical asset pricing data that appears to show that there is a relatively stable, downward sloping equilibrium relationship between US funding advantage and Debt-to-GDP for the period 1920-2007 (e.g. Krishnamurthy and Vissing-Jorgensen (2012)). We replicate the patterns visually in the top subplot of Figure 1, which plots the most commonly used measure of government funding advantage against the market value of debt-to-GDP. This calculates government funding advantage as the difference between two yield indices. The first is the Moody's Seasoned AAA-rated long-maturity corporate bond index (FRED code: AAA), which is constructed from a sample of industrial and utility bonds (industrial only after 2002) with more than 20 years to maturity. The second is the Federal Reserve Bulletin's long-term US government bond yield index (FRED code: LTGOVTBD), which is constructed as the average yield on *all* outstanding government bonds neither due nor callable in less than 10 years. For brevity, we will call this the *index-based* AAA Corporate-Treasury spread throughout the paper. This has led many researchers to ignore the institutional features of the treasury market and the financial sector, and instead focus on reduce form models that generate an equilibrium relationship of the form:

$$\chi_t \approx \omega \log \left(\Omega \left(\frac{q_t^b B_t}{Y_t}; \zeta_t \right) \right), \qquad \frac{(q_t^b - q_t^h) B_t}{Y_t} \approx \frac{q_t^b B_t}{Y_t} \left(1 + \Omega \left(\frac{q_t^b B_t}{Y_t}; \zeta_t \right) \right) \tag{2.1}$$

where Ω is a function that is decreasing in debt-to-GDP $q_t^b b_t / y_t$ and ζ_t is an exogenous demand shifter orthogonal to government policy. As many papers in macro and safe-asset literatures have shown (and deployed in their work), the stable equilibrium relationship in this scatter plot is well captured by a bond-in-the-utility model with exogenous, independent demand shocks, which produces both the downward sloping equilibrium relationship and can account for the small deviations from the trend.

However, in Lehner et al. (2025), we show that this apparently stable equilibrium relationship comes from a mismeasurement of Corporate and Treasury yields. This is because the index-based spread effectively compares the difference between yields on nominal corporate bonds and the yields on government bonds with a put option on inflation and different tax treatment. After correcting for the differences in bond features, the actual historical relationship for the period 1920-2007 is shown in the second subplot of Figure 1, which shows very little stable connection between spreads and quantities. Interpreted through the lens of a bond-in-the-utility model, the exogenous demand shifters ζ_t, would need to account for most of the variation in the data and the dependence on quantities is not particularly important for predicting equilibrium changes to the funding advantage.

The high inflation period in the 1970-80s (the red dots and lines on the scatter plot) offers a particularly interesting example of how our new series changes our understanding of government funding advantage. Looking at the top panel, one can get the impression that the highest-grade corporate-Treasury spread started to increase when inflation shocks started to devalue long-term government debt after 1965. So it looks like the economy could be moving along a stable demand function for US Treasurys. Indeed, in the top panel, the spread reaches its maximum value in the midst of the high inflation in the mid 1970s. The middle panel, with our data, tells a very different story: as government debt got devalued in the 1970-80s, the highest-grade corporate-Treasury spread fell to around zero, its lowest value in the sample. So it looks like high inflation coincided with a breakdown (or leftward shift) of the relationship between spreads and quantities.

The picture becomes more complicated when we look at our long sample from 1865-2024 in the bottom subplot. The different colored dots represent periods that historians typically describe as having different regulatory constraints or different monetary policies. Evidently, there are low-frequency changes to the level and curvature of the equilibrium relationship that correlate with historical policy regime changes. US funding advantage appeared in the late 1860s, well before Bretton-Woods, and fell to zero during the high inflation of the 1970s, despite the emergence of US dollar denominated debt as the international reserve asset.

To help see these descriptive patterns more clearly, Figure 2 plots times series for our entire sample from 1860-2024. The top subplot show the 15-year spread between corporate and treasury yields (the orange line) and the market value of debt-to-GDP (the black line). The bottom subplot shows the rolling bond-stock beta (calculated as the coefficient when treasury returns are regressed against stock returns) over a 3-year centered window. The treat the bond-stock beta as a proxy for how effectively treasuries can be used to hedge risk. The spread is systematically higher during the National Banking Era (approximately 1862-1920), lower during the rest of the twentieth century, and higher again over the last 15 years. The co-movement between debt-to-GDP and the spread varies greatly throughout the sample, while there is a noisy, but consistently negative relationship between the bond-stock beta and the spread.

To make these observations about co-movements more formal, in Table 2, we regress the spread against Debt-to-GDP, the bond-stock beta, stock market volatility, and controls for regulatory eras. In column (1) we show that, unconditionally, dummies for the National Banking Era, and the Post GFC period explain the majority of the variation in the long sample (an adjusted R^2 of 0.70). Introducing the log-debt-to-GDP ratio and stock market volatility in column (2) does help explain additional variation (the adjusted R^2 increases to 0.77) but there is no significantly negative relationship to log-debt-to-GDP. By contrast, introducing the bond-stock beta and stock market volatility in column (3) leads to greater forecastability (the adjusted R^2 increases to 0.86) and the relationship to the bond-stock beta is significant at the 5% threshold. In the final column we include all variables. This does recover a negative relationship between spreads and log-debt-to-GDP during main time period (1917-2010). However, the relationship is actually positive during the National Banking Era and insignficant after the GFC. Furthermore, the introducing log-debt-to-GDP only increases the adjusted R^2 from 0.855 to 0.864, which is a negligible improvement. This reinforces what we saw in the historical episodes—the historical equilibrium relationship between quantities and spreads is not mechanically negative and quantities changes are not sufficient for explaining the historical movements. None of these regressions identify demand functions and so are not inconsistent

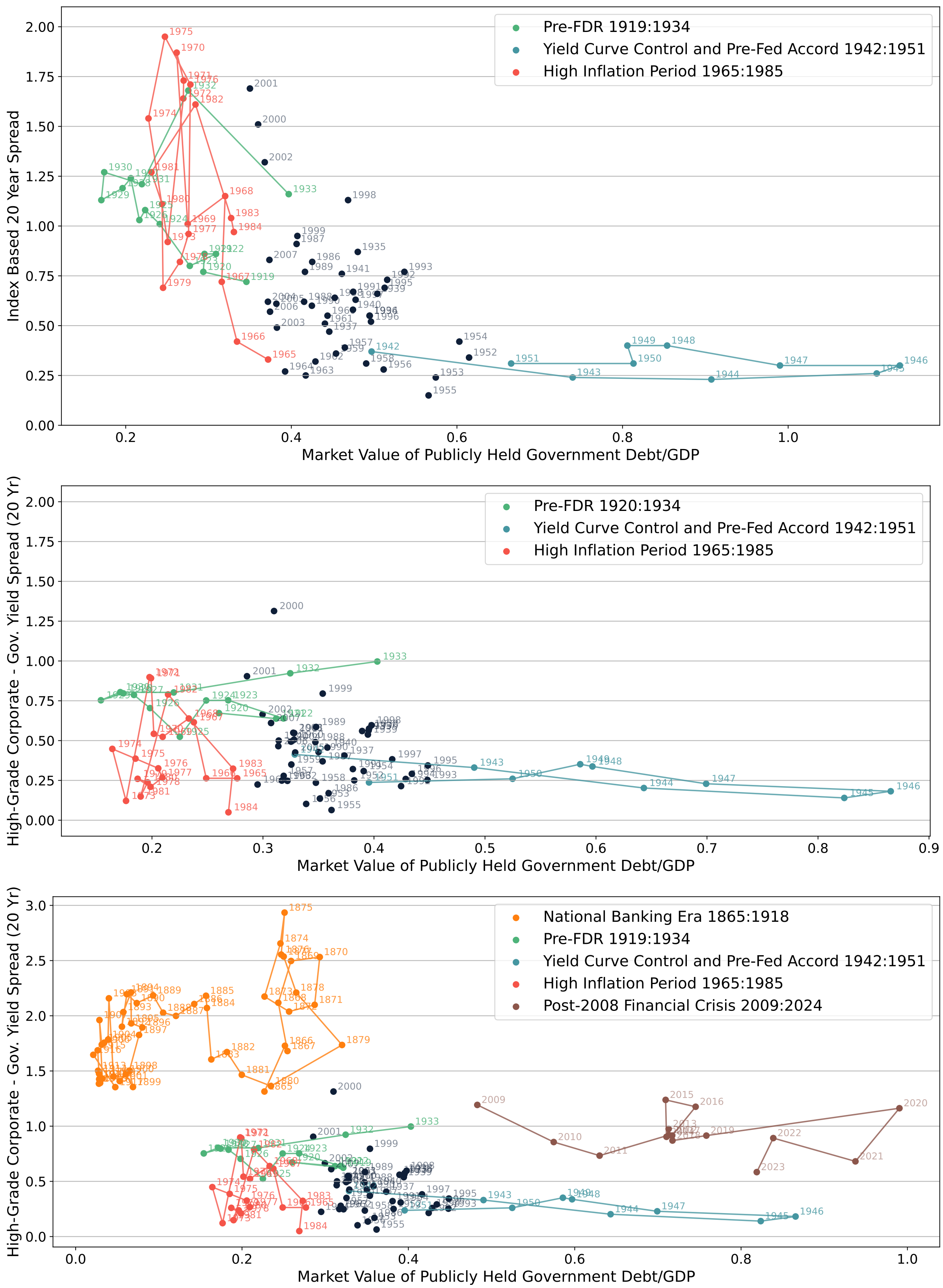

Figure 1: (a) The top panel replicates Krishnamurthy and Vissing-Jorgensen (2012) using their data and time period from 1920-2007. (b) The middle panel uses our estimate of the spread to replicate the top panel. (c) The bottom panel uses our estimate for our full sample from 1865-2024.

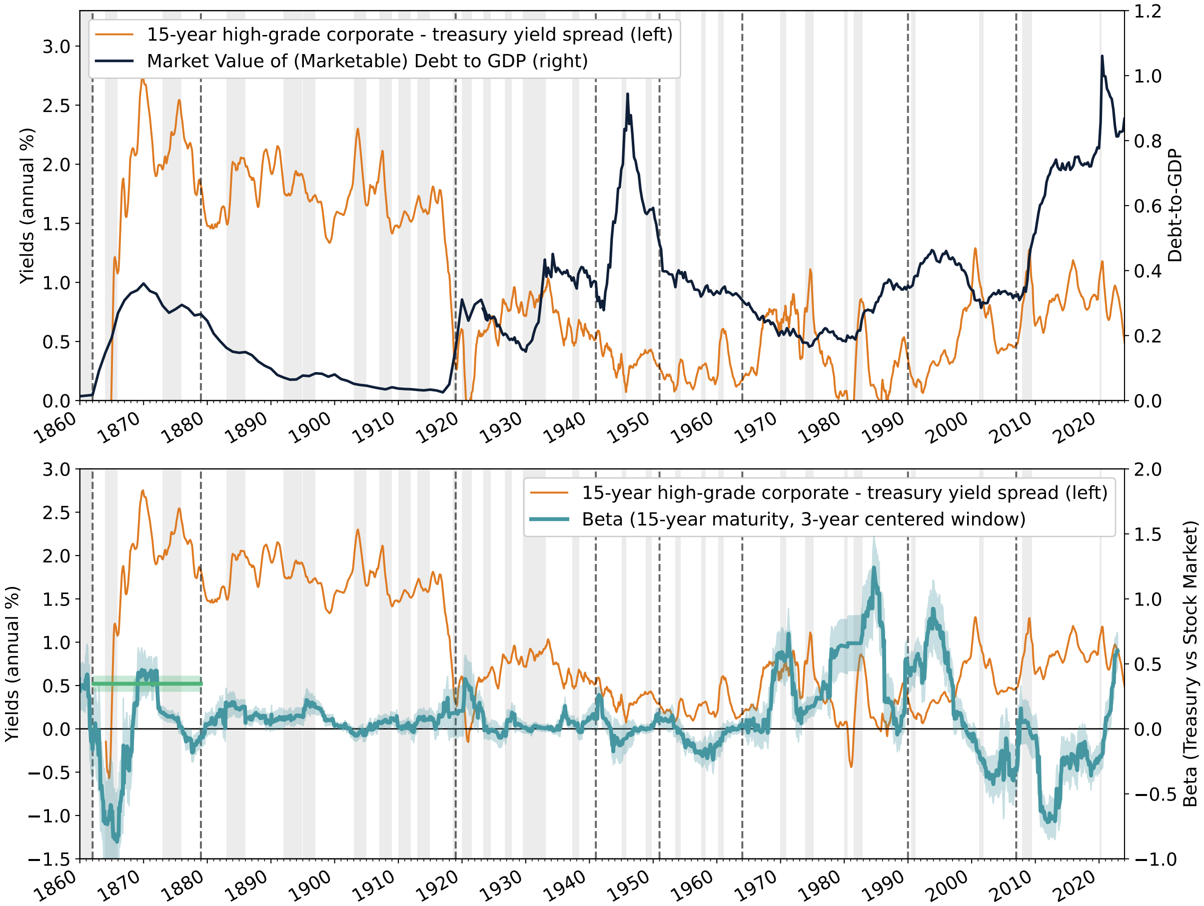

Figure 2: Full Sample: 1860-2024

with the large applied microeconomic literature that use a collection of different instruments to identify that demand for Treasuries is downward sloping in market value of Treasury holdings. Indeed, all the modeling in our paper will generate demand functions that match the microeconomic literature. Instead, our results emphasize that the macro-finance practice of targeting stable equilibrium relationships between quantities and spreads is problematic.

Which kind of equilibrium relationship macro-finance is targeting has far-reaching implications, which raises the stakes on getting it correct in empirical work and macroeconomic modeling. If the US government faces a stable, policy invariant equilibrium pricing function, then the government can enact a very wide range policies (e.g. the inflation of government debt and the changing the financial sector) without changing its monopoly position. By contrast, if we think the US faces a policy-variant equilibrium pricing function, then the government faces a very different choice set. It can potentially expand the equilibrium pricing function for government debt but it can also potentially erode it. This opens up a collection of interesting questions about how government policies interact with government funding advantage. Can the government systematically intervene in government debt markets to change its funding advantage? Does return risk impact the funding advantage? What is the actual choice set faced by a government?

These are general equilibrium questions and require a structural model. In the next section, we

Table 1: Regression Results: Funding Advantage

	Dependent variable: Funding Advantage (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) $\times$ Pre-1920 Dummy		0.225*		0.308**
		(0.120)		(0.122)
log(Debt/GDP) $\times$ Post-2010 Dummy		0.350		1.667
		(0.938)		(1.104)
Volatility $\times$ Pre-1920 Dummy		-1.722***	-0.473	-0.430
		(0.634)	(0.614)	(0.615)
Volatility $\times$ Post-2010 Dummy		-2.587***	-1.914	-3.127*
		(0.920)	(1.421)	(1.737)
Slope $\times$ Pre-1920 Dummy		0.109**	0.068	0.012
		(0.043)	(0.047)	(0.056)
Slope $\times$ Post-2010 Dummy		0.000	0.003	0.062
		(0.125)	(0.093)	(0.111)
Beta $\times$ Pre-1920 Dummy			0.732	0.222
			(0.713)	(0.904)
Beta $\times$ 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
Observations	163	163	138	138
Adjusted R^2	0.704	0.767	0.855	0.864

Table 2: Regression Analysis

build a general equilibrium model that endogenizes government funding advantage. We attempt to nest the many different stories that policy makers have put forward by focusing on modeling the role that Treasuries can play in helping financial intermediaries to manage liquidity and risk in financial markets. This will ultimately allow us to connect financial regulation, market structure, and monetary-fiscal policy to government funding advantage.

3 A Model of Government Funding Advantage

In this section, we outline a tractable macro-finance model in which government funding advantage is endogenous and policy dependent. Conceptually, we do this by modeling an environment in which financial assets can take on a special role to help banks manage contract settlement frictions and their associated risks. If government bonds take on this role, then they trade at a higher price and lower yield than a private sector bond with an identical cash-flow stream, thereby giving the government a funding advantage. We use our model to show how financial regulation can be used to make government bonds a "safe asset" for managing settlement within the financial sector.

Formally, we study a stochastic neoclassical growth model with a banking sector that engages in maturity transaction. Households need deposits in order to trade and produce input goods. Banks provide these deposits but cannot costlessly raise equity from households when settling deposit withdrawals. This is the main financial friction in our environment. It ultimately exposes banks to the risk of costly equity issuance and/or costly asset sales in the "crisis" states when households need more liquidity. The frictions make our environment a "second-best" world with two interconnected asset pricing distortions: a "liquidity spread" on financial sector liabilities and a "hedging spread" on assets that can help banks to self-insure against high withdrawal shocks. We assume that absent financial regulation, government and highest-grade corporate debt are equally useful for hedging settlement risks in the interbank market. That is, government debt does not have an immutable, special role in the economy.

We introduce a government into this environment that faces exogenous expenditure shocks, can raise taxes, and can manipulate asset markets by imposing restrictions on financial sector portfolios. This introduces additional asset-specific regulatory pricing distortions, which creates direct regulatory demand for government debt (a *forced holding effect*) and also changes the equilibrium co-movement between government debt prices and aggregate shocks (a *hedging effect*). In particular, the regulatory portfolio restrictions induce crowding into the secondary government debt market in crisis times. This makes government debt an effective hedging asset, which in turn amplifies the government's funding advantage.

The implied regulatory wedges function as a form of "financial tax" that banks seek to minimize. A key feature of our model is that banks have the ability to mitigate the impact of these wedges, though only by incurring a cost. When this cost is high, regulation generates strong captive demand for government debt, producing a sizable funding advantage. However, unless the cost is prohibitive, the banking sector's profit-maximizing behavior renders such captive demand inherently fragile.

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. There is a final good that is used for consumption and investment and there is an input good that is combined with capital to produce final goods. There is a unit continuum of households, a unit continuum of banks, and a unit continuum of firms. There is a government that purchases consumption goods, issues debt, B_t, in the primary asset market, raises taxes from the family in the afternoon, and imposes regulatory constraints on bank portfolios. There is an exogenous state $\boldsymbol{\varepsilon}_t$ that is realized at the start of the morning market and follows a Markov Chain with transition matrix Π. We denote variables in the morning market with a breve, $\breve{v}$, and in the afternoon market without a breve, v. We use a lower case letter v to denote a variable for an individual agent and a capital letter V to denote the aggregate variable.

Firms and production: Firms control an "afternoon" Cobb-Douglas production technology that transforms k_{t-1} units of capital and m_t units of "input goods" into $y_t = z(\boldsymbol{\varepsilon}_t)k_{t-1}^{\alpha}m_t^{1-\alpha}$ units of final goods in the afternoon of t. Capital depreciates at rate $\delta > 0$, so firms—who own the capital stock—enter each period t with $(1-\delta)k_{t-1}$ units. In the afternoon of t, prior to production, they can convert final goods to capital goods $1-1$. This implies a law of motion for capital stock $k_t = (1-\delta)k_{t-1} + i_t$, where i_t is investment of final goods. Firms can issue long-term bonds, h_t, and equity, n_t in the afternoon market. Long term bonds repay a fraction ω of the outstanding balance in final goods each afternoon. Following the macro-finance literature (e.g. Holmstrom and Tirole (1997), Kiyotaki and Moore (2019)), firms face a collateral constraint that debt must be backed by capital: $q_t^h h_t \leq \theta q_t^k k_t$, where q_t^h and q_t^k are the price of bonds and capital respectively.

Households: The economy is populated by a continuum of households with discount factor β. In the morning, households produce input goods according to a production function $m_t = \breve{l}_t$ where $\breve{l}_t$ is labor supply. However, only a fraction $1-\lambda(\boldsymbol{\varepsilon}_t)$ of households can use their own labor to produce input goods. The remaining fraction $\lambda(\boldsymbol{\varepsilon}_t)$ need to use the labor of other households but lack the commitment required to issue credit and so must pay for labor inputs using deposits when purchasing labor (i.e. they face a "deposit-in-advance" constraint). All households supply labor at linear disutility. Households can store the goods from morning to afternoon and sell them to firms. In the afternoon, all households get flow utility $u(c_t)$ from consuming c_t final goods in the afternoon.

Banks: In the afternoon of each period $t-1$, a one period lived representative bank is set up and issues demand deposits, d_{t-1}, and equity, e_{t-1}, to the households. The following period t, the banks service the liquidity needs of the households. This means that a fraction $\lambda(\boldsymbol{\varepsilon}_t)$ of the households transfer deposits to other households. As a result, each bank faces a gross outflow of $\lambda(\boldsymbol{\varepsilon}_t)d_{t-1}$ deposits at the beginning of the morning market and a gross inflow of $\lambda(\boldsymbol{\varepsilon}_t)d_{t-1}$ deposits at the end of the morning market. Each deposit promises 1 unit of morning input goods. Following in the spirit of Freeman (1996a,b), the interbank morning markets are characterized by settlement frictions that prevent banks from freely "netting out" their outflows and future inflows. Formally, banks cannot write uncollateralized IOUs with each other. Instead, they must settle gross deposit outflows in the morning market by either raising costly funds from households or selling their assets. In particular, banks can issue "non-preferred equity" $\breve{e}_t$ at morning price $\breve{q}_t^e$, which returns one final good per share in the afternoon, but this entails a quadratic resource cost $\Psi(\breve{q}_t^e\breve{e}_t) = \frac{\psi}{2}(\breve{q}_t^e\breve{e}_t)^2$ incurred in the afternoon.[2] In addition, banks can also force their

[2] $\breve{e}_t$ could equivalently be interpreted as an intra-period loan from households to banks because there is no risk between

depositors to swap their idle deposits for equity in the amount $\breve{f}_t$ and absorb bank losses in the afternoon at linear resource cost $\Phi(\breve{f}_t) = \phi\breve{f}_t$. This could be interpreted as conditional exit from banking sector activities, strategic default, or a type of contract renegotiation in the morning market. Regardless of the interpretation, parameter $\phi > 0$ dictates the banking sector's capacity to relax its regulatory constraints. In the afternoon, banks sell their remaining assets to the newly formed banks, pay out dividends x_t^e per share, and then exit.[3]

Markets: We use the input good as the numeriare in the morning market and final goods as the numeraire in the afternoon market. In the afternoon, government bonds, corporate bonds, firm equity, bank deposits, bank equity, input goods, and capital are traded in competitive markets at prices $(q_t^b, q^h, q_t^n, q_t^d, q_t^e, q_t^m, q_t^k)$ respectively. In the morning, after the shocks are realized, banks can trade government bonds, at price $\breve{q}_t^b$, and corporate bonds, at price $\breve{q}_t^h$, in the secondary asset markets, and issue non-preferred equity at price $\breve{q}^e$. However, they cannot short-sell during the morning market.

Government: In the afternoon of period t, the government purchases consumption goods $g(\varepsilon_t)Y_t$, raises lump-sum taxes $\tau_t Y_t$ on the household, and issues long-term bonds in the primary asset market that repay a fraction ω of the outstanding balance in consumption goods at time t. The government's one-period budget constraint in the afternoon is:

$$\left(\omega + (1-\omega)q_t^b\right)B_{t-1} \leq (\tau_t - g(\varepsilon_t))Y_t + q_t^b B_t. \tag{3.1}$$

where B_t denote government bonds outstanding at t. In addition, the government follows an exogenously determined fiscal rule, stipulating that taxes follow:

$$\tau_t = \overline{\tau} + \eta\left(\frac{B_{t-1}}{Y_t} - \bar{\mathsf{b}}\right) \tag{3.2}$$

where $\bar{\mathsf{b}}$ is a "target level" of debt-to-output ratio (evaluated at par) and $\eta \geq 0$ measures the sensitivity of tax-to-output to deviations from the target level of outstanding debt-to-output. In Section 4 we extend the model to consider nominal debt and inflation.

The government can also impose restrictions on banks' portfolios after re-trading in the secondary asset markets, which we model with a stylized minimum capital requirement:[4]

$$\underbrace{\breve{q}_t^b\breve{b}_t + \breve{q}_t^h\breve{h}_t - (d_{t-1} - \breve{f}_t)}_{\text{net worth after re-trading}} \geq \varrho\underbrace{\left(\kappa^b\left(\breve{q}_t^b\breve{b}_t\right) + \kappa^h\left(\breve{q}_t^h\breve{h}_t\right)\right)}_{\text{weighted assets}} \tag{3.3}$$

where d_{t-1} is the bank's deposits at the beginning of the morning of period t, $\breve{f}_t$ is the volume of the forced deposit-to-equity swap, and $\left(\breve{b}_t, \breve{h}_t\right)$ denote the bank's post-trade holdings of government debt and corporate debt, respectively. The tuple $(\varrho, \kappa^b, \kappa^h)$ is a set of regulatory parameters. Specifically, $\varrho \in [0,1]$ is the minimum net-worth ratio, requiring banks to hold sufficient equity against their weighted

morning and afternoon.

[3]We use bank exit for expositional simplicity. Equivalently, we could model the banks recapitalizing in the afternoon by issuing new equity frictionlessly.

[4]Alternatively, we can think of this as a leverage constraint that restricts the bank's ability to back its deposit with long term assets.

long-term assets. The parameters $\kappa^b, \kappa^h \in [0, 1]$ are the assigned "penalty weights" on government debt and private sector securities, respectively, used in the computation of regulatory asset values. Assets with lower penalty weights contribute more favorably toward meeting regulatory capital requirements. For simplicity, we define the composite regulatory parameters $\mathcal{K}^b := 1 - \varrho\kappa^b$ and $\mathcal{K}^h := 1 - \varrho\kappa^h$ and refer to $\mathcal{K}^b - \mathcal{K}^h$ as the relative regulatory privilege from holding government debt compared to corporate bonds. A higher $\mathcal{K}^b$ and lower $\mathcal{K}^h$ indicating more privilege.[5]

Discussion of model features: Our environment is set up to nest a collection of important classes of macroeconomic models:

(i) *Neoclassical growth models:* Our model is a variant of the standard neoclassical growth model in the sense that the behavior of households and firms during the afternoon sub-period will be able to be described by well-known equilibrium conditions with "wedges". What differentiates our framework is the introduction of frictional interbank asset markets that operate in an intermediate stage—opening after aggregate shocks have been realized but before the afternoon markets open—and endogenize the wedges in the afternoon Euler equations. Our goal is to make the minimal deviation from the standard neoclassical growth model required to create a role for "safe-assets" in the financial sector. Accordingly, in Section 3.2 we first characterize equilibrium in these interbank asset markets, treating the decisions of households and firms, along with the banking sector's afternoon decisions, as given. In Section 3.3, we then complete the equilibrium characterization by studying the remaining decisions of households, firms, and banks.

(ii) *Banking models:* The macro-finance literature has proposed many ways of integrating a banking sector into macroeconomic modeling. Our environment combines a model of settlement frictions (in the spirit of Freeman (1996a,b)) with a model of costly equity raising (in the spirit of Gertler and Kiyotaki (2010)). Our contribution is to highlight how the price processes of different bonds can change their non-pecuniary role for settlement of contracts in the financial sector. Throughout the main text of the paper, we focus on an environment in which there are no net real outflow from the banking sector in the morning market so the frictions in the banking sector are entirely related to problems of settling net transactions. We choose this modeling approach because empirically most deposit withdrawals are returned to the financial system after trading completed. In Appendix D, we offer an alternative, more complicated version of the model in which banks face real net outflows in the morning market and there are heterogeneous banks. This environment nests models with consumption shocks (e.g. Diamond and Dybvig (1983)) and models with heterogeneous banks (e.g. Allen and Gale (1998), Gertler and Kiyotaki (2010)) We show that, although this environment cannot be characterized as cleanly in closed form, it none-the-less delivers the same economic insights.

(iii) *Alternative regulations:* We have interpreted $(\varrho, \kappa^b, \kappa^h)$ as the weights in explicit macroprudential regulation. One alternative interpretation is that they could reflect implicit pressure on the banking sector to purchase government debt (e.g. in the US during WWII). Another alternative is that it could reflect collateral requirements at a government discount window (e.g. in the US after

[5] For example, (κ^b, κ^h) could be interpreted as Basel-3 weights or National Banking Era restrictions.

the introduction of the Fed). In this case regulatory privilege would map to a lower haircut for Treasuries at the discount window.

(iv) *Alternative financial intermediaries:* We have focused on the banking sector because that has historically been a large buyer of government debt. However, 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 in the intermediary Euler equations, (iii) the government restricts the portfolio that the financial intermediary. In this sense, the forces in our model also apply to insurance companies, pension funds, and other financial intermediaries.

3.2 Interbank Asset Markets and Captive Demand

We set up the equilibrium recursively. The morning aggregate state vector is $\breve{\mathbf{s}} := (\boldsymbol{\varepsilon}, K, B, D, H)$ and the afternoon state vector is $\mathbf{s} = (\boldsymbol{\varepsilon}, K, B) \subset \breve{\mathbf{s}}$. We guess and verify that afternoon prices are functions of the form $(q^d(\mathbf{s}), q^e(\mathbf{s}), q^k(\mathbf{s}), q^b(\mathbf{s}), q^h(\mathbf{s}), q^n(\mathbf{s}))$ and morning prices are functions of the form $\big(\breve{q}^b(\breve{\mathbf{s}}), \breve{q}^h(\breve{\mathbf{s}}), \breve{q}^e(\breve{\mathbf{s}})\big)$. In this subsection we characterize the equilibrium in the morning interbank market, which is the novel feature of the model. In Subsection 3.3, we characterize general equilibrium.

In the morning, each bank enters with a portfolio (b, h, d) of government bonds, corporate bonds, and deposits chosen in the preceding afternoon sub-period. They then face the budget constraint:

$$\breve{q}^b(\breve{\mathbf{s}})\breve{b}(\breve{\mathbf{s}}) + \breve{q}^h(\breve{\mathbf{s}})\breve{h}(\breve{\mathbf{s}}) - \breve{d}(\breve{\mathbf{s}}) - \breve{q}^e(\breve{\mathbf{s}})\breve{e}(\breve{\mathbf{s}}) - \breve{f}(\breve{\mathbf{s}}) \leq \breve{q}^b(\breve{\mathbf{s}})b + \breve{q}^h(\breve{\mathbf{s}})h - d, \qquad \forall\ \breve{\mathbf{s}} \tag{3.4}$$

along with the net settlement restriction:

$$\lambda(\breve{\mathbf{s}})d \leq \breve{q}^b(\breve{\mathbf{s}})\big(b - \breve{b}(\breve{\mathbf{s}})\big) + \breve{q}^h(\breve{\mathbf{s}})\big(h - \breve{h}(\breve{\mathbf{s}})\big) + \breve{q}^e(\breve{\mathbf{s}})\breve{e}(\breve{\mathbf{s}}), \qquad \forall\ \breve{\mathbf{s}} \tag{3.5}$$

where $\big(\breve{b}, \breve{h}, \breve{d}\big)(\cdot)$ denote the remaining portfolio of government bond, corporate bond, and deposits after servicing depositors. Constraint (3.5) states that, to finance morning deposit withdrawals, $\lambda(\cdot)d$, the bank may sell its bonds amounting to $\big(b - \breve{b}(\cdot),\ h - \breve{h}(\cdot)\big)$, or raise additional funds equal to $\breve{q}^e(\cdot)\breve{e}(\cdot)$ from households with idle deposits, where each unit of $\breve{e}$ denotes a unit of "non-preferred equity" that returns one final good in the afternoon.[6] Finally, $\breve{f}(\cdot)$ denotes the amount of deposits banks can swap for risky liabilities for the specific purpose of relaxing the regulatory constraint (3.3). The regulatory constraint can be rewritten as

$$d - \breve{f}(\breve{\mathbf{s}}) \leq \mathcal{K}^b\breve{q}^b(\breve{\mathbf{s}})\breve{b}(\breve{\mathbf{s}}) + \mathcal{K}^h\breve{q}^h(\breve{\mathbf{s}})\breve{h}(\breve{\mathbf{s}}), \qquad \forall\ \breve{\mathbf{s}} \tag{3.6}$$

In the afternoon, banks pay their equity and deposit holders subject to the budget constraint:

$$x^e(\mathbf{s})e + \breve{d}(\mathbf{s}) \leq x^b(\mathbf{s})\breve{b}(\mathbf{s}) + x^h(\mathbf{s})\breve{h}(\mathbf{s}) - \breve{e}(\mathbf{s}) - \Psi\left(\breve{q}^e(\mathbf{s})\breve{e}(\mathbf{s})\right) - (1+\phi)\breve{f}(\mathbf{s}), \qquad \forall\ \mathbf{s} \tag{3.7}$$

where $\Psi(\cdot)$ is the cost of raising morning equity, ϕ is the linear cost of forcing depositors to swap deposits for equity in the morning, and $x^b(\cdot)$ and $x^h(\cdot)$ are the afternoon payoffs from government bonds and

[6] $\breve{e}$ could equivalently be interpreted an intra-period loan from households to banks because there is no risk between morning and afternoon.

corporate bonds, respectively:

$$x^b(\mathbf{s}) := \Big(\omega + (1-\omega)q^b(\mathbf{s})\Big), \qquad \forall\ \mathbf{s}$$
$$x^h(\mathbf{s}) := \Big(\omega + (1-\omega)q^h(\mathbf{s})\Big), \qquad \forall\ \mathbf{s}.$$

Taking the predetermined individual portfolios (b, h, d, e), morning asset prices $\big(\breve{q}^b, \breve{q}^h, \breve{q}^e\big)(\cdot)$, and the afternoon payoffs $\big(x^b, x^h\big)(\cdot)$ as given, banks solve the following problem each morning for all $\mathbf{s}$:

$$\begin{aligned} W(b,h,d,e;\ \mathbf{s}) := &\max_{(\breve{e},\breve{d},\breve{b},\breve{h},x^e)(\cdot)} \Big\{\ x^e(\mathbf{s})e\ \Big\} \\ s.t. \qquad &(3.4),\ (3.5),\ (3.6),\ (3.7), \\ &0 \le \breve{e}(\breve{\mathbf{s}}),\ \breve{f}(\breve{\mathbf{s}}),\ \breve{b}(\breve{\mathbf{s}}),\ \breve{h}(\breve{\mathbf{s}}), \qquad \forall \mathbf{s} \end{aligned} \tag{3.8}$$

where $W(\cdot)$ is the value of the bank in the morning. The necessary first order conditions are:

$$[\breve{e}(\cdot)]: \qquad \breve{q}^e(\mathbf{s})\big(1+\breve{\mu}^e(\breve{\mathbf{s}})\big) = 1 + \partial_{\breve{e}}\Psi\Big(\breve{q}^e(\breve{\mathbf{s}})\breve{e}(\breve{\mathbf{s}})\Big)\breve{q}^e(\breve{\mathbf{s}}) \tag{3.9}$$

$$[\breve{f}(\cdot)]: \qquad \breve{\mu}^r(\breve{\mathbf{s}}) \le \phi \qquad \text{with } = \text{ if } \breve{f}(\mathbf{s}) > 0 \tag{3.10}$$

$$[\breve{b}(\cdot)]: \qquad \breve{q}^b(\breve{\mathbf{s}})\big(1+\breve{\mu}^e(\breve{\mathbf{s}})\big) = x^b(\breve{\mathbf{s}}) + \mathcal{K}^b\breve{\mu}^r(\breve{\mathbf{s}})\breve{q}^b(\breve{\mathbf{s}}) \tag{3.11}$$

$$[\breve{h}(\cdot)]: \qquad \breve{q}^h(\breve{\mathbf{s}})\big(1+\breve{\mu}^e(\breve{\mathbf{s}})\big) = x^h(\breve{\mathbf{s}}) + \mathcal{K}^h\breve{\mu}^r(\breve{\mathbf{s}})\breve{q}^h(\breve{\mathbf{s}}) \tag{3.12}$$

where $\breve{\mu}^e(\cdot) \ge 0$ and $\breve{\mu}^r(\cdot) \ge 0$ are the Lagrange multipliers on the settlement constraint (3.5) and the regulatory constraint (3.6) respectively and we have dropped the short selling constraints since they will not bind. Equation (3.9) equates the marginal cost of issuing non-preferred stocks to the marginal benefit of relaxing the morning budget through additional resources from the households. Condition (3.10) can be interpreted as saying that there is an upper bound on how much regulatory pressure the government can place on the banking sector to purchase government debt before they exit the market. Equations (3.11) and (3.12) equate the marginal cost of purchasing each asset in the secondary asset markets with its corresponding pecuniary payoff and non-pecuniary benefit arising from a relaxed regulatory constraint.

Definition 1 (Competitive Interbank Market Equilibrium)**.** Given initial aggregate asset holdings (B, H, D) and afternoon payout functions $\big(x^b, x^h\big)(\cdot)$, a competitive interbank market equilibrium is a collection of morning price functions $\big(\breve{q}^b, \breve{q}^h, \breve{q}^e\big)(\cdot)$ and bank policies $\big(\breve{b}, \breve{h}, \breve{e}, x^e\big)(\cdot)$, such that

- Taking prices as given, banks solve (3.8),
- Morning asset markets clear (where the clearing price in the morning equity market is the price at which households are indifferent about providing equity):

$$\breve{b}(\breve{\mathbf{s}}) = B, \qquad \breve{h}(\breve{\mathbf{s}}) = H, \qquad \breve{q}^e(\breve{\mathbf{s}}) = 1, \qquad \forall \breve{\mathbf{s}}. \tag{3.13}$$

Our morning market is sufficiently simple that equilibrium can be characterized in closed form, which we do in Proposition 1 below.

Proposition 1. *In a competitive interbank market equilibrium, price functions* $\big(\breve{q}^b, \breve{q}^h, \breve{\mu}^e, \breve{\mu}^r\big)(\cdot)$ *satisfy* *the following for all states* $\mathbf{s}$*:*

$$\begin{aligned}
\breve{q}^j(\breve{\mathbf{s}}) &= \frac{x^j(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})-\mathcal{K}^j\breve{\mu}^r(\breve{\mathbf{s}})}, \qquad\qquad j\in\{b,h\}\\
\breve{\mu}^e(\breve{\mathbf{s}}) &= \psi\lambda(\breve{\mathbf{s}})D,\\
\breve{\mu}^r(\breve{\mathbf{s}}) &= \min\left\{\breve{\mu}^{r\star}(\breve{\mathbf{s}}),\ \phi\right\},\\
\frac{\breve{\mu}^{r\star}(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})} &= \begin{cases}(\mathfrak{B}(\breve{\mathbf{s}})/2)-\sqrt{(\mathfrak{B}(\breve{\mathbf{s}})/2)^2-\mathfrak{C}(\breve{\mathbf{s}})}, & \textit{if} \quad \mathfrak{B}(\breve{\mathbf{s}})>0 \quad \textit{and} \quad \mathfrak{B}(\mathbf{s})^2\geq 4\mathfrak{C}(\breve{\mathbf{s}})>0\\ 0 & \textit{otherwise}\end{cases}
\end{aligned}$$

where $\mathfrak{B}(\breve{\mathbf{s}}) := \frac{1}{\mathcal{K}^b\mathcal{K}^h}\left((\mathcal{K}^b+\mathcal{K}^h)-\frac{\mathcal{K}^h\mathcal{K}^b x^b(\breve{\mathbf{s}})B+\mathcal{K}^b\mathcal{K}^h x^h(\breve{\mathbf{s}})H}{D(1+\breve{\mu}^e(\breve{\mathbf{s}}))}\right)$ *and* $\mathfrak{C}(\breve{\mathbf{s}}) := \frac{1}{\mathcal{K}^b\mathcal{K}^h}\left(1-\frac{\mathcal{K}^b x^b(\breve{\mathbf{s}})B+\mathcal{K}^h x^h(\breve{\mathbf{s}})H}{D(1+\breve{\mu}^e(\breve{\mathbf{s}}))}\right)$.

Proof. We obtain the stated conditions by rearranging FOCs (3.11) and (3.12), and plugging market clearing into the regulatory constraint (3.3). For the final step, observe that the regulatory constraint complementarity condition is:

$$0=\mu^r(\breve{\mathbf{s}})\left(\frac{\mathcal{K}^b x^b(\mathbf{s})B}{1+\breve{\mu}^e(\breve{\mathbf{s}})-\mathcal{K}^b\breve{\mu}^r(\breve{\mathbf{s}})}+\frac{\mathcal{K}^h x^h(\mathbf{s})H}{1+\breve{\mu}^e(\breve{\mathbf{s}})-\mathcal{K}^h\breve{\mu}^r(\breve{\mathbf{s}})}-D\right)$$

So, we either have that $\mu^r(\breve{\mathbf{s}})=0$ or that the expression in the parentheses is zero equivalent to:

$$\begin{aligned}
&\frac{\left(1-\mathcal{K}^h\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}\right)\mathcal{K}^b x^b(\breve{\mathbf{s}})B+\left(1-\mathcal{K}^b\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}\right)\mathcal{K}^h x^h(\breve{\mathbf{s}})H}{\left(1-\mathcal{K}^h\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}\right)\left(1-\mathcal{K}^b\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}\right)}=(1+\breve{\mu}^e(\breve{\mathbf{s}}))D\\
&\mathcal{K}^h\mathcal{K}^b\left(\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}\right)^2-\left[(\mathcal{K}^b+\mathcal{K}^h)-\mathcal{K}^h\mathcal{K}^b\left(\frac{x^b(\breve{\mathbf{s}})B+x^h(\breve{\mathbf{s}})H}{\big(1+\breve{\mu}^e(\breve{\mathbf{s}})\big)D}\right)\right]\left(\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}\right)\\
&\qquad+\left[1-\frac{\big(\mathcal{K}^b x^b(\breve{\mathbf{s}})B+\mathcal{K}^h x^h(\breve{\mathbf{s}})H\big)}{\big(1+\breve{\mu}^e(\breve{\mathbf{s}})\big)D}\right]=0
\end{aligned}$$

For $\mathcal{K}^b,\mathcal{K}^h>0$, the expression is a quadratic equation in terms of the ratio $\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}$. When two positive roots exist, the lower root is the only economically relevant solution given by the stated formula. When there is a positive and a negative root, one of the implied morning prices becomes negative. This case is inconsistent with an equilibrium with binding regulatory constraint. If $\mathcal{K}^b=0$ or $\mathcal{K}^h=0$, the equation becomes linear. For the special case of $\mathcal{K}^h=0$, we get that:

$$\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}=\frac{1}{\mathcal{K}^b}-\frac{x^b(\breve{\mathbf{s}})B}{\big(1+\breve{\mu}^e(\breve{\mathbf{s}})\big)D}$$

Plugging the asset market clearing conditions (3.13) into the aggregated version of the morning budget constraint (3.4) implies $\breve{e}(\mathbf{s})=\lambda(\breve{\mathbf{s}})D$. Combined with (3.9), this provides an expression for $\breve{\mu}^e(\breve{\mathbf{s}})$. □

Proposition 1 highlights how the distortions in the model shape the morning market equilibrium. First, banks face an equity raising friction in the morning market when attempting to cover withdrawals, which appears as the positive Lagrange multiplier on the morning settlement constraint $\breve{\mu}^e(\mathbf{s})>0$. That is, banks place an additional value on resources in the morning market compared to the afternoon market because it is the morning market when they cannot frictionlessly raise resources from households. This is the key friction that appears in much of the macro-finance literature (e.g. Gertler and Kiyotaki (2010)). Second, the regulatory constraint on banks potentially binds, which appears as a positive Lagrange multiplier $\breve{\mu}^r(\mathbf{s}) > 0$. Our goal is to understand how the government can manipulate this regulatory Lagrange multiplier to change the price process and role of government debt in the morning market.

The combination of the two frictions determines the relative morning price:

$$\frac{\breve{q}^b(\breve{\mathbf{s}})}{\breve{q}^h(\breve{\mathbf{s}})} = \left(\frac{x^b(\breve{\mathbf{s}})}{x^h(\breve{\mathbf{s}})}\right)\left(\frac{1-\mathcal{K}^h\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}}{1-\mathcal{K}^b\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}}\right) \approx 1+\left(\frac{1-\omega}{\omega}\right)\left(q^b(\mathbf{s})-q^h(\mathbf{s})\right)+\left(\mathcal{K}^b-\mathcal{K}^h\right)\frac{\breve{\mu}^r(\breve{\mathbf{s}})}{1+\breve{\mu}^e(\breve{\mathbf{s}})}. \quad (3.14)$$

So, we can see that when government debt is privileged ($\mathcal{K}^b > \mathcal{K}^h$), then a tighter relative regulatory constraint (a larger $\breve{\mu}^r/(1+\breve{\mu}^e)$) leads to higher relative morning price of government debt. To understand when and how we get this outcome, we explore the equilibrium progressively in Corollary 1. We start by considering an environment without financial regulation to explain how the interbank market frictions lead to asset price movements that complicates the banking sector's capacity to service its non-state-contingent deposits. We then introduce financial regulation and show how it can generate "captive" bank demand for government debt in bad times and so changes the state-dependence of prices to make government debt a good hedge against the problems arising from aggregate "withdrawal shocks".

Corollary 1. *We have the following:*

(i) Absent financial frictions ($\breve{\mu}^e(\cdot) = 0$) or financial regulation ($\breve{\mu}^r(\cdot) = 0$), morning prices are equal to the afternoon payoffs $q^j(\cdot) = x^j(\cdot)$.

(ii) With financial frictions ($\breve{\mu}^e(\cdot) > 0$) but absent financial regulation ($\breve{\mu}^r(\cdot) = 0$), bonds trade at a discount in the morning $q^j(\cdot) < x^j(\cdot)$ but government and corporate bonds are perfect substitutes in the interbank market. In addition, $\mathbb{C}ov(\breve{q}^b, \breve{\mu}^e) < 0$ and $\mathbb{C}ov(\breve{q}^h, \breve{\mu}^e) < 0$.

(iii) With regulatory constraints that privilege government debt ($\mathcal{K}^b > \mathcal{K}^h$), government and corporate bonds are imperfect substitutes in the interbank market. While government debt becomes a hedge against aggregate shocks ($\mathbb{C}ov(\breve{q}^b, \breve{\mu}^e) > 0$), the corporate debt prices fall in bad times ($\mathbb{C}ov(\breve{q}^h, \breve{\mu}^e) < 0$).

The first part of Corollary 1 describes our morning market with frictionless settlement and no regulation. In this case, the banks can costlessly raise resources from the households to cover morning deposit withdrawal obligations and then repay the households when they receive payments. This means that morning market prices are simply the payoffs in the afternoon and banks have no trouble handling withdrawals. This would ultimately mean that banks can essentially close out the liquidity premium in the economy.

The second part of Corollary 1 then describes the economy with morning equity raising frictions but without any regulation. In this case, banks face a penalty when raising funds from households in the morning market. Government and corporate bonds become perfect substitutes, with equal returns between morning and afternoon:

$$\frac{x^b(\mathbf{s})}{\breve{q}^b(\mathbf{s})} = \frac{x^h(\mathbf{s})}{\breve{q}^h(\mathbf{s})} = 1+\breve{\mu}^e(\mathbf{s}) = 1+\psi\lambda(\mathbf{s})d.$$

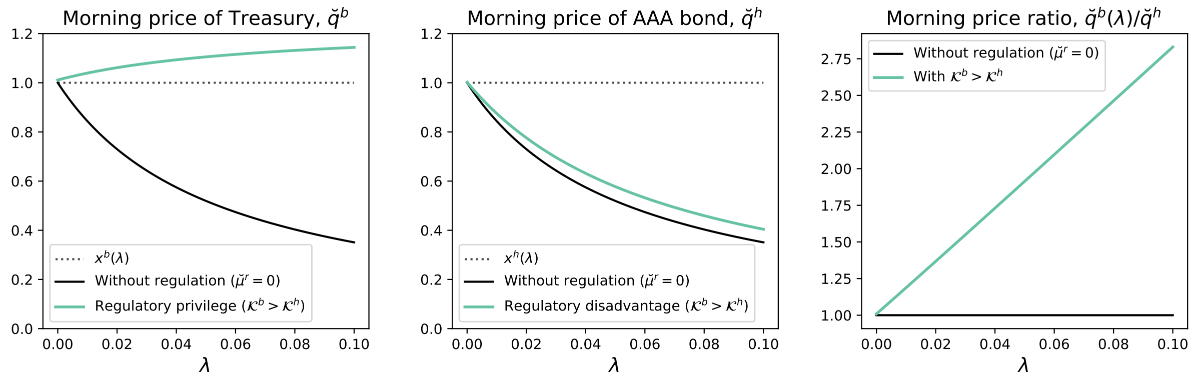

Figure 3: Morning Asset Prices With and Without Financial Privilege.

Black line shows the morning market prices in an environment without regulation. The teal line shows the morning market asset prices in an environment with regulations that privilege government debt. We used $b = 3.0$, $h = 3.5$, $d = 3.7$, $\psi = 5$, $\mathcal{K}^b = 1$, $\mathcal{K}^h = 0.19$.

Moreover, equity raising constraints imply that the marginal value of resources is greater inside the bank than outside, so $\breve{\mu}^e(\mathbf{s}) > 0$. In other words, the market's intertemporal rate of substitution between morning and afternoon exceeds that of households and as a result, morning asset prices $\breve{q}^i(\mathbf{s})$ fall below their afternoon payoffs $x^i(\mathbf{s})$ for $i \in \{b, h\}$, despite the absence of risk or discounting between morning and afternoon. In addition, higher withdrawal shocks raise $\breve{\mu}^e(\mathbf{s})$, thereby intensifying the downward pressure on interbank asset prices.

The final part of Corollary 1 introduces government regulation. Consider first the case in which deposit default costs are so large, $\phi \nearrow \infty$, that banks always choose $\breve{f}_t = 0$. Assume that $\mathcal{K}^b = \mathcal{K}^h = \mathcal{K}$ and $\varrho > 0$. In this symmetric case, the regulatory constraint restricts bank leverage but allows perfect substitution between government and corporate bonds for the purpose of satisfying regulatory requirements. The morning-to-afternoon returns of government and corporate bonds remain identical. However, the market's intertemporal rate is now influenced by an additional factor beyond forced asset sales—namely, regulatory-induced asset demand:

$$\frac{x^b(\breve{\mathbf{s}})}{\breve{q}^b(\breve{\mathbf{s}})} = \frac{x^h(\mathbf{s})}{\breve{q}^h(\breve{\mathbf{s}})} = 1 + \breve{\mu}^e(\breve{\mathbf{s}}) - \mathcal{K}\breve{\mu}^r(\breve{\mathbf{s}}) = \mathcal{K}\left(\frac{x^b(\breve{\mathbf{s}})b + x^h(\breve{\mathbf{s}})h}{d}\right)$$

Relative to the environment without regulation, interbank asset prices are now shaped by the tightness of the regulatory constraint $\breve{\mu}^r(\breve{\mathbf{s}})$: the tighter the constraint, the greater the upward pressure on morning prices. This mechanism generates a powerful countervailing force to $\breve{\mu}^e(\breve{\mathbf{s}})$. Several implications follow. Higher bank leverage—measured by deposit issuance relative to assets—raises morning asset prices. In particular, interbank asset prices decline as the aggregate supply of regulatory assets (government and corporate debt) increases. In contrast to the case without regulation, the cyclicality of interbank asset prices is determined solely by the cyclicality of afternoon payoffs. Interbank asset prices are insulated from the state-dependence of $\breve{\mu}^e(\breve{\mathbf{s}})$, because $\breve{\mu}^r(\breve{\mathbf{s}})$ offsets its effect: when forced sales depress prices, the regulatory constraint tightens, inducing additional regulatory demand that inflates prices. When $x^b(\breve{\mathbf{s}}) = x^h(\breve{\mathbf{s}})$, we have $\mathbb{C}\mathrm{ov}(\breve{q}^b, \breve{\mu}^e) = \mathbb{C}\mathrm{ov}(\breve{q}^h, \breve{\mu}^e) = 0$.

If financial regulation privileges government debt $\mathcal{K}^b > \mathcal{K}^h$, it increases pressure on the banking sector to hold government debt. Interbank asset prices continue to be shaped by the countervailing forces of forced selling and regulatory-induced demand. From Proposition 1, asset prices $(\breve{q}^b(\breve{\mathbf{s}}), \breve{q}^h(\breve{\mathbf{s}}))$ satisfy

$$d = \frac{\mathcal{K}^b x^b(\breve{\mathbf{s}}) b}{\frac{x^b(\breve{\mathbf{s}})}{\breve{q}^b(\breve{\mathbf{s}})}} + \frac{\mathcal{K}^b x^h(\breve{\mathbf{s}}) h}{\left((1+\breve{\mu}^e(\breve{\mathbf{s}}))\frac{\mathcal{K}^b - \mathcal{K}^h}{\mathcal{K}^h} + \frac{x^b(\breve{\mathbf{s}})}{\breve{q}^b(\breve{\mathbf{s}})}\right)} \qquad \breve{q}^h(\breve{\mathbf{s}}) = \frac{d - \mathcal{K}^b \breve{q}^b(\breve{\mathbf{s}}) b}{\mathcal{K}^h h}$$

The first equation shows that given (b, h, d) and $(x^b(\cdot), x^h(\cdot))$ there is a positive relationship between $\breve{\mu}^e(\breve{\mathbf{s}})$ and $\breve{q}^b(\breve{\mathbf{s}})$ whenever regulation prioritizes government debt $(\mathcal{K}^b > \mathcal{K}^h)$. In other words, regulation creates "captive demand", whereby periods of high withdrawals are accompanied by increased demand for government debt. Conceptually, the government exploits forced selling in the interbank market to tilt funding towards government debt in high withdrawal states. The second equation illustrates the corresponding cost borne by the private-sector asset: as funding is redirected away from the corporate bond, its interbank price declines in bad states.

3.3 General Equilibrium

We now complete the model by recursively characterizing general equilibrium across the morning and afternoon markets. This allows us to study how the price dynamics in the morning market generate a government funding advantage in the afternoon market.

Household problem: At the start of the afternoon sub-period, suppose the family has unspent wealth a and input goods m. The family's budget constraint in the afternoon sub-period at time t is:

$$c + q^d(\mathbf{s})d' + q^e(\mathbf{s})e' + q^n(\mathbf{s})n' \leq a + q^m m - \tau(\mathbf{s})Y(\mathbf{s}) \tag{3.15}$$

where c denotes goods consumed by the household in the afternoon sub-period, q^m is the afternoon price of the input good, m is the amount of input good produced by the household in the morning and stored between the morning and afternoon, and (d', e', n') denote the family portfolio of bank deposits, bank and firm equity, respectively, i denotes consumption goods used for capital production, and $\tau(\mathbf{s})$ denotes the tax-to-output ratio in the afternoon sub-period.

In the following morning sub-period, the new exogenous aggregate states $\boldsymbol{\varepsilon}'$ and the households' idiosyncratic shock for their morning trading needs are realized with probability λ. Unconstrained households that can self-produce choose their own labor effort $\breve{l}_u$ and potentially contribute additional equity $\breve{e}$ that is repaid in the afternoon. So the financial wealth and input goods that unconstrained households bring into the following afternoon are:

$$\begin{aligned} a'_u &= (d - \breve{q}^e \breve{e}' + \breve{e}') + x^e(\mathbf{s}')e + (x^n(\mathbf{s}') + q^n(\mathbf{s}'))n \\ m'_u &= \breve{l}'_u \end{aligned} \tag{3.16}$$

Constrained households that need to purchase inputs choose how much labor to sell to the market $\breve{l}_c$ and how much labor to purchase from the market $\breve{\ell}$ subject to the deposit in advance constraint:

$$\breve{w}(\mathbf{s}')\breve{\ell}' \leq \nu d \tag{3.17}$$

So the wealth and input goods that they bring into the afternoon are:

$$\begin{aligned} a'_c &= d - \breve{w}(\mathbf{s}')\breve{\ell}' + \breve{w}(\mathbf{s}')\breve{l}'_c + x^e(\mathbf{s}')e + (x^n(\mathbf{s}') + q^n(\mathbf{s}'))n \\ m'_c &= \breve{\ell}' \end{aligned} \tag{3.18}$$

Let $V(a, m, \mathbf{s})$ denote the value of the household with unspent wealth a and input goods m at the start of the afternoon. Then, taking as given the law of motion for the aggregate states, the value function $V(a, m, \mathbf{s})$ satisfies the Bellman equation (3.19) below:

$$\begin{aligned} V(a, m, \mathbf{s}) = \max_{\left\{\substack{\breve{l}^c, \breve{l}^u, \breve{\ell}, \breve{e}, \\ c, m, e, d, n}\right\}} &\left\{ u(c) + \beta \mathbb{E}_{\mathbf{s}} \left[\lambda(\mathbf{s}')(-\zeta^c(\mathbf{s}')\breve{l}_c + V(a'_c, m'_c, \mathbf{s}')) + (1 - \lambda(\mathbf{s}'))(-\zeta^u(\mathbf{s}')\breve{l}_u + V(a'_u, m'_u, \mathbf{s}')) \right] \right\} \\ s.t. \qquad & (3.15), (3.16), (3.17), (3.18). \end{aligned} \tag{3.19}$$

The necessary first order conditions and the envelope theorem imply:

$$\begin{aligned} [\breve{l}_u] : \qquad & q^m(\mathbf{s})\partial_c u(c) = \zeta^u(\mathbf{s}) \\ [\breve{l}_c] : \qquad & \breve{w}(\mathbf{s})\partial_c u(c) = \zeta^c(\mathbf{s}) \\ [\breve{\ell}] : \qquad & q^m(\mathbf{s})\partial_c u(c) = \breve{w}(\mathbf{s})\Big(\partial_c u(c) + \breve{\mu}^d(\mathbf{s})\Big) \end{aligned}$$

along with the condition that $\breve{q}^e = 1$. Let $\zeta^u(\mathbf{s}) = \zeta^c(\mathbf{s}) + \breve{w}(\mathbf{s})\breve{\mu}^d(\mathbf{s})$ implying $m_u = m_c$ in equilibrium. This leads to the first-order-conditions (FOCs) after imposing the Envelope condition:

$$\begin{aligned} q^d(\mathbf{s}) &= \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s})\Big(1 + \lambda(\mathbf{s}')\breve{L}(\mathbf{s}')\Big)\Big] \\ q^e(\mathbf{s}) &= \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s})x^e(\mathbf{s}')\Big] \\ q^n(\mathbf{s}) &= \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s})x^n(\mathbf{s}')\Big] \end{aligned}$$

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

$$\begin{aligned} \xi(\mathbf{s}'; \mathbf{s}) &:= \beta \frac{\partial_c u(c(\mathbf{s}'))}{\partial_c u(c(\mathbf{s}))}, \\ \breve{L}(\mathbf{s}) &:= \frac{\nu \breve{\mu}^d(\mathbf{s}')}{\partial_c u(c(\mathbf{s}))}. \end{aligned}$$

The liquidity wedge, $\breve{L}(\mathbf{s}')$, appears because demand deposits provide liquidity services to the households by allowing them to insure trading shocks in the morning sub-period. The presence of this asset-specific wedge implies that households are willing to hold demand deposits at a discount.

Bank problem: In the afternoon new banks choose portfolios (b', h', d') of government bonds, corporate bonds, and deposits. Taking prices and the household's SDF as given, the representative bank solves:

$$\begin{aligned} \max_{b',h',d'} \quad & \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}';\mathbf{s})W(b',h',d';\mathbf{s}')\Big] + q^d(\mathbf{s})d' - q^b(\mathbf{s})b' - q^h(\mathbf{s})h' \\ s.t. \quad & 0 \le b',\ h',\ d' \end{aligned} \tag{3.20}$$

where ξ is the household's stochastic discount factor. The first order conditions for the portfolio choice in the afternoon market are (dropping the short selling constraints which don't bind):

$$[b']: \qquad q^b(\mathbf{s}) = \mathbb{E}_{\mathbf{s}}\Big[\xi(\breve{\mathbf{s}}';\mathbf{s})\Big(1+\breve{\mu}^e(\breve{\mathbf{s}}')\Big)\breve{q}^b(\mathbf{s}')\Big] \tag{3.21}$$

$$[h']: \qquad q^h(\mathbf{s}) = \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}';\mathbf{s})\Big(1+\breve{\mu}^e(\breve{\mathbf{s}}')\Big)\breve{q}^h(\breve{\mathbf{s}}')\Big] \tag{3.22}$$

$$[d']: \qquad q^d(\mathbf{s}) = \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}';\mathbf{s})\Big(1+\lambda(\mathbf{s}')\partial_{\breve{e}}\Psi(\breve{\mathbf{s}}')+\breve{\mu}^r(\breve{\mathbf{s}}')\Big)\Big] \tag{3.23}$$

where we used the Envelope conditions. We can see that equations (3.21), and (3.22), are the standard portfolio choice equations augmented with the wedge $\breve{\mu}^e(\cdot)$ reflecting how the interbank asset market frictions distort the bank's portfolio. Equation (3.23) equates the deposit price to the risk-weighted average marginal cost of servicing a unit of deposits in the morning and afternoon.

Firm problem: Taking prices and the household's SDF as given, the representative firm solves:

$$\begin{aligned} V^f(k,h,\mathbf{s}) = \max_{m,k',h'} \quad & \Big\{ z(\mathbf{s})k^\alpha m^{1-\alpha} - q^m(\mathbf{s})m + q^h(\mathbf{s})h' - q^k(\mathbf{s})k' - \Big(\omega + (1-\omega)q^h(\mathbf{s})\Big)h/\pi(\mathbf{s}) + \\ & + q^k(\mathbf{s})(1-\delta)k + \mathbb{E}_{\mathbf{s}}\left[\xi(\mathbf{s}';\mathbf{s})V^f(k',h',\mathbf{s}')\right] \Big\} \\ s.t. \quad & q^h h' \le \theta q^k k' \end{aligned} \tag{3.24}$$

The first order conditions are:

$$\begin{aligned} [m]: & \qquad q^m(\mathbf{s}) = (1-\alpha)z(\mathbf{s})k^\alpha m^{-\alpha} \\ [k']: & \qquad q^k(\mathbf{s})\left(1-\theta\mu^h(\mathbf{s})\right) = \mathbb{E}_{\mathbf{s}}\left[\xi(\mathbf{s}';\mathbf{s})x^n(\mathbf{s}')\right] \\ [h']: & \qquad q^h(\mathbf{s})\left(1-\mu^h(\mathbf{s})\right) = \mathbb{E}_{\mathbf{s}}\left[\xi(\mathbf{s}';\mathbf{s})x^h(\mathbf{s}')\right] \end{aligned}$$

where the afternoon payoff from firm equity is

$$x^n(\mathbf{s}) := \alpha y(\mathbf{s})/k + (1-\delta)q^k(\mathbf{s})$$

In equilibrium, the multiplier μ^h is linked to the banking frictions. The higher μ^h (higher liquidity premium on corporate debt), the more distortion in capital choice (capital price is above "fundamental value").

We can now set up a competitive equilibrium. Given a fiscal rule (3.2) and bond price function $q^b(\cdot)$, a budget-feasible government issuance rule $B'(\mathbf{s})$ satisfies (3.1).

Definition 2 (Budget-feasible Competitive Equilibrium)**.** Given regulation parameters $(\varrho,\kappa^b,\kappa^h)$, and a budget-feasible government policy $\big(\tau,g,B'\big)(\cdot)$, a competitive equilibrium is a collection of functions for prices $\big(q^d,q^e,q^n,q^h,q^k,q^b,\breve{q}^h,\breve{q}^b,\breve{q}^e,\breve{w}\big)(\cdot)$, payoffs $\big(x^e,x^n\big)(\cdot)$, household policies $\big(d_h',e',n',c,\breve{\ell},\breve{l}_c,\breve{l}_u,i_h\big)(\cdot)$, bank policies $\left(\breve{b}, \breve{h}, \breve{e}, \breve{f}, d', h', b', x^e\right)(\cdot)$, and firm policies $\left(k', l_f, h'_f\right)(\cdot)$ such that

- Taking prices as given, households solve (3.19), banks solve (3.20), and firms solve (3.24),
- The morning interbank market $\left(\breve{q}^h, \breve{q}^b, \breve{q}^e, \breve{b}, \breve{h}, \breve{e}\right)(\cdot)$ variables satisfy the morning market equilibrium (Definition 1) and the morning labor market clears: $\breve{l}_c = \breve{\ell}$.
- The afternoon input good, capital, and goods markets clear:

$$m_f(\mathbf{s}) = m(\mathbf{s}), \qquad i_h(\mathbf{s}) = k'(\mathbf{s}) - (1-\delta)k, \qquad c(\mathbf{s}) + i(\mathbf{s}) + g(\mathbf{s}) = y(\mathbf{s}) - \Psi(\mathbf{s}) - \Phi(\mathbf{s}),$$

  and afternoon asset markets clear:

$$d'_h(\mathbf{s}) = d'(\mathbf{s}), \qquad e'(\mathbf{s}) = 1, \qquad n'(\mathbf{s}) = 1, \qquad b'(\mathbf{s}) = B'(\mathbf{s}), \qquad h'_f(\mathbf{s}) = h'(\mathbf{s}).$$

3.4 Understanding Government Funding Advantage

We now return to the question of the government's funding advantage, which we define as the differential between the yield on government and AAA corporate bonds. Because the two securities deliver identical cash-flow streams (i.e. they have the same ω), any observed yield spread must reflect differences in the non-pecuniary benefits generated by their differential regulatory value. Formally, we define the government funding advantage as:

$$\begin{aligned}\chi(\mathbf{s}) :=& -\omega\log(q^h(\mathbf{s})) - (-\omega\log(q^b(\mathbf{s})))\\ =&\ \omega\log\left(\mathbb{E}_{\mathbf{s}}\left[\xi(\mathbf{s}';\mathbf{s})\Big(1+\breve{\mu}^e(\breve{\mathbf{s}}')\Big)\frac{\breve{q}^b(\breve{\mathbf{s}}')}{\breve{q}^h(\breve{\mathbf{s}}')}\breve{q}^h(\breve{\mathbf{s}}')\right]\right) - \omega\log\left(\mathbb{E}_{\mathbf{s}}\left[\xi(\mathbf{s}';\mathbf{s})\Big(1+\breve{\mu}^e(\breve{\mathbf{s}}')\Big)\breve{q}^h(\breve{\mathbf{s}}')\right]\right)\end{aligned} \tag{3.25}$$

where we have expanded the terms using the bank first order conditions. We interpret $\chi(\mathbf{s})$ as the model counterpart to our empirical measure of government funding advantage from Section 2.1.

In our model, government funding advantage arises from the special role that government debt plays in the financial sector in the morning market. We can see this by expanding (3.25) to get the approximate expression:

$$\chi(\mathbf{s}) \approx \underbrace{\omega\log\left(\mathbb{E}_{\mathbf{s}}\left[\frac{\breve{q}^b(\breve{\mathbf{s}}')}{\breve{q}^h(\breve{\mathbf{s}}')}\right]\right)}_{\text{forced holdings}} + \underbrace{\omega\mathbb{C}\mathrm{ov}_{\mathbf{s}}\left(\frac{\xi(\mathbf{s}';\mathbf{s})\big(1+\breve{\mu}^e(\breve{\mathbf{s}}')\big)\breve{q}^h(\breve{\mathbf{s}}')}{q^h(\breve{\mathbf{s}})},\ \frac{\breve{q}^b(\breve{\mathbf{s}}')/\breve{q}^h(\breve{\mathbf{s}}')}{\mathbb{E}_{\mathbf{s}}\left[\breve{q}^b(\breve{\mathbf{s}}')/\breve{q}^h(\breve{\mathbf{s}}')\right]}\right)}_{\text{hedging motive}}$$

So, the government's funding advantage arises from the average appreciation of government debt in the next period's morning markets and the covariance between government debt appreciation and the bank's marginal valuation of additional resources. By introducing regulation that ensures that re-trading government debt is valuable in bad times, the government introduces a positive covariance and so introduces a government borrowing cost advantage. That is, regulation makes government debt a particularly "good-hedge" for mitigating the banking sector's frictions in the morning market and so earns a premium.

Figure 4 illustrates the government funding advantage—along with its two primary components—relative to the regulatory privilege of Treasuries. We can see that regulation can dictate which asset becomes a good hedge against the banking sector's settlement risks. In this sense, there is self-confirming

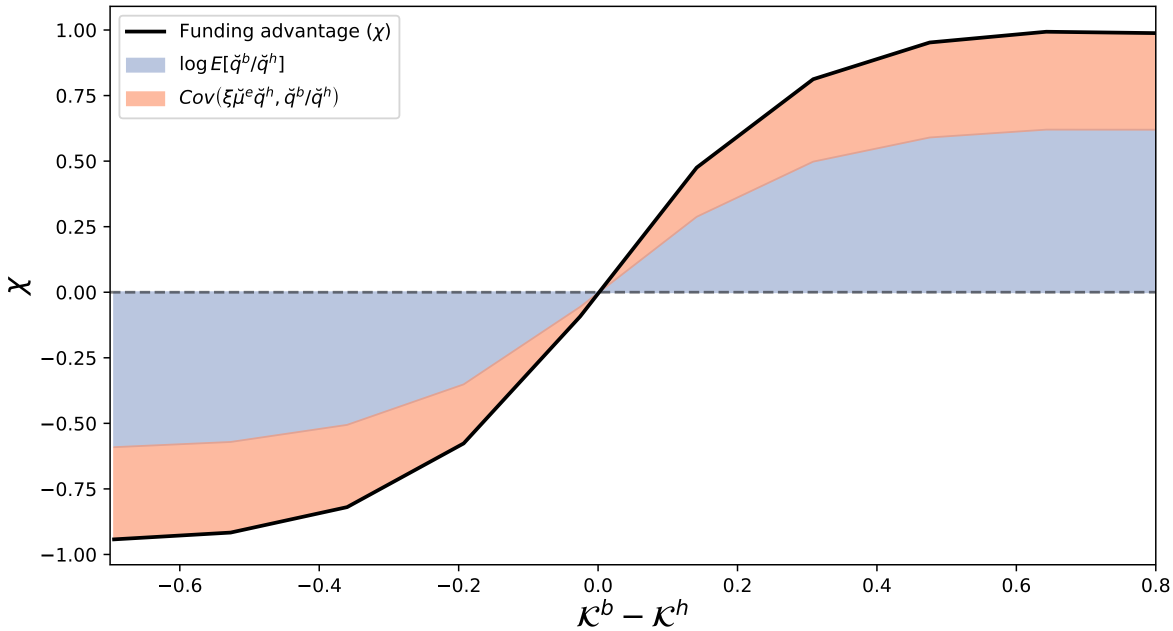

Figure 4: Decomposition of funding advantage as a function of regulatory privilege.

We used $b = 3.0$, $h = 3.5$, $d = 3.7$, $\psi = 5$.

nature of regulatory "risk weights". Specifically, when corporate debt holds the regulatory advantage ($\mathcal{K}^b - \mathcal{K}^h < 0$), the covariance term is negative, meaning government debt prices are low precisely when banks need them to be high. Conversely, when government debt is privileged ($\mathcal{K}^b - \mathcal{K}^h > 0$), the covariance term turns positive (government debt becomes a good hedge), contributing a non-trivial increase in the government funding advantage.

3.5 Fragility of Government Funding Advantage

In the previous section, the government could create a highly "captive" market for its debt because the only way the banking sector could "escape" the regulatory constraint was to de-lever and give up the liquidity premium. However, there are many reasons to believe that the financial sector is able to make adjustments to evade regulatory constraints. In this section, we focus on bank "exit" or "escape" from the regulatory sector by allowing $\phi < \infty$. An alternative, but related, approach would be to introduce storage or a foreign asset that the financial sector could use to substitute away from the regulated banking system.

Conceptually, we now have two endogenous components to funding advantage: the extent to which the government forces the banking sector to purchase government bonds (an "intensive margin") and the size of the regulated market in the morning (an "extensive margin"). We show that once we allow banks a costly escape from the regulatory constraint, then we no longer have that the hedging motive is necessarily positive and increasing in regulatory privilege.

Figure 4 plots the morning price of treasuries, the morning price of corporate bonds, and the decomposition of the funding advantage into the forced holding term ($\log \mathbb{E}[\breve{q}^b/\breve{q}^h]$) and the hedging term ($Cov(\xi(1+\breve{\mu}^e)\breve{q}^h, \breve{q}^b/\breve{q}^h)$. Relative to plots 3 and 4 in the previous section, we can see that now the hedging role of government debt can potentially collapse if the government pushes the regulatory privilege of government debt sufficiently high. In particular, the morning price of treasuries now once again falls for severe crises (large values of λ) and $Cov(\xi(1+\breve{\mu}^e)\breve{q}^h, \breve{q}^b/\breve{q}^h)$ is decreasing in the size of the regulatory privilege $\mathcal{K}^b - \mathcal{K}^h$. Intuitively, Figures 3 and 4 in Section 3—constructed under $\phi = \infty$—only had an "intensive margin effect": as the government increases pressure on banks to hold government debt, there is more captive demand in bad states of the world when the regulatory constraint is tighter. $\phi < \infty$ introduces an additional "extensive margin effect" that banks can exit the regulated sector and shrink the size of the captive market. Ultimately, this means that, as government increases regulatory pressure, the hedging benefit of government debt declines.

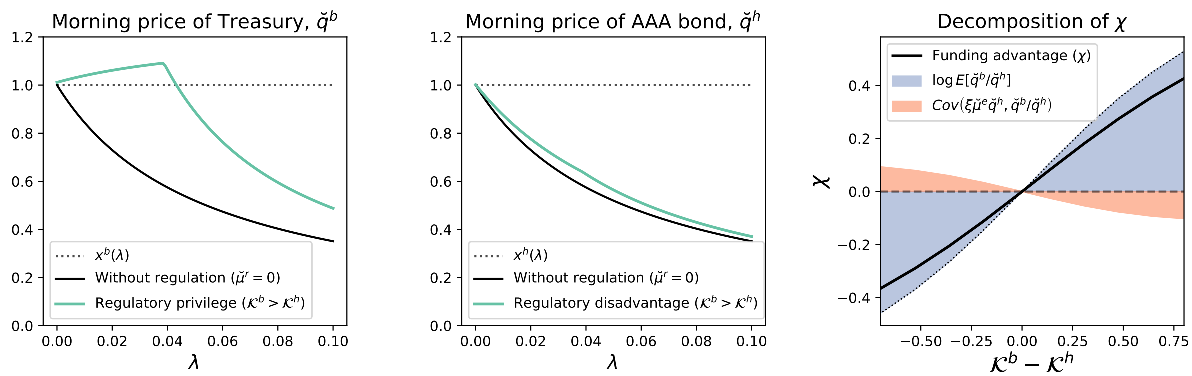

Figure 5: Morning Asset Prices With and Without Financial Privilege.

Black line shows the morning market prices in an environment without regulation. The teal line shows the morning market asset prices in an environment with regulations that privilege government debt. We used $b = 3.0$, $h = 3.5$, $d = 3.7$, $\psi = 5$, $\psi^r = 0.8$, $\mathcal{K}^b = 1$, $\mathcal{K}^h = 0.19$.

4 Monetary-Fiscal Policy and Government Funding Advantage

Section 3 built a model for understanding how a government can gain and lose a funding advantage. We now consider how this interacts with government monetary-fiscal policy and the government budget constraint. We show that the government faces a type of domestic financing trilemma. It cannot simultaneously choose: (i) a high funding advantage, (ii) financial sector stability, and (iii) monetary-fiscal policy that destabilizes treasury prices through inflation.

4.1 Environment Changes

The setup is as in Section 3.1 but we introduce nominal debt and inflation risk.

Government: We now assume that the government issues money and that both government bonds and corporate bonds pay in units of money. We impose that the government chooses supply so that gross inflation $1+\pi(\boldsymbol{\varepsilon}_t)$ is a lognormal random variable with mean one, standard deviation σ_π, and is (positively) correlated with the withdrawal shock $\lambda(\boldsymbol{\varepsilon}_t)$. We follow Woodford and Walsh (2005) and take the cashless limit so that money quantities do not affect the equilibrium.[7] We continue to use morning and afternoon goods as the numeraire. The government's one-period real budget constraint in the afternoon now becomes:

$$\left(\omega + (1-\omega)q_t^b\right)\frac{B_{t-1}}{(1+\pi(\boldsymbol{\varepsilon}_t))Y_t} \leq \tau_t - g(\boldsymbol{\varepsilon}_t) + \frac{q_t^b B_t}{Y_t}$$

and the politically determined fiscal rule becomes:

$$\tau_t = \eta\left(\frac{B_{t-1}}{(1+\pi(\boldsymbol{\varepsilon}_t))Y_t} - \bar{\mathsf{b}}\right).$$

where B_t denotes the total real principle promised. So, we can see that the inflation of the nominal government debt appears like an haircut on the real value of government debt.

Asset pricing: The real afternoon payoffs for holding government and corporate bonds become:

$$x^j(\mathbf{s}) := \frac{1}{\big(1+\pi(\boldsymbol{\varepsilon}_t)\big)}\left(\omega + (1-\omega)q^j(\mathbf{s})\right), \qquad j \in \{b,h\}, \quad \forall\, \mathbf{s} \tag{4.1}$$

Otherwise, the equilibrium asset pricing conditions remain the same.

4.2 Asset Scarcity and Government Funding Advantage

Both regulations and fiscal rules influence the government funding advantage. Figure 6 presents scatter plots correlating the funding advantage with debt-to-GDP ratios across various policy combinations. For a fixed debt-to-GDP target (left two and right two clusters), increasing regulatory privilege, $(\mathcal{K}^b - \mathcal{K}^h)\uparrow$, raises both the average funding advantage and its sensitivity (slope) to the debt-to-GDP ratio. Conversely, for a given level of regulatory privilege (top two and bottom two clusters), higher debt-to-GDP targets result in a lower average funding advantage and a flatter slope. Ultimately, our environment is sufficiently flexible to generate patterns resembling those in the data from Section 2.

4.3 Inflation Risk and Government Funding Advantage

Figure 7 plots the morning price of Treasuries, the morning price of corporate bonds, and the funding advantage as a function of inflation risk. The black lines show the economy with regulatory privilege but without debt devaluation through inflation while the green line shows the economy with inflation. Evidently, the introduction of inflation risk changes both the forced holding and hedging components of χ. The introduction of inflation risk turns Treasuries into assets that devalue during crises (high λ) and so reverses the sign of the hedging motive. It also decreases the forced holding component of χ so higher values of σ_π end up leading to a lower value of χ.

To understand how the introduction of inflation risk changes the role of government debt in the financial sector, we can return to the characterization of the interbank market. Revisiting the expression

[7] There is a long literature pointing out the issues with taking a cashless limit (see Lagos (2024)). We abstract from these issues to focus on long-term debt pricing rather than monetary economics.

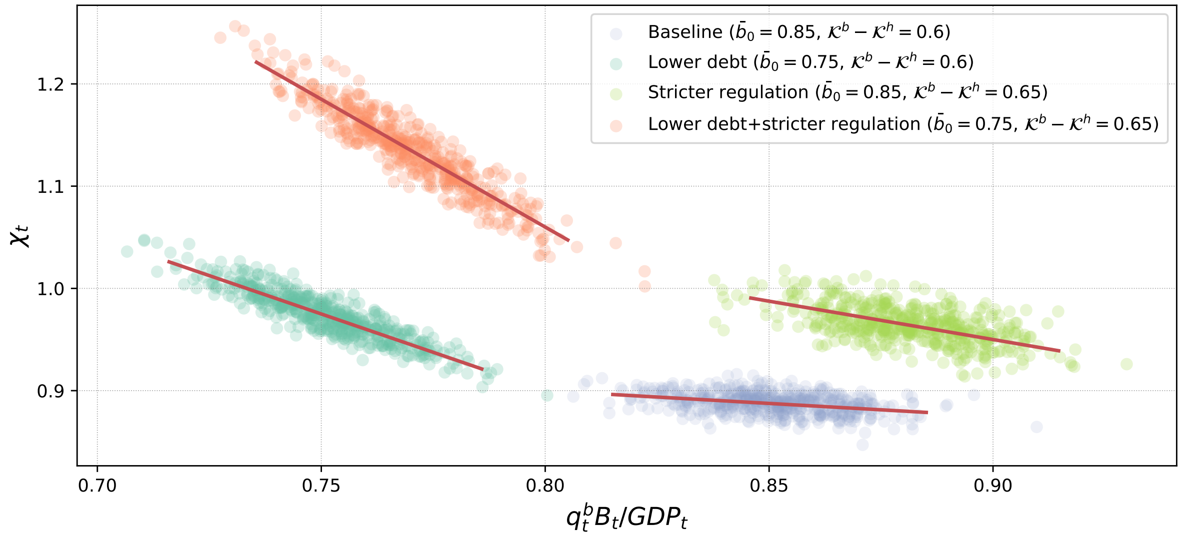

Figure 6: Funding advantage vs debt-to-GDP under different policy mixes.

Different colors represent different policy mixes: blue cluster (bottom right) shows the baseline with regulatory privilege $\mathcal{K}^b - \mathcal{K}^h = 0.6$ and debt-to-GDP target $\overline{\mathsf{b}} = 0.85$; green cluster (bottom left) shows regulatory privilege $\mathcal{K}^b - \mathcal{K}^h = 0.6$ and a lower debt-to-GDP target of $\overline{\mathsf{b}} = 0.75$; yellow cluster (top right) shows higher regulatory privilege $\mathcal{K}^b - \mathcal{K}^h = 0.66$ and debt-to-GDP target of $\overline{\mathsf{b}} = 0.85$; orange cluster (top left) shows higher regulatory privilege $\mathcal{K}^b - \mathcal{K}^h = 0.65$ and lower debt-to-GDP target $\overline{\mathsf{b}} = 0.75$ than the baseline.

for the relative price ratio in the morning market, (3.14), we can see that the direct impact of $\pi(\varepsilon_t)$ on payouts from equation (4.1) does not show up in the funding advantage because both government and corporate bonds are nominal so the direct impact of inflation is differenced out. Instead, higher inflation risk changes the magnitude and sign of μ^r.

Conceptually, the combination of regulatory privilege and government devaluation through inflation leads to these outcomes because the combination puts the banking sector in a difficult position. If banks don't purchase government debt in the morning market, then they violate the regulatory constraint. However, if they purchase government debt, then the government's monetary-fiscal policy devalues their debt in the afternoon and forces losses onto the equity holders. The banks respond to this lose-lose situation by effectively "exiting" the deposit market (i.e. inflation activates the "extensive margin" to push banks out of the market).

Taken together, our results show that our model gives the government both the strength to create a funding advantage but also makes the funding advantage fragile and sensitive to monetary-fiscal policy—the government must supports the longer term value of government debt in order to keep its funding advantage.

4.4 A Domestic Financing Trilemma

We close this section by bringing our results together and returning to the feasible policy combinations of the government. We focus on two government policy parameters: the degree of regulatory privilege for government debt ($\mathcal{K}^b - \mathcal{K}^h$) and inflation volatility (σ_π). Figure 8 shows two equilibrium variables as

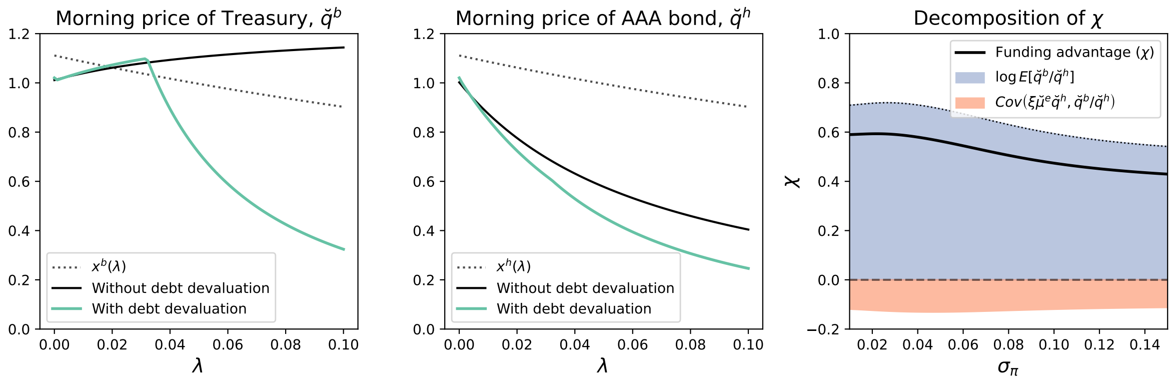

Figure 7: Morning Asset Prices With and Without Debt Devaluation.

Black lines shows the morning market prices in an environment with regulatory privilege without debt devaluation through inflation. Green lines show the morning market prices for an economy with regulatory privilege and inflation. Dashed lines show the afternoon payoff. The final subplot decomposes the funding advantage χ.

these variables are changed: the frequency of forced equity raising (or bank default) (on the LHS) and the government funding advantage, χ, (on the RHS). The x-axis show σ_π and the y-axis shows $\mathcal{K}^b - \mathcal{K}^h$. The ergodic mean magnitudes of the morning equity raised and the funding advantage are indicated by a heat map. Evidently, increasing financial repression can increase the private-public borrowing cost spread. However, when accompanied by a devaluation of US debt, increasing financial repression also leads to higher distress in the financial sector. As discussed, this is because banks are being forced to hold debt with a negative return and so they start to force losses onto depositors and exit the deposit market.

We summarize these observations as a stylized "trilemma" for the government. In our model, by varying $\mathcal{K}^b - \mathcal{K}^h$ and σ_π, the government cannot choose all three of:

1. High government funding advantage (a high χ),
2. A well-functioning, profitable, and stable financial sector (low costly equity raising or default, $\breve{e}^r$), and
3. Monetary-fiscal policy that generates high inflation risk (a high σ_π).

Intuitively, this Trilemma says that when a government uses the financial sector to generate funding advantage, then it intertwines the balances sheets of the banking sector and the government, which constrains the range of feasible government policies. If the government sets a high $\mathcal{K}^b - \mathcal{K}^h$ (choosing part 1 of the trilemma), then it either needs to run monetary-fiscal policy that targets bond price stability (giving up part 3 of the trilemma) or it will put the financial sector into distress (giving up part 2 of the trilemma). In this sense, our model of endogenous funding advantage both gives the government more freedom to expand funding advantage but also highlights that this freedom rests on a stable monetary-fiscal environment.

This trilemma can also be interpreted as introducing a notion of financial dominance to complement existing notions of fiscal and monetary dominance. There are many macroeconomic theories and models of monetary-fiscal interactions (e.g. Keynes (1924), Friedman (1995), Hansen (1949), Tobin (1969), Sargent and Wallace (1981), Wallace (1981), Aiyagari and Gertler (1985), Leeper (1991), Sims (1994),

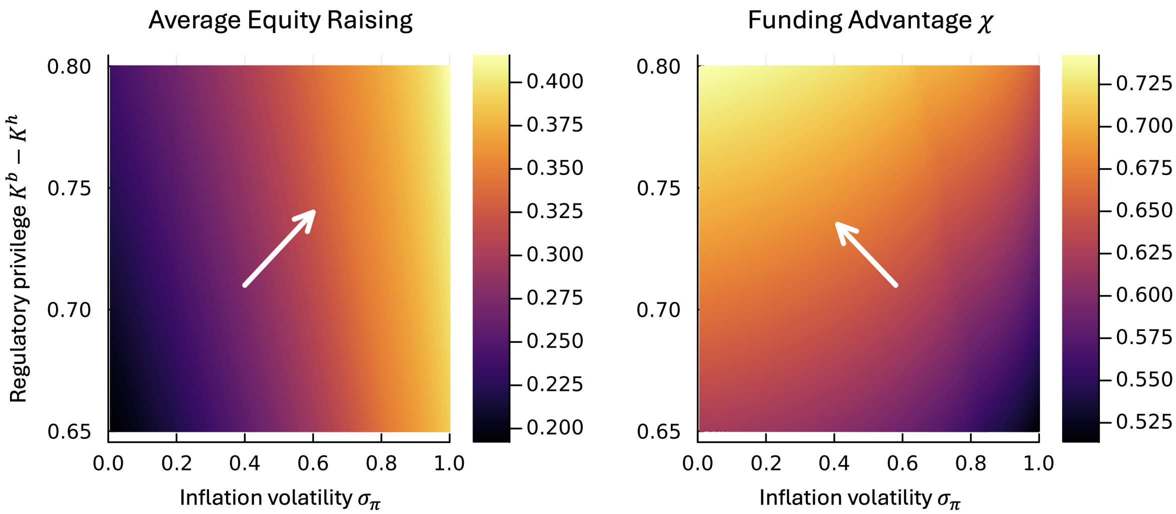

Figure 8: Government Financing Trade-offs

The left subplot shows a heat map with level of government bond regulatory privilege on the y-axis, the inflation volatility on the x-axis, and average forced equity raising (or default) in the financial sector as the color. The right subplot shows a heat map with the same x and y-axes but with the private-public borrowing cost spread as the color.

Woodford (1994), Cochrane (2023)). This papers often present a type of dichotomy between monetary dominance on the one hand and fiscal dominance on the other hand. In the former case, monetary policy is actively chosen by the government and fiscal policy has to accommodate to deliver the desired nominal interest rate path. In the later case, fiscal policy is chosen by the government and monetary policy accommodates to deliver the required monetary policy. However, very few of these papers consider the role of the financial sector in assessing government debt sustainability even though historically much US federal debt has been held by financial intermediaries. Our trilemma suggests that introducing a financial sector leads to the possibility of financial dominance. If the government chooses a high funding advantage and a stable financial sector, then it must run combined monetary-fiscal policy that stabilizes long-term debt prices and protects the balance sheet of the financial sector.

5 Revisiting Funding Advantage in the 1970s: A Comparison Across Models

In this section, we revisit the 1970s-80s in the United States, which is one of the periods in US history with the highest inflation volatility and lowest government funding advantage.[8] We use this historical episode to highlight how our model jointly explains the loss of funding advantage during this period. We contrast this to other models (namely bond-in-the-utility and bond-in-advance), which give the counterfactual prediction that a higher inflation volatility should coincide with higher funding advantage.

[8]The only period since 1790 with higher inflation volatility is the Civil War.

5.1 A Historical Episode of High Inflation

Figure 9 depicts our historical estimates (from Lehner et al. (2025)) for the ratio of the market value of government debt to GDP, the 15 year government advantage, and the correlation between Treasury returns and stock returns (which we refer to as the bond-stock beta) during the the period from 1971 to 1980.[9] This is the period in our overall sample from 1860-2025 with the largest increase in the bond-stock beta, which goes from approximately zero to approximately 0.8 during the early 1980s. We interpret the bond-stock beta as a data counterpart to the hedging role of Treasuries in our model, with a positive β indicating that government debt is a poor hedge and a negative beta indicating that government debt is a good hedge. So, this indicates holding treasuries provided almost no hedge against aggregate risk during this period. The increase in the bond-stock beta corresponds to a sustained decline in the funding spread even though the Debt-to-GDP ratio moves very little during the period. This means that 1970s-80s are a key period there there are large changes in US government funding advantage that are no associated with quantity changed.

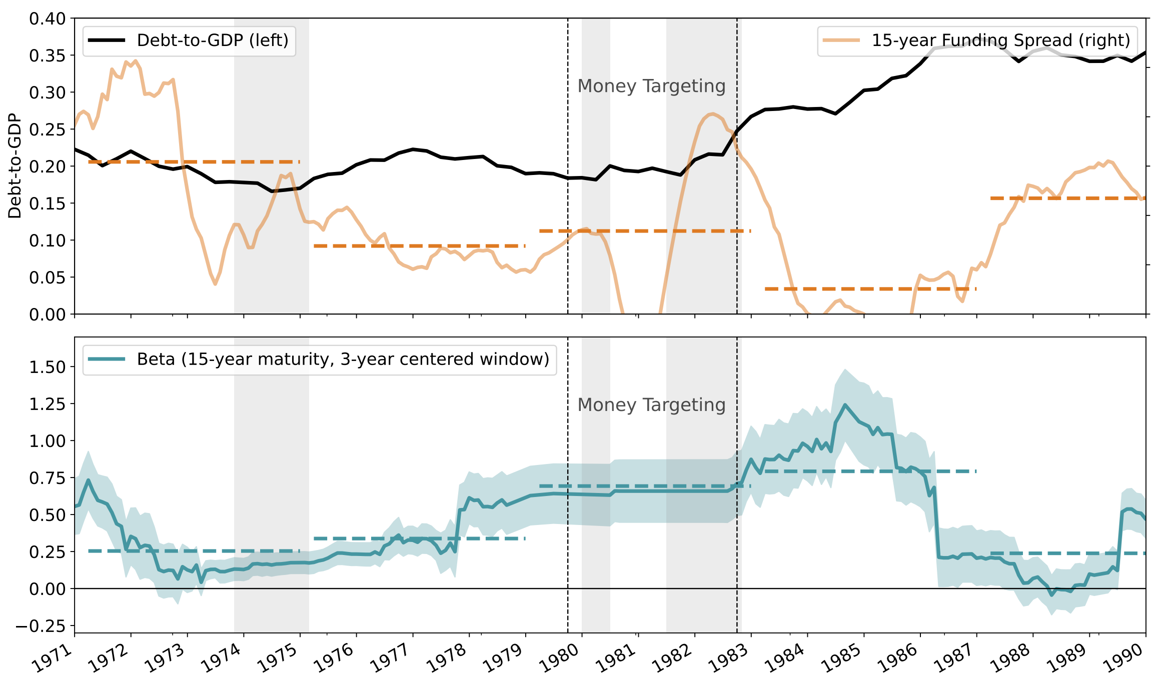

Figure 9: Sub-period From 1971 to 1990.

5.2 Interpretation Through Our Model

At a stylized level, we can interpret the 1970s-80s through the lens of our trilemma. During this period, the US government ran systematically high (and volatile) inflation leading to the real devaluation of US debt. According to the trilemma, this meant it had to choose between maintaining its funding advantage

[9]Technically, the bond-stock "beta" is the coefficient when excess holding returns are regressed against excess stock returns (which we refer to as the bond-stock beta). Formally, for each maturity j, we regress the monthly excess holding return $rx_{t+1}^{j-1} = \log(q_{t+1}^{(j-1)}) - \log(q_t^{(j)}) - r_t$ against the monthly percentage change in the GFD historical total return index on US equities.

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 at the expense of the government's funding advantage. So our model interprets Figure 9 as the government choosing to lose its funding advantage from 1975 to 1985 rather than forcing a financial crisis. Indeed, if we look at evidence on banking sector government debt holdings, we see that the balance sheet of the banking sector went from being approximately 90% treasuries and reserves during World War I to approximately 20% treasuries in the 1980 (see Chari et al. (2020)).

5.3 Other Models Fail in the 1970s

When presented through our model and the data, it may seem natural that the government completely lost its funding advantage during the 1970s when inflation volatility emergence and holding government debt become more risky. However, many other commonly used models end up generating the opposite prediction.

To compare to other papers it is helpful to define a synthetic reference asset. Let f index an additional zero-net supply bonds issued by the private sector with the same payouts as government debt (same ω) but that is only held by the household sector and does not trade in the morning market. Let q^f denote the price of the bond and let $x^f := \omega + (1-\omega)q^f$ denote the afternoon payoff on the bonds. Then, we can decompose the difference between the household required rate of return and the treasury yield (sometimes referred to as the "convenience yield" in the literature) as:

$$
\begin{aligned}
&-\omega \log(\mathbb{E}[\xi(\mathbf{s}') \mid \mathbf{s}]) - (-\omega \log(q^b(\mathbf{s}))) \\
&= \underbrace{\omega \log\left(\mathbb{E}\left[\xi(\mathbf{s}')\breve{\mu}^e(\mathbf{s}')\frac{\breve{q}^b(\mathbf{s}')}{\breve{q}^h(\mathbf{s}')}\breve{q}^h(\mathbf{s}') \mid \mathbf{s}\right]\right) - \omega \log\left(\mathbb{E}\left[\xi(\mathbf{s}')\breve{\mu}^e(\mathbf{s}')\breve{q}^h(\mathbf{s}') \mid \mathbf{s}\right]\right)}_{\text{Private-public borrowing cost spread} =: \chi} \\
&+ \underbrace{\omega \log\left(\mathbb{E}\left[\xi(\mathbf{s}')\breve{\mu}^e(\lambda', \mathbf{s}')\breve{q}^h(\mathbf{s}') \mid \mathbf{s}\right]\right) - \omega \log\left(\mathbb{E}\left[\xi(\mathbf{s}')x^f(\mathbf{s}') \mid \mathbf{s}\right]\right)}_{\text{Market segmentation/liquidity spread} =: \chi^b} \\
&+ \underbrace{\omega \log\left(\mathbb{E}\left[\xi(\mathbf{s}')x^f(\mathbf{s}') \mid \mathbf{s}\right]\right) - \omega \log(\mathbb{E}[\xi(\mathbf{s}') \mid \mathbf{s}])}_{\text{Risk premium (using the household SDF)}}
\end{aligned}
\tag{5.1}
$$

The first component is the government funding advantage we have discussed above. The second component is the difference between the banking sector's valuation of a hypothetical bond with the same cash-flows as government debt and the household's valuation of the same bond. We interpret this wedge as the spread coming from the market segmentation that prevents households from directly holding assets and/or the additional liquidity of the bond for the financial sector. Expanding the second term gives the analogous expression:

$$
\chi^b(\mathbf{s}) \approx \omega \log\left(\mathbb{E}\left[\breve{\mu}^e(\mathbf{s}')\right]\right) + \omega \mathrm{Cov}\left(\frac{\xi(\mathbf{s})\breve{q}^h(\mathbf{s})}{\mathbb{E}[\xi(\mathbf{s}')\breve{q}^h(\mathbf{s}')]}, \frac{\breve{\mu}^e(\mathbf{s})}{\mathbb{E}\left[\breve{\mu}^e(\mathbf{s}')\right]}\right),
$$

which shows that the frictions in the banking sector, as captured by $\breve{\mu}^e$, distort the return required by the banking sector to hold government debt. That is, χ^b is the risk-premium arising from market segmentation and bank frictions. The final component is the risk premium on government debt, as valued by the family of households in the economy.

The decomposition in equation (5.1) highlights how our model nests or relates to alternative models of government funding advantage used in the literature:

1. *Bond-in-the-utility (BIU):* Suppose we remove the morning market, regulatory constraints, and banking sector and instead introduce a utility benefit of holding government debt and capital in the afternoon market. Then the household Bellman equation becomes:

$$V(a, \mathbf{s}) = \max_{c,b',k'} \left\{u(c) + \nu(q^b(\mathbf{s})b, q^k(\mathbf{s})k) + \beta\mathbb{E}[V(a', \mathbf{s})]\right\} \quad s.t.$$
$$c + q^b(\mathbf{s})b' + q^k(\mathbf{s})k' \le a - \tau(\mathbf{s})$$
$$a' = x^b(\mathbf{s})b' + x^k(\mathbf{s})k',$$

   which leads to the FOC for government debt:

$$q^b(\mathbf{s}) = \left(\frac{1}{1 - \partial_{q^b b}\nu(q^b b, q^k k)/u'(c)}\right)\mathbb{E}_{\mathbf{s}}[\xi(\mathbf{s}'; \mathbf{s})q^b(\mathbf{s}')].$$

   For one-period bonds, this implies that the private-public borrowing cost spread becomes:

$$\chi(\mathbf{s}) = \log\left(\frac{1}{1 - \partial_{q^b b}\nu(q^b b, q^k k)/u'(c)}\right). \tag{5.2}$$

   and for longer duration bonds the spread becomes (approximately to first order):

$$\begin{aligned}\chi(\mathbf{s}) \approx\ & \omega \log\left(\frac{1}{1 - \partial_{q^b b}\nu(q^b b, q^k k)/u'(c)}\right) \\ & + \omega\left(\log\left(\mathbb{E}_t\left[q^b(\mathbf{s}')|\mathbf{s}\right]\right) - \log\left(\mathbb{E}_t\left[q^f(\mathbf{s}')|\mathbf{s}\right]\right)\right) \\ & + \omega\left(\frac{Cov\left[\xi(\mathbf{s}'; \mathbf{s}), q^b(\mathbf{s}')|\mathbf{s}\right]}{\mathbb{E}_t\left[\xi(\mathbf{s}'; \mathbf{s})\right]\mathbb{E}_t\left[q^b(\mathbf{s}')|\mathbf{s}\right]} - \frac{Cov\left[\xi(\mathbf{s}'; \mathbf{s}), q^f(\mathbf{s}')|\mathbf{s}\right]}{\mathbb{E}_t\left[\xi(\mathbf{s}'; \mathbf{s})\right]\mathbb{E}_t\left[q^f(\mathbf{s}')|\mathbf{s}\right]}\right)\end{aligned}$$

   The one-period bonds, the BIU model has the particularly stark prediction that government policies only impact the private-public borrowing cost spread by changing $q^b b$ rather than changing the elasticity parameters. For the multi-period bonds, this is approximately but not exactly true. Relative to the BIU formulation, our model endogenizes how the scale and elasticity parameters in the functional form BIU $\nu(q^b(\mathbf{s})b, q^k(\mathbf{s})k)$ relate to the government repression parameters and fiscal rule. This provides a richer connection between goverment policy and government funding advantage.

2. *Segmentation with Bond-in-Utility:* Suppose we take the BIU formulation from the previous bullet (i.e. no morning market) but now introduce a banking sector that receives utility from holding government debt. In this case, the private-public borrowing cost spread is still given by equation (5.2) so we still have all the benefits and costs of a BIU model. However, the model does opens up a market segmentation spread $\chi^b > 0$ that can be used to match additional spreads in the data.

3. *Bond collateral/bond-in-advance:* A number of papers model a binding bond collateral constraint (motivated by moral hazard problems or other information frictions). We can nest this in our environment by removing the interbank market frictions, removing idiosyncratic deposit withdrawal

shocks, removing the possibility of bank deposit default, and replacing our regulatory constraint by a linear collateral ratio in the morning market:

$$(1-\lambda)d \leq \kappa \breve{q}^b(\mathbf{s})\breve{b}$$

Deposits, d, are chosen in the previous afternoon and, in equilibrium banks hold all the government debt so $\breve{b} = B$. Assuming the collateral constraint binds, this implies that the bond price in the morning market is given by:

$$\breve{q}^b(\mathbf{s}) = \frac{(1-\lambda)d}{\kappa B}$$

So, the morning price is inversely related to κ and is not influenced by future government debt prices or other government policies.

Each of these commonly used models generates "captive demand" for government debt that is not eroded by inflation risk. To make this concrete, we examine analytically how inflation risk impacts funding advantage in BIU model. Under BIU, we have:

$$\chi_t \approx \omega \log\left(\Omega\left(\frac{q_t^b b_t}{y_t};\zeta_t\right)\right), \qquad \frac{(q_t^b - q_t^h)b_t}{y_t} \approx \frac{q_t^b b_t}{y_t}\left(1+\Omega\left(\frac{q_t^b b_t}{y_t};\zeta_t\right)\right) \tag{5.3}$$

where for short-term debt the formulas are precise and $\Omega\left(\frac{q_t^b b_t}{y_t};\zeta_t\right) = \frac{1}{1-\partial_{q^b b}\nu(q^b b, q^k k)/u'(c)}$. This implies that the convenience revenue maximizing debt-to-GDP ratio is independent of other government policies. We illustrate this with the red arrows in the top subplot in Figure 10, which show how an increase in the market value of government debt-to-GDP lowers the spread and moves the economy along the convenience revenue curve. In this sense, in these models the government faces a "Laffer curve" style revenue maximization challenge reminiscent of the monetary literature.

We can then consider how devaluation risk changes government funding advantage in a BIU model. Suppose the government introduces a monetary-fiscal policy that makes government debt a worse hedge (e.g. in our model this would be an increase in σ_π) and so devalues the total government debt portfolio (a decrease in q_t^b). Figure 10 shows the impact on the private-public borrowing spread and convenience revenue under the BIU specification (5.3) (the red arrows) and compares it a model like ours where higher inflation volatility ends up decreasing demand (the blue arrows). The plot uses the analytical formula for the BIU model for the black line and is illustrative for the blue line. Evidently, under the BIU model, increasing return risk moves the economy up along the private-public borrowing spread curve and the convenience revenue curve. In this sense, return risk does not change the convenience revenue trade-off but rather provides another way of moving to the convenience revenue maximizing value of $q_t^b b_t/y_t$. By contrast, in our model, as we saw in Section 4, introducing return risk shifts the private-public borrowing spread curve down. This contracts the convenience revenue curve and so the government budget constraint. We can interpret these difference in terms of decreases in the quantity (b_t) and quality (β_t) of government debt. In the BIU model, changes to quantity and quality both enter the private-public borrowing spread formula in the same way by decreasing $q_t^b b_t$ and increasing private-public borrowing spread. By contrast, in the data and our more general model, decreases in quality shift the private-public borrowing spread to Debt-to-GDP relationship, which leads to a decrease in the private-public borrowing spread.

6 Counterfactual: Financing Large Debt increases With or Without Repression

We conclude the paper by examining the macroeconomic implications of a government that seeks to finance large spending increases by imposing restrictions on financial sector portfolios. We first consider the four major debt expansions in the US history: the Civil War, World War I, World War II, and the Global Financial Crisis. We then compute counterfactual experiments if the government had financed any of these major debt expansions with alternative policies.

6.1 Historical Episodes of Large Debt-to-GDP Increases

The top four subplots of Figure 11 show the Debt-to-GDP ratio and the private-public borrowing spread during the Civil War, the Global Financial Crisis, World War I, and World War II, which are the periods in our historical sample with large increases in the market value of government debt-to-GDP (ranging from 25 to 60 percentage points).

Evidently, during both the Civil War and the Global Financial Crisis the US government was able to simultaneously increase debt-to-GDP and its funding advantage. These are both episodes when government debt issuance coincided with large changes to financial sector regulation that increased financial sector incentives to hold treasuries. For the Civil War episode, between 1862-6, Congress passed a collection of National Banking Acts, which established a system of nationally charted banks that were allowed to issue bank notes up to 90% of the minimum of par and market value of qualifying US federal bonds[10] and could only issue a narrow range of loans[11]. For the Global Financial Crisis, Congress enacted the Dodd-Frank Act in July 2010 and the Basel III rules were adopted in 2012. Both of these regulatory changes introduced a large collection of portfolio constraints on the banking sector that penalized bank leverage ratios and encouraged bank government debt holding. Interpreted through the lens of our model, neither period is consistent with the commonly used stable equilibrium relationship outlined in equation (5.3). Instead, both periods are consistent with regulation shifting the government debt demand curve up at the same time as supply increased.

The episode with a clear negative relationship between debt supply and the government funding spread is World War I, although identification is complicated by the gradual retiring of the national banking system after the introduction of the Fed in 1913. The story during World War II is more complicated. On average, the very large debt-to-GDP increase during the war does coincide with lower government funding advantage, although the decrease is small and the relationship is less clear after the war, particularly once the Treasury-Fed Accord is agreed and the Fed becomes independent.

[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] 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.

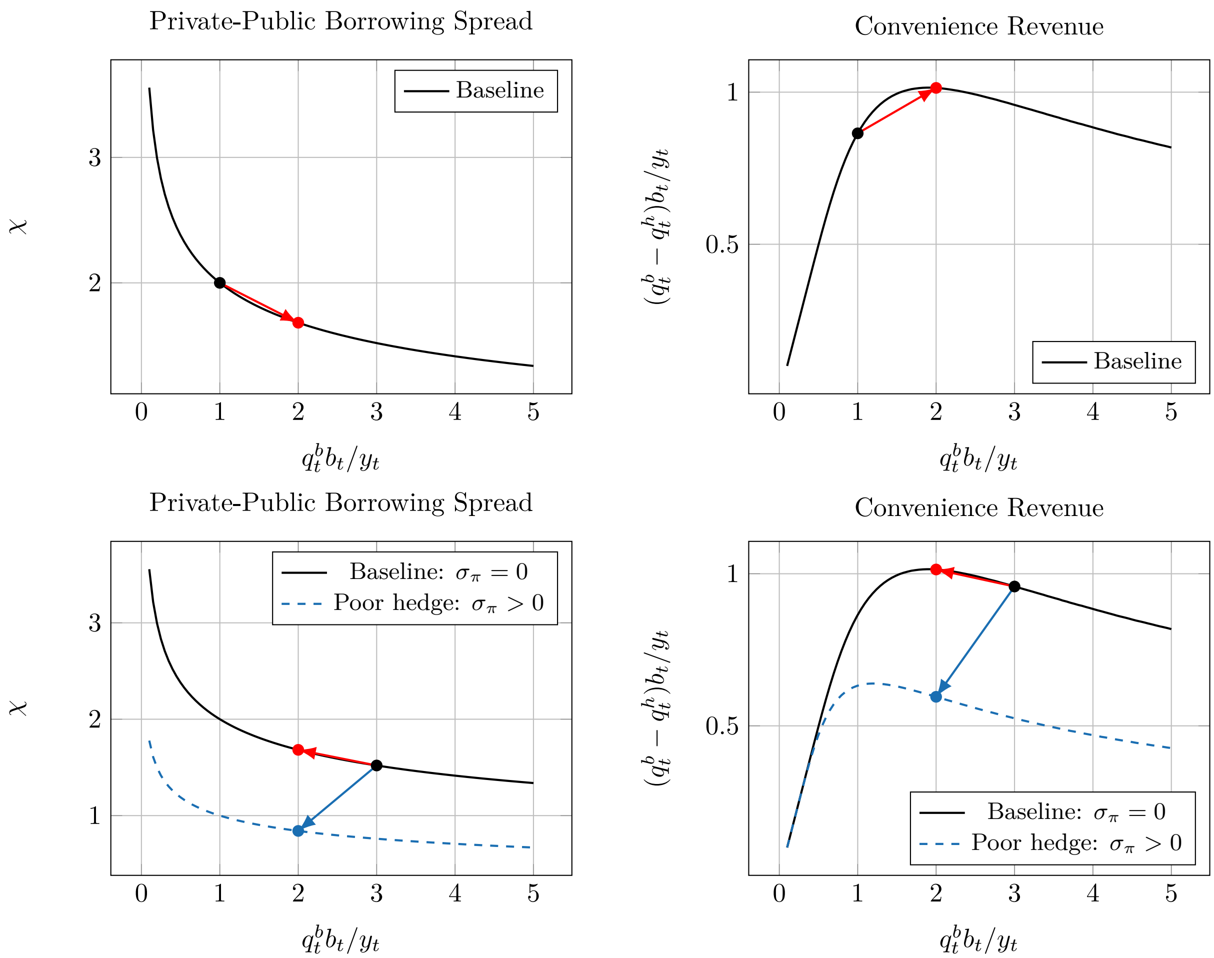

Figure 10: Top plot: shows the impact of a debt-to-GDP increase in a BIU model. Middle plot: show the impact of regulation that increases government debt demand. Bottom plot: shows the impact of an increase in risk on holding government debt.

The bottom four plots in Figure 11 show the rolling bond-stock beta calculated over a 3-year centered window during the four large debt-to-GDP increases in our sample.[12] We can see a striking difference between outcomes during the Global Financial Crisis when government funding advantage went up and World War I when government funding advantage went down. Following the introduction of the Dodd-Frank Act in 2012, the bond-stock beta dropped sharply indicating that holding government debt became a good hedge against aggregate risk. By contrast, during World War I, the bond-stock beta went from zero to weakly positive. For World War II, the bond-stock beta was never significantly different to zero during the period of yield curve control (1942-1951) when the Fed and treasury worked together to stabilize the yield curve. For the Civil War, the short maturity Greenback yield curve estimates are too noisy during the greenback period (1862-1879) to get a clear estimate. However, we can see that the beta for gold-denominated government debt is negative during the war. While it becomes temporarily positive after the war, once convertibility is restored, the bond-stock beta is essentially zero indicating that throughout the 19th century when government funding advantage was high government debt was a "safe-asset" compared to equities.

6.2 Refinancing WWI

We use our model to revisit the financing of World War I. We calibrate the real business cycle parameters $(\beta, \gamma, \alpha, \delta, \omega, \phi, \theta, g, \rho_z)$ externally to match standard parameters in the RBC model. We calibrate the parameters $(\lambda, \nu, \psi, \zeta_c, \varrho\kappa^h, \overline{\mathsf{b}}, \overline{\tau})$ internally to target average spreads and bank leverage (see Appendix C additional details) for the period.

Figure 12 show a counterfactual path if World War I were financed with similar level of government debt regulatory privilege to the Global Financial Crisis to make government debt a safe asset during the period, like it was during the Global Financial crisis. We feed in a sequence of government spending shocks to match spending-to-GDP during World War I. We then show Debt-to-GDP, the funding advantage, taxes-to-GDP, Investment/Capital, and Deposits-to-GDP under a counterfactual economy with higher regulatory privilege. We can see the basic trade-offs for the economy. Under our baseline calibration, government funding advantage decreases dramatically from around 1% to 0.5% as the debt-to-GDP ratio expands from close to zero to around 0.3 (as it does in the data in Figure 11). By contrast, when we tighten regulatory privilege at the outset of the War, then the funding advantage increases (as it does in the data for the Civil War and Financial Crisis). This decreases the average tax burden in the economy but also decreases both investment/capital and deposits/capital. This comes from the contract of the financial sector in the face of the tighter regulatory privilege.

[12] The bond-stock "beta" is the coefficient when excess holding returns are regressed against excess stock returns (which we refer to as the bond-stock beta). Formally, for each maturity j, we regress the monthly excess holding return $rx_{t+1}^{j-1} = \log(q_{t+1}^{(j-1)} - \log(q_t^{(j)}) - r_t$ against the monthly percentage change in the GFD historical total return index on US equities.

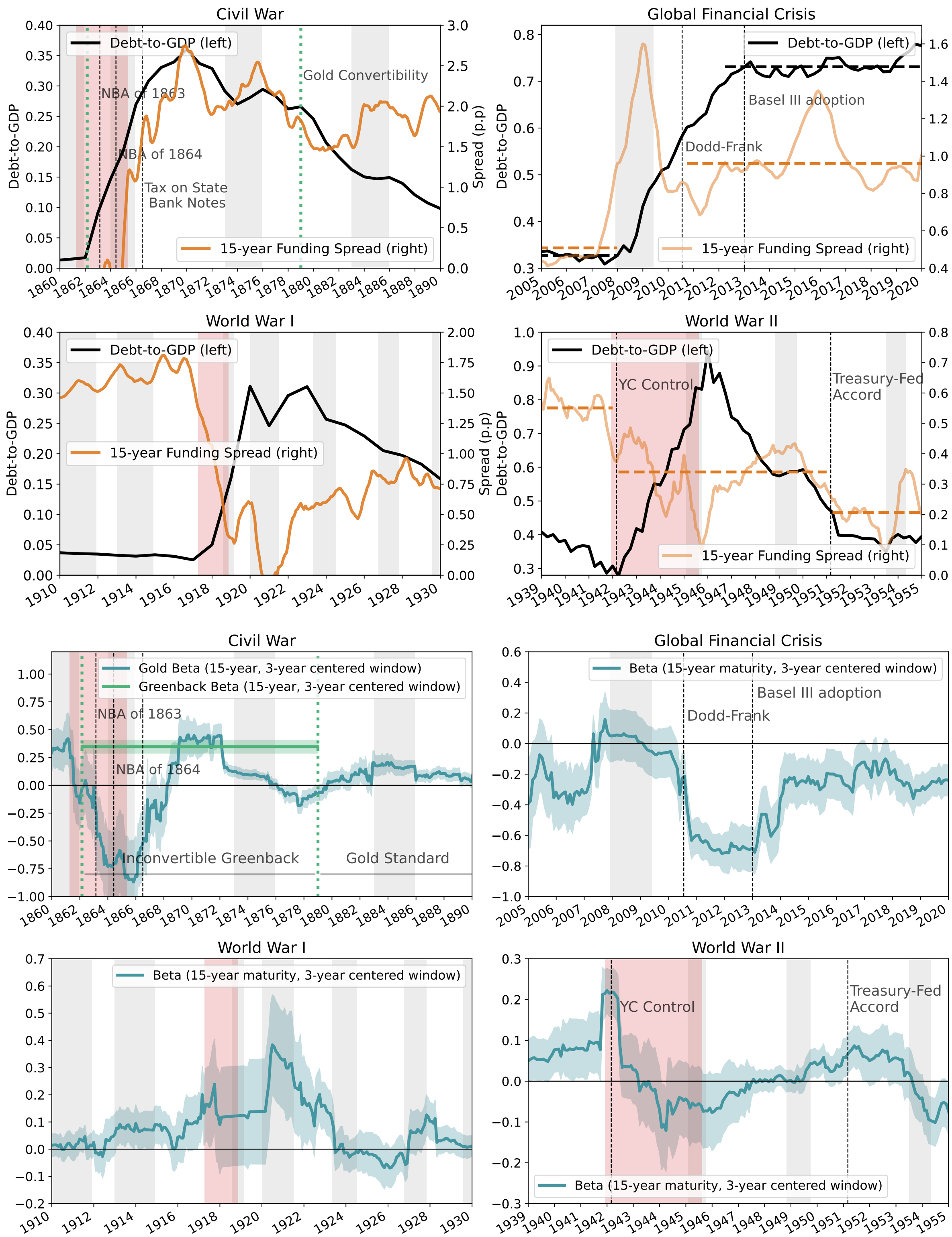

Figure 11: Four Large Debt Expansions: The top four plots show the market value of debt-to-GDP and 15 year private-public borrowing spread during the Civil War, Global Financial Crisis, World War I, and World War II. The bottom four plots show the rolling 36 month bond-stock beta during the same period. The shaded areas show 95% confidence intervals.

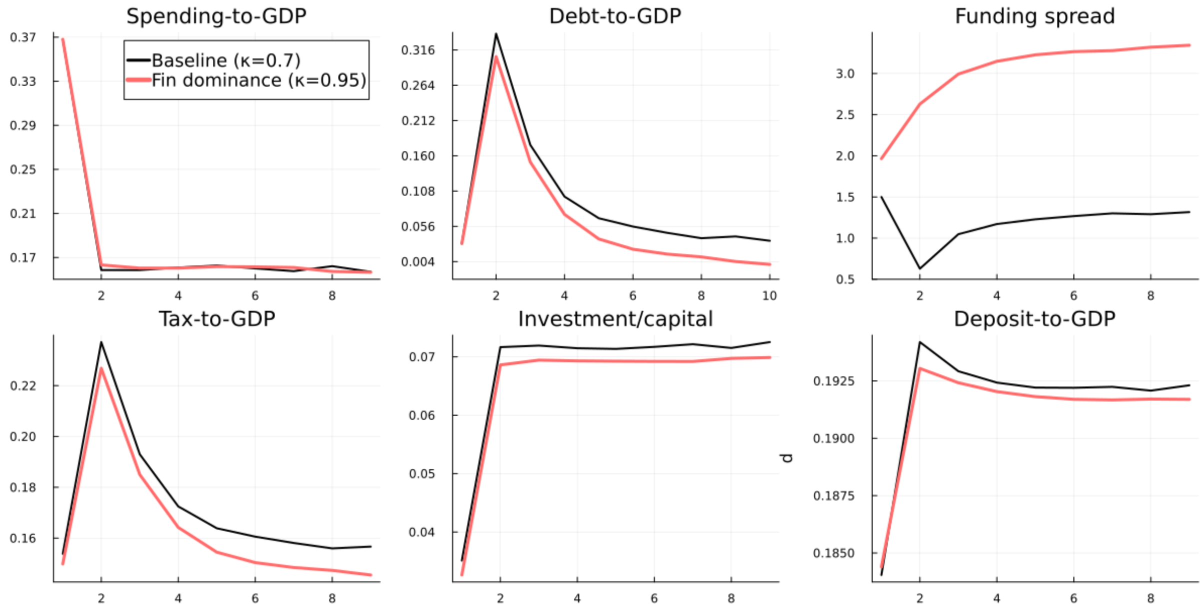

Figure 12: Counterfactual Expansion. The baseline sets $\kappa = \mathcal{K}^b - \mathcal{K}^h = 0.7$ and the counterfactual increases this to $\kappa = \mathcal{K}^b - \mathcal{K}^h = 0.95$.

7 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 inflation 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 funding 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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A Additional Empirical Evidence

In this section of the appendix, we include additional empirical results. Table 3 shows the regression for the full sample with different controls. Table 4 shows moments for different subperiods.

B Derivations

Taking prices and the household's SDF as given, the representative firm solves:

$$\begin{aligned} V^f(a_f, \mathbf{s}) = & \max_{l/k,\delta^n,k',h'} \left\{ \delta^n + \mathbb{E}_{\mathbf{s}} \left[\xi(\mathbf{s}';\mathbf{s}) V^f(a'_f, \mathbf{s}') \right] \right\} \\ s.t. \quad & \delta_n + q^k(\mathbf{s})k' - q^h(\mathbf{s})h' = a_f \\ & a'_f = \Big(z(\mathbf{s}')(l'/k')^{1-\alpha} - w(\mathbf{s}')(l'/k') + (1-\delta)q^k(\mathbf{s}') \Big) k' - \Big(\omega + (1-\omega) q^h(\mathbf{s}') \Big) h' \\ & q^h(\mathbf{s})h' \leq \theta q^k(\mathbf{s})k' \end{aligned}$$

The first-order-condition with respect to the labor-capital ratio implies

$$(1-\alpha)z(\mathbf{s})(l/k)^{-\alpha} = w(\mathbf{s}) \qquad \Rightarrow \qquad z(\mathbf{s})(l/k)^{1-\alpha} - w(\mathbf{s})(l/k) = \alpha \frac{y(\mathbf{s})}{k} =: r^k(\mathbf{s})$$

Let the afternoon-to-afternoon returns on capital and on the corporate bond be given by:

$$R^k(\mathbf{s}';\mathbf{s}) := \frac{r^k(\mathbf{s}') + (1-\delta)q^k(\mathbf{s}')}{q^k(\mathbf{s})} \qquad\qquad R^h(\mathbf{s}';\mathbf{s}) := \frac{\omega + (1-\omega)q^b(\mathbf{s}')}{q^b(\mathbf{s})}$$

and let

$$\varphi^k := \frac{q^k(\mathbf{s})k'}{q^k(\mathbf{s})k' - q^h(\mathbf{s})h'}$$

Guess that $V^f(a_f, \mathbf{s}) = \upsilon(\varphi^k, \mathbf{s})a_f$, then the Bellman equation becomes

$$\begin{aligned} \upsilon(\mathbf{s})a_f = & \max_{\delta_f, \varphi^k} \left\{ \delta_f + \mathbb{E}_{\mathbf{s}} \left[\xi(\mathbf{s}';\mathbf{s})\upsilon(\mathbf{s}') \Big(R^k(\mathbf{s}';\mathbf{s})\varphi^k + R^h(\mathbf{s}';\mathbf{s})(1-\varphi^k) \Big) (a_f - \delta_f) \right] \right\} \\ s.t. \quad & \varphi^k = \frac{1}{1-\theta} \end{aligned}$$

The FOC w.r.t. δ_f leads to

$$1 = \mathbb{E}_{\mathbf{s}} \left[\xi(\mathbf{s}';\mathbf{s})\upsilon(\mathbf{s}') \Big(R^k(\mathbf{s}';\mathbf{s})\varphi^k + R^h(\mathbf{s}';\mathbf{s})(1-\varphi^k) \Big) \right]$$

implying $\upsilon(\mathbf{s}) = 1$. Plugging in the collateral constraint

$$1 - \theta = \mathbb{E}_{\mathbf{s}} \left[\xi(\mathbf{s}';\mathbf{s}) \Big(R^k(\mathbf{s}';\mathbf{s}) - R^h(\mathbf{s}';\mathbf{s})\theta \Big) \right]$$

	Dependent variable: 10y AAA Corporate Bond Yield - 10y Treasury Yield		
	(1)	(2)	(3)
const	1.064***	1.957***	1.946***
	(0.200)	(0.318)	(0.315)
debt-to-GDP	-0.331***	0.052	0.046
	(0.037)	(0.061)	(0.061)
sigma(R)	-0.379***	-0.012	-0.022
	(0.085)	(0.136)	(0.135)
slope	0.011	-0.034	-0.024
	(0.030)	(0.027)	(0.028)
volatility	1.451***	-0.237	-0.221
	(0.334)	(0.438)	(0.435)
1920-2024		-1.047***	
		(0.379)	
1920-2024*debt-to-GDP		-0.261***	
		(0.090)	
1920-2024*sigma(R)		-0.290*	
		(0.169)	
1920-2024*vol		2.101***	
		(0.639)	
1920-2007			-1.006***
			(0.381)
1920-2007*debt-to-GDP			-0.335***
			(0.108)
1920-2007*sigma(R)			-0.344**
			(0.173)
1920-2007*vol			2.172***
			(0.663)
2009-2024			-0.488
			(1.647)
2009-2024*debt-to-GDP			0.516
			(1.144)
2009-2024*sigma(R)			-0.264
			(0.789)
2009-2024*vol			-0.884
			(1.755)
Observations	154	154	154
R^2	0.598	0.725	0.736
Adjusted R^2	0.587	0.709	0.714
Residual Std. Error	0.398 (df=149)	0.334 (df=145)	0.332 (df=141)
F Statistic	55.402*** (df=4; 149)	47.668*** (df=8; 145)	32.758*** (df=12; 141)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 3: Regressions for the sample 1870-2024. The first column regresses the spread on debt-to-GDP, government debt return volatility, slope, volatility. The second column introduces a dummy for the National Banking Era (1870-1919). The third column introduces dummies for the National Banking Era (1870-1919), Post WWI (1920-2007), and Post-GFC (2009-2024) periods. We drop the year 2008.

	1870-1919	1920-1951	1952-1993	1994-2007	2008-2025
Private-public borrowing cost spread: (χ_t)					
mean	1.734	1.066	0.431	0.663	0.717
vol	0.277	0.302	0.269	0.228	0.247
corr($\cdot$, Δy)	-0.142	-0.121	-0.128	-0.557	-0.529
Debt-to-GDP: $(q_t^b b_t/y_t)$					
mean	0.126	0.512	0.477	0.655	1.07
vol	0.065	0.174	0.137	0.047	0.084
corr($\cdot$, Δy)	0.044	-0.24	-0.049	-0.374	-0.079
Real return: $((\omega + (1-\omega)q_{t+1}^b)/q_t^b - 1)$					
mean	2.338	2.262	1.818	3.004	1.057
vol	4.71	7.68	8.61	9.57	10.09
corr($\cdot$, Δy)	-0.206	-0.295	-0.14	-0.414	0.131
Surplus-to-GDP: $(g_t - \tau_t)/y_t$					
mean	0.071	-3.794	-1.956	-1.168	-6.153
vol	2.611	7.298	1.067	1.763	3.554
corr($\cdot$, Δy)	-0.083	-0.221	-0.261	0.137	0.356

Table 4: Summary statistics for different policy eras.

which is the same condition as the one below

$$1 - \mathbb{E}_{\mathbf{s}}\left[\xi(\mathbf{s}';\mathbf{s})R^k(\mathbf{s}';\mathbf{s})\right] = \theta\,\underbrace{\left(1 - \mathbb{E}_{\mathbf{s}}\left[\xi(\mathbf{s}';\mathbf{s})R^h(\mathbf{s}';\mathbf{s})\right]\right)}_{\mu^h}$$

In equilibrium, the multiplier μ^h is linked to the banking frictions. The higher μ^h (higher liquidity premium on corporate debt), the more distortion in capital choice (capital price is above "fundamental value").

C Calibration

In this section of the Appendix, we discuss the calibration of the model.

C.1 Steady-state Equilibrium Conditions

$$
\begin{aligned}
\breve{\mu}^e &= 1 + \psi\left(\lambda d\right) \\
\breve{q}^b &= \frac{\omega + (1-\omega)q^b}{\breve{\mu}^e - (1-\varrho\kappa^b)\breve{\mu}^r} \\
\breve{q}^h &= \frac{\omega + (1-\omega)q^h}{\breve{\mu}^e - (1-\varrho\kappa^h)\breve{\mu}^r} \\
0 &= \Big((1-\varrho\kappa^b)\breve{q}^b b + (1-\varrho\kappa^h)\breve{q}^h h - d\Big)\breve{\mu}^r \\
q^e &= \beta\left[\left(\omega + (1-\omega)q^b\right) b + \left(\omega + (1-\omega)q^h\right) h - d - \frac{\psi}{2}\Big(\lambda d\Big)^2\right] \\
1 &= \beta\left(\frac{1}{1-(1-\varrho\kappa^b)\frac{\breve{\mu}^r}{\breve{\mu}^e}}\right)\left(\frac{\omega + (1-\omega)q^b}{q^b}\right) \\
1 &= \beta\left(\frac{1}{1-(1-\varrho\kappa^h)\frac{\breve{\mu}^r}{\breve{\mu}^e}}\right)\left(\frac{\omega + (1-\omega)q^h}{q^h}\right) \\
q^d &= \beta\Big(1 + \lambda(\breve{\mu}^e - 1) + \breve{\mu}^r\Big) \\
q^d &= \beta\Big(1 + \lambda\frac{\nu\breve{\mu}^d}{c^{-\gamma}}\Big) \\
\breve{w} &= \frac{\zeta^c}{c^{-\gamma}} \\
\breve{w}\breve{\ell} &= \nu d \\
m &= \phi\breve{\ell} \\
d\Big(1 + \frac{\breve{\mu}^d}{c^{-\gamma}}\Big) &= (1-\alpha)zk^\alpha m^{-\alpha}\phi\frac{\breve{\ell}}{\nu} \\
k &= (1-\delta)k + i \\
q^k\left(1 - \mu^h\theta\right) &= \beta\left(\alpha k^{\alpha-1}m^{1-\alpha} + (1-\delta)q^k\right) \\
q^h\left(1 - \mu^h\right) &= \beta\left(\omega + (1-\omega)q^h\right) \\
q^h h &= \theta q^k k \\
\overline{\tau} &= \left(\frac{\omega + (1-\omega)q^b}{q^b} - 1\right)\left(\frac{q^b b}{y}\right) + g \\
q^b b &= \bar{\mathsf{b}} z k^\alpha m^{1-\alpha} \\
zk^\alpha m^{1-\alpha}(1-g) &= c + i + \frac{\psi}{2}\Big(\lambda d\Big)^2
\end{aligned}
$$

where we used that as long as $d > 0$ in steady-state, the deposit-in-advance constraint must bind.

C.2 Parameterization

Define steady-state asset returns as

$$R := \beta^{-1} \qquad R^k := \frac{r^k + (1-\delta)q^k}{q^k} \qquad R^h := \frac{\omega + (1-\omega)q^h}{q^h}$$

$$R^b := \frac{\omega + (1-\omega)q^b}{q^b} \qquad R^d := \frac{1}{q^d}$$

There are standard parameters we set externally

Parameter	Description	Value
β	subjective discount factor (annual)	1/(1+4/400)
γ	risk-aversion	1
α	capital share (goods)	0.36
δ	depreciation of capital	0.025
ω	inverse maturity of long-term debt	$1/(4 \times 5)$
ϕ	productivity of labor	1
θ	collateral constraint	0.1
g	expenditure-to-output ratio	0.1
ρ_z	persistence of tfp	0.95

Parameters to calibrate internally: $(\lambda, \nu, \psi, \zeta_c, \varrho\kappa^h, \overline{\mathsf{b}}, \overline{\tau})$

Target	Description	Value	Parameter
χ	funding advantage (annualized)	1.0 %	$\varrho\kappa^h$
$R^d = 1/q^d$	deposit rate (annualized)	0.0 %	ν
$R^b = 1 + \omega(1/q^b - 1)$	hpr on treasury (annualized)	2.0 %	$\overline{\tau}$
$\mathcal{L} = \frac{q^b b + q^h h}{q^b b + q^h h - q^d d}$	bank leverage	4	λ
$\overline{\mathsf{b}} = q^b b/y$	debt-to-GDP ratio	0.35	$\overline{\mathsf{b}}$
m	intermediate goods	1	ζ_c
$(1 - \varrho\kappa^b)$	regulatory value of Treasury	1	ψ
vol(y)	GDP volatility		σ_z
vol($q^b b/y$)	debt-to-GDP volatility		η

D Model With Heterogeneous Banks and Morning Consumption

D.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 and raises taxes τ_t from the family in the afternoon.

Production technologies: There are two linear production technologies. One is a "morning" short term production technology that transforms m_t goods in the afternoon market at time t into $\breve{y}_{t+1} = \breve{z}_{t+1} m_t$ goods in the morning market at time $t+1$. Banks can store these goods without cost between morning and afternoon. The other is an "afternoon" production technology that transforms k_t units of capital into $y_{t+1} = z_{t+1} k_t$ units of consumption goods in the afternoon of $t+1$. Capital investment involves an adjustment cost so investment i_t at time t yields $\Phi(\iota_t) k_{t-1}$ additional units of capital at the end of period t, where $\iota_t := i_t / k_{t-1}$ is the investment rate as a proportion of capital available at time t. Capital depreciates at rate $\delta > 0$ so the evolution of physical capital follows:

$$k_t = (1 - \delta) k_{t-1} + \Phi(\iota_t) k_{t-1}.$$

The productivities $(\breve{z}_t, z_t) = (\breve{z}(\varepsilon_t^z), z(\varepsilon_t^z))$ depend upon an exogenous state ε_t^z that is realized at the start of the morning market and follows a Markov Chain with transition matrix Π^z.

Households: We model intra-period heterogeneity in the spirit of Lucas (1990) by using a family of households that separate across islands in the morning sub-periods and pool resources in the afternoon sub-periods. In each afternoon, the family pools after-tax unspent wealth and 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 but 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 in the morning sub-period. First, on each island, in the morning of each time t, a random fraction λ_t of households get utility $u(\breve{c}_t)$ from consuming $\breve{c}_t$, and then die. Second, the fraction λ_t is a random variable following a distribution $\lambda_t \sim \pi(\lambda_t)$ with mean Λ. In the afternoon, surviving members—of fraction $(1 - \Lambda)$—return to the family and a fraction Λ of new members are born keeping the afternoon size of the family unchanged. All family members get utility $u(c_t)$ from consuming c_t in the afternoon. Since λ_t characterizes the heterogeneity across islands we refer to islands by λ_t.

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. The following period $t+1$, households on island λ_{t+1} can withdraw deposits for resources $\breve{x}^d_{t+1}(\lambda_{t+1}) \leq 1$ either in the morning or in the afternoon of period $t+1$. Banks face a penalty $\Psi(1-\breve{x}^d_{t+1})$ for deviating from full repayment of deposits that captures the household need for deposit certainty. In the morning, banks cannot pay or issue dividends. In the afternoon, banks sell their remaining assets to the newly formed banks, pay out dividends $x^e_{t+1}(\lambda_{t+1})$ per share, and then exit.[13]

Markets: We use goods as the numeraire. In the afternoon, government bonds, capital, bank deposits, and bank equity are traded in competitive markets at prices $(q^b_t, q^k_t, q^d_t, q^e_t)$ respectively.[14] In the morning, after the shocks are realized, banks can trade government bonds, at price $\breve{q}^b_t$, and claims on capital, at price $\breve{q}^k_t$, in the secondary asset markets. However, they cannot issue equity or short-sell during the morning market.

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 long-term bonds in the primary asset market that repay a fraction ω of the outstanding balance in consumption goods at time t. The government's one-period budget constraint in the afternoon is:

$$(\omega + (1-\omega)q^b_t)B_{t-1} \leq \tau_t - g_t + q^b_t B_t. \tag{D.1}$$

The government faces an exogenous stochastic fiscal rule. Taxes are an exogenous function of output: $\tau_t = \tau y_t$, where $\tau \in [0,1]$ is a scalar. The government's primary deficit follows an exogenous stochastic process:

$$g_t - \tau y_t = -\eta\Big(B_{t-1} - \bar{b} y_t\Big) + y_t\Big(\sigma^z(\varepsilon^z_t) + \sigma^g \varepsilon^g_t\Big) \tag{D.2}$$

where $\bar{b}$ is a "target level" of debt-to-output ratio and $\eta \geq 0$ measures the sensitivity of primary deficit-to-output to deviations from the target level of outstanding debt-to-output, and ε^g_t is an exogenous state that is realized at the start of the morning market and follows a Markov Chain with transition matrix Π^g. The budget constraint (3.1) and the fiscal rule (3.2) imply an issuance rule for b_t, which is potentially exposed to both TFP shocks through σ^z and government spending shocks through σ^g.

The government can also impose restrictions on banks' portfolios after re-trading in the secondary asset markets, which we model with the constraint:

$$\begin{aligned}\varrho^{\frac{1}{\alpha}}(1-\lambda_t)\breve{x}^d_t(\lambda_t)d_{t-1} &\leq \Upsilon\Big(\breve{q}^b_t\breve{b}_t(\lambda_t),\ \breve{q}^k_t\breve{k}_t(\lambda_t)\Big) \\ &:= \Big(\kappa\big(\breve{q}^b_t\breve{b}_t(\lambda_t)\big)^\alpha + (1-\kappa)\big(\breve{q}^k_t\breve{k}_t(\lambda_t)\big)^\alpha\Big)^{\frac{1}{\alpha}}\end{aligned} \tag{D.3}$$

where $(1-\lambda_t)d_{t-1}$ is bank λ_t's remaining share of deposits at the end of the morning of period t, and $\big(\breve{b}_t(\lambda_t), \breve{k}_t(\lambda_t)\big)$ denote bank λ's post-trade holdings of government debt and claims on capital, respec-

[13] We use bank exit for expositional simplicity. Equivalently, we could model the banks recapitalizing in the afternoon by issuing new equity.

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

tively. 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. We refer to $\kappa = 0.5$ as a "neutral" regulatory regime and $\kappa > 0.5$ as a "repression" regime.[15]

Parametric forms: For numerical exercises, we impose the following parametric forms. We let $u(c) = c^{1-\gamma}/(1-\gamma)$, $\Phi(\iota) = \iota - \frac{\phi}{2}(\iota - \delta)^2$, and $\Psi(1 - \breve{x}^d) = \psi(1 - \breve{x}^d)$.

D.1.1 A Broader Interpretation

We have written the model to focus on how portfolio restrictions on the banking sector change the price process for government debt. This because banks have historically been large holders of government debt. However, the forces in the model generalize to other environments.

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 (e.g. in the US during WWII). Another alternative is that it could reflect collateral requirements at a government discount window (e.g. in the US after the introduction of the FED). For the latter case, the regulatory requirement is only faced by banks that take significant losses in the morning market 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 in the intermediary Euler equations, (iii) the government restricts the portfolio that the financial intermediary. In this sense, the forces in our model also apply to insurance companies, pension funds, and other financial intermediaries.

D.2 Equilibrium

We set up the equilibrium recursively using the notation that $(\breve{v}, v)$ denotes a variable in the morning and afternoon of the current period respectively and $(\breve{v}', v')$ denotes a variable in the morning and afternoon of the next period respectively. The aggregate state vector each period is $\mathbf{s} := (\boldsymbol{\varepsilon}, k, b, m, d)$, where $\boldsymbol{\varepsilon} := (\varepsilon^z, \varepsilon^g)$ is the vector of exogenous aggregate states, k is aggregate capital stock, b is government debt outstanding. The endogenous state variables k and b evolve according to:

$$k' = (1-\delta)k + \Phi(\iota)k \tag{D.4}$$

$$q^b(\mathbf{s})b' = \big(\eta\bar{b} + \sigma^z(\varepsilon^z) + \sigma^g\varepsilon^g\big)zk + \big(\omega - \eta + (1-\omega)q^b(\mathbf{s})\big)b. \tag{D.5}$$

We guess and verify that afternoon prices are functions $(q^d(\mathbf{s}), q^e(\mathbf{s}), q^k(\mathbf{s}), q^b(\mathbf{s}))$ and the follow period morning prices are functions $\big(\breve{q}^k(\mathbf{s}'), \breve{q}^b(\mathbf{s}')\big)$.

[15] $\kappa = 0.5$ refers to a regulatory regime that treats government debt and capital symmetrically and just restricts bank risk taking through $\varrho > 0$. Since, absent regulation, government debt and capital have the same return process, we refer to this as a "neutral" regime. $\kappa > 0.5$ is a regime that incentivizes the holding of government debt over capital as regulatory collateral, while $\kappa < 0.5$ corresponds to the opposite case.

Family problem: At the start of the afternoon sub-period, suppose the family has unspent wealth a. The family's budget constraint in the afternoon sub-period at time t is:

$$c + q^d(\mathbf{s})d' + q^e(\mathbf{s})e' \leq a - \tau(\mathbf{s}) \tag{D.6}$$

where c denotes goods consumed by the family in the afternoon sub-period, (d', e') denote the family portfolio of bank deposits and equity on each island,[16] and $\tau(\mathbf{s})$ denotes the individual lump sum tax in the afternoon sub-period.

In the following morning sub-period, the household members of the family separate across islands. The new exogenous aggregate states $(\boldsymbol{\varepsilon}', b')$ are realized and each island receives its idiosyncratic shock draw $\lambda' \sim \pi(\lambda')$ for the fraction of households who have morning consumption needs (we refer to an island with a draw λ' as a "λ'-island"). Households only have access to the deposits held in the bank on their island so, for a given $\mathbf{s}$, a household on an λ'-island consumes $\breve{x}^d(\lambda', \mathbf{s}')d'$, where $\breve{x}^d(\cdot)$ denotes the function for deposit repayment. Household financial wealth not used for consumption in the morning market is returned to the family in the afternoon so, for a given $\mathbf{s}$, the evolution of family wealth between afternoon sub-periods is:

$$a' = \sum_{\lambda'} \Big(x^e(\lambda', \mathbf{s}')e' + (1 - \lambda')\breve{x}^d(\lambda', \mathbf{s}')d' \Big) \pi(\lambda') \tag{D.7}$$

where $x^e(\cdot)$ is the dividend per equity share function.

Let $V(a, \mathbf{s})$ denote the value of the household with unspent wealth a at the start of the afternoon. Then, taking as given the law of motion for the aggregate states (D.4) and (D.5), the value function $V(a, \mathbf{s})$ satisfies the Bellman equation (D.8) below:

$$\begin{aligned} V(a, \mathbf{s}) = \max_{\{c,e,d\}} & \left\{ u(c) + \beta \mathbb{E} \left[\sum_{\lambda'} \lambda' u\big(\breve{x}^d(\lambda', \mathbf{s}')d'\big)\pi(\lambda') + (1 - \Lambda)V(a', \mathbf{s}') \mid \mathbf{s} \right] \right\} \\ s.t. \qquad & (\text{D.6}), (\text{D.7}). \end{aligned} \tag{D.8}$$

This leads to the first-order-conditions (FOCs) after imposing the Envelope condition:

$$q^d(\mathbf{s}) = \mathbb{E}\Big[\xi(\mathbf{s}'; \mathbf{s})\breve{N}(\mathbf{s}') \;\Big|\; \mathbf{s}\Big] \tag{D.9}$$

$$q^e(\mathbf{s}) = \mathbb{E}\Big[\xi(\mathbf{s}'; \mathbf{s}) \sum_{\lambda'} x^e(\lambda', \mathbf{s}')\pi(\lambda') \;\Big|\; \mathbf{s}\Big] \tag{D.10}$$

where the stochastic discount factor (SDF) and the "liquidity wedge" for a given $(\lambda', \mathbf{s}')$ are defined by:

$$\begin{aligned} \xi(\mathbf{s}'; \mathbf{s}) &:= \beta(1 - \Lambda)\frac{\partial_c u(c(\mathbf{s}'))}{\partial_c u(c(\mathbf{s}))}, \\ \breve{N}(\mathbf{s}') &:= \sum_{\lambda'} \left(\left(1 - \lambda' + \lambda' \frac{\partial_c u(\breve{x}^d(\lambda', \mathbf{s}')d')}{(1 - \Lambda)\partial_c u(c(\mathbf{s}'))} \right) \breve{x}^d(\lambda', \mathbf{s}') \right) \pi(\lambda'). \end{aligned} \tag{D.11}$$

The liquidity wedge, $\breve{N}(\lambda', \mathbf{s}')$, appears because demand deposits provide liquidity services to the house-

[16] The islands are symmetric in the afternoon market so the family allocates resources equally across them.

holds by allowing them to insure consumption shocks in the morning sub-period. The presence of this asset-specific wedge implies that households are willing to hold demand deposits at a discount.

Bank problem: In the afternoon a new bank is created[17], it chooses a portfolio (m', b', k') of reserve assets, government bonds, and capital. In the following morning, given $\mathbf{s}'$, banks on a λ'-island face the withdrawal constraint $\forall(\lambda', \mathbf{s}')$:

$$\lambda' \breve{x}^d(\lambda', \mathbf{s}')d' \leq \breve{z}'m' + \breve{q}^b(\mathbf{s}')\big(b' - \breve{b}(\lambda', \mathbf{s}')\big) + \breve{q}^k(\mathbf{s}')\big(k' - \breve{k}(\lambda', \mathbf{s}')\big), \tag{D.12}$$

where $\big(\breve{b}(\lambda', \mathbf{s}'), \breve{k}(\lambda', \mathbf{s}')\big)$ denote the bank's portfolios of government bonds and capital chosen in the morning and so $\big(b' - \breve{b}(\lambda', \mathbf{s}'),\ k' - \breve{k}(\lambda', \mathbf{s}')\big)$ denotes the sale of government bonds and capital to finance deposit withdrawals. In the following afternoon, the bank repays equity and deposit holders subject to the budget constraint $\forall(\lambda', \mathbf{s}')$:

$$x^e(\lambda', \mathbf{s}') + (1 - \lambda')\breve{x}^d(\lambda', \mathbf{s}')d' \leq x^k(\lambda', \mathbf{s}')\breve{k}(\lambda', \mathbf{s}') + x^b(\lambda', \mathbf{s}')\breve{b}(\lambda', \mathbf{s}'). \tag{D.13}$$

where $x^k(\lambda', \mathbf{s}')$ and $x^b(\lambda', \mathbf{s}')$ are the afternoon payoffs from capital and government debt:

$$\begin{aligned}
x^k(\lambda', \mathbf{s}') &:= z' - \iota(\lambda', \mathbf{s}') + q^k(\mathbf{s}')\big[(1 - \delta) + \Phi(\iota(\lambda', \mathbf{s}')\big] \\
x^b(\lambda', \mathbf{s}') &:= \omega + (1 - \omega)q^b(\mathbf{s}').
\end{aligned}$$

Taking as given the law of motion for the aggregate states, (D.4) and (D.5), the representative bank solves the problem (D.14) below:

$$\begin{aligned}
&\max_{\substack{m', k', b', d', \breve{x}^d(\cdot), \\ x^e(\cdot), \breve{b}(\cdot), \breve{k}(\cdot), \iota(\cdot)}} \quad \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s}) \sum_{\lambda'} \{x^e(\lambda', \mathbf{s}') - \Psi(\cdot)d'\}\pi(\lambda')\Big] + q^d(\mathbf{s})d' - m' - q^k(\mathbf{s})k' - q^b(\mathbf{s})b' \\
&\quad s.t. \qquad (\text{D.12}), (\text{D.13}), (\text{D.3}), \quad \Psi(\lambda', \mathbf{s}') = \psi(1 - \breve{x}^d(\lambda', \mathbf{s}')) \\
&\qquad\qquad\quad 0 \leq b',\ k',\ m',\ d',\ \breve{b}(\lambda', \mathbf{s}'),\ \breve{k}(\lambda', \mathbf{s}'),\ 1 - \breve{x}^d(\lambda', \mathbf{s}'), \quad \forall(\lambda', \mathbf{s}')
\end{aligned} \tag{D.14}$$

where ξ is the household's stochastic discount factor and Ψ is the default penalty. The first order conditions for the portfolio choice in the afternoon market are (dropping the short selling constraints which don't bind):

$$[m']: \qquad 1 = \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s})\breve{M}(\mathbf{s}')\breve{z}'\Big] \tag{D.15}$$

$$[k']: \qquad q^k(\mathbf{s}) = \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s})\breve{M}(\mathbf{s}')\breve{q}^k(\mathbf{s}')\Big] \tag{D.16}$$

$$[b']: \qquad q^b(\mathbf{s}) = \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s})\breve{M}(\mathbf{s}')\breve{q}^b(\mathbf{s}')\Big] \tag{D.17}$$

$$\begin{aligned}
[d']: \qquad q^d(\mathbf{s}) = \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s}) \sum_{\lambda'} \Big((1 - \lambda')\big[1 + \breve{\mu}^r(\lambda', \mathbf{s}')\big]\Big)\breve{x}^d(\lambda', \mathbf{s}')\pi(\lambda')\Big] \\
+ \mathbb{E}_{\mathbf{s}}\Big[\xi(\mathbf{s}'; \mathbf{s}) \sum_{\lambda'} \Big(\lambda'\breve{\mu}^e(\lambda', \mathbf{s}')\breve{x}^d(\lambda', \mathbf{s}') + \Psi(\lambda', \mathbf{s}')\Big)\pi(\lambda')\Big]
\end{aligned} \tag{D.18}$$

[17] Or equivalently, the existing banks raise equity in a frictionless market.

where $\breve{M}(\mathbf{s}')$ is the average marginal value of wealth in the morning conditional on the aggregate state $\mathbf{s}'$:

$$\breve{M}(\mathbf{s}') := \sum_{\lambda'} \breve{\mu}^e(\lambda', \mathbf{s}')\pi(\lambda') \tag{D.19}$$

We can see that equations (D.15), (D.16), and (D.17), are the standard portfolio choice equations augmented with the wedge $\breve{M}(\mathbf{s}')$ reflecting how the interbank market frictions in the morning market distort the bank's portfolio. Equation (D.18) equates the deposit price to the risk-weighted average marginal cost of servicing a unit of deposits in the morning and afternoon.

The first order conditions for the morning market choices and other λ' dependent choices are (dropping the short selling constraints which don't bind):

$$[\breve{x}^d(\cdot)]: \qquad \partial\Psi\Big(1 - \breve{x}^d(\lambda', \mathbf{s}')\Big) = \lambda'\breve{\mu}^e(\lambda', \mathbf{s}') + (1-\lambda')\Big(1 + \breve{\mu}^r(\lambda', \mathbf{s}')\Big) \tag{D.20}$$

$$[\breve{k}(\cdot)]: \qquad \breve{\mu}^r(\lambda', \mathbf{s}')\partial_{\breve{q}^k\breve{k}}\Upsilon(\lambda', \mathbf{s}') = \breve{\mu}^e(\lambda', \mathbf{s}') - \underline{\breve{\mu}}^k(\lambda', \mathbf{s}') - \breve{R}^k(\mathbf{s}') \tag{D.21}$$

$$[\breve{b}(\cdot)]: \qquad \breve{\mu}^r(\lambda', \mathbf{s}')\partial_{\breve{q}^b\breve{b}}\Upsilon(\lambda', \mathbf{s}') = \breve{\mu}^e(\lambda', \mathbf{s}') - \underline{\breve{\mu}}^b(\lambda', \mathbf{s}') - \breve{R}^b(\mathbf{s}') \tag{D.22}$$

$$[\iota(\cdot)]: \qquad q^k(\mathbf{s}') = \Big(\partial\Phi_\iota(\iota(\lambda', \mathbf{s}'))\Big)^{-1} \tag{D.23}$$

where $\breve{R}^k$ and $\breve{R}^b$ are the morning to afternoon returns:

$$\breve{R}^k(\mathbf{s}') = \frac{x^k(\mathbf{s}')}{\breve{q}^k(\mathbf{s}')} \qquad\qquad \breve{R}^b(\mathbf{s}') = \frac{x^b(\mathbf{s}')}{\breve{q}^b(\mathbf{s}')}$$

Equation (D.20) equates the marginal cost of defaulting on a deposit to the marginal benefit of relaxing the budget and regulatory constraints through deposit default. Equations (D.21) and (D.22) equate the marginal value of relaxing the regulatory constraint with the opportunity cost of foregone investment. Equation (D.23) equates the marginal cost of investment to the price of capital, which implies that ι (and therefore x^k and $\breve{R}^k$) is independent of λ'.

We can now set up a competitive equilibrium. Given a fiscal rule (D.2) and bond price function $q^b(\cdot)$, a budget-feasible government issuance rule $B'(\mathbf{s})$ satisfies (D.1).

Definition 3 (Budget-feasible Competitive Equilibrium)**.** Given regulation parameters (ϱ, κ), and a budget-feasible government policy $\{\tau(\cdot), g(\cdot), B'(\cdot)\}$, a competitive equilibrium is a collection of functions for prices $\{q^d(\cdot), q^e(\cdot), q^k(\cdot), q^b(\cdot), \breve{q}^k(\cdot), \breve{q}^b(\cdot)\}$, payoffs $\{\breve{x}^d(\cdot), x^e(\cdot)\}$, household policies $\{d^h(\cdot), e'(\cdot), c(\cdot)\}$, and bank policies $\{d'(\cdot), m'(\cdot), k'(\cdot), \iota(\cdot), b'(\cdot), \breve{k}(\cdot), \breve{b}(\cdot)\}$, such that

- Taking prices as given, the family solves (D.8),
- Taking prices as given, banks solve (D.14),
- Afternoon and morning goods markets clear:

$$c(\mathbf{s}) + m'(\mathbf{s}) + \iota(\mathbf{s})k + g(\mathbf{s}) = zk, \tag{D.24}$$

$$\sum_{\lambda}\big(\lambda\breve{x}^d(\lambda, \mathbf{s})d\big)\pi(\lambda) = \breve{z}m, \tag{D.25}$$

morning asset markets clear:

$$\sum_{\lambda} \breve{b}(\lambda, \mathbf{s})\pi(\lambda) = b, \qquad \sum_{\lambda} \breve{k}(\lambda, \mathbf{s})\pi(\lambda) = k, \tag{D.26}$$

and afternoon asset markets clear:

$$d^h(\mathbf{s}) = d'(\mathbf{s}), \qquad e'(\mathbf{s}) = 1, \qquad b'(\mathbf{s}) = B'(\mathbf{s}) \qquad k'(\mathbf{s}) = [1 - \delta + \Phi(\iota(\mathbf{s}))]k.$$

The afternoon market is the standard neoclassical growth model augmented with morning market frictions summarized by the liquidity distortion $\breve{N}(\mathbf{s}) \neq 1$ (equation (D.11) and the interbank market distortion $\breve{M}(\mathbf{s}) \neq 1$ (equation (D.19)). We can see this formally by observing that the afternoon market functions $(c(\mathbf{s}), g(\mathbf{s}), \iota(\mathbf{s}), m'(\mathbf{s}), d'(\mathbf{s}), q^d(\mathbf{s}), q^e(\mathbf{s}), q^k(\mathbf{s}), q^b(\mathbf{s}))$ solve equations (D.9), (D.10), (D.15), (D.16), (D.17), (D.18), (D.23), (D.24), and (D.2).

The novel features of our model appear in the morning market, which generate the liquidity and interbank market distortions. We characterize the equilibrium in the morning market in Proposition (2) below. In the next section, we study how government policies affect the functioning of the morning market.

Proposition 2. *Suppose the short-selling constraints don't bind.*[18] *Then given the state* $\mathbf{s}$*, morning price functions* $\big(\breve{q}^k(\cdot), \breve{q}^b(\cdot)\big)$ *and afternoon payout functions* $\big(x^b(\cdot), x^k(\cdot)\big)$*, the morning choice functions* $\big(\breve{x}^d(\cdot),$ $\breve{b}(\cdot)$, $\breve{k}(\cdot)$, $\breve{\mu}^r(\cdot)$, $\breve{\mu}^e(\cdot)\big)$ *satisfy the equations:*

$$\begin{aligned}
\breve{x}^d(\lambda, \mathbf{s}) &= 1 - [\partial_{\breve{x}^d}\Psi]^{-1}\left(\lambda\breve{\mu}^e(\lambda, \mathbf{s}) + (1 - \lambda)\Big(1 + \breve{\mu}^r(\lambda, \mathbf{s})\Big)\right) \\
\frac{x^k(\mathbf{s})}{\breve{q}^k(\mathbf{s})} &= \breve{\mu}^e(\lambda, \mathbf{s}) - \breve{\mu}^r(\lambda, \mathbf{s})\partial_{\breve{q}^k\breve{k}}\Upsilon(\lambda, \mathbf{s}) \\
\frac{x^b(\mathbf{s})}{\breve{q}^b(\mathbf{s})} &= \breve{\mu}^e(\lambda, \mathbf{s}) - \breve{\mu}^r(\lambda, \mathbf{s})\partial_{\breve{q}^b\breve{b}}\Upsilon(\lambda, \mathbf{s}) \\
\lambda\breve{x}^d(\lambda, \mathbf{s})d &= \breve{z}(\mathbf{s})m + \breve{q}^b(\mathbf{s})\big(b - \breve{b}(\lambda, \mathbf{s})\big) + \breve{q}^k(\mathbf{s})\big(k - \breve{k}(\lambda, \mathbf{s})\big) \\
\breve{\mu}^r(\lambda, \mathbf{s}) &\approx \left(\frac{(1 - \lambda)\breve{x}^d(\lambda, \mathbf{s})\, d}{\Upsilon(\lambda, \mathbf{s})}\right)^{\varpi^r - 1}
\end{aligned}$$

The prices $(\breve{q}^k(\cdot), \breve{q}^b(\cdot))$ *are then pinned down by the asset market clearing conditions in* (D.26)*.*

Proof. The first four equations follow directly from rearranging the bank morning FOCs (D.20), (D.21), and (D.22) and the morning goods market clearing condition (D.25). The final equation is an approximation to the Lagrange multiplier that holds exactly in the limit as $\varpi \to \infty$. □

D.3 Morning (Inter-bank) Asset Market and "Captive Demand"

The morning market is governed by the difficulty of managing deposit withdrawals. In our environment, households have a desire for non-state-contingent deposit payouts. Banks offer such deposits but this exposes them to idiosyncratic deposit withdrawal shocks, which they have to try to manage. The economy has low return reserves that payoff in the morning period as well as high return long-term assets (capital

[18] For example, Ψ is convex and Υ is Cobb-Douglas.

and government bonds) that payoff in the afternoon market. In a frictionless world, banks could purchase long-term assets in the afternoon market, then cover deposit withdrawals in the morning market by raising resources from households using the future payout on long-term assets as backing. The difficulty for banks is that frictions in the morning market prevent them from interacting with households and instead force them to sell their long-term assets to other banks in the interbank market. This means that the household stochastic discount factor does not set the inter-temporal rate of substitution between morning and afternoon. Instead, the rate is set by prices in the interbank market. Unfortunately for banks, the interbank market rate is constrained by the aggregate reserves that banks have brought into the market and so morning market asset prices are low. This pushes the market's intertermporal rate of substitution above the household's rate, which potentially leads to banks defaulting on deposits.

Our government "exploits" the frictions in the interbank market rather than attempting to completely "resolve" them. In principle, the government could use tax revenue to directly intermediate the interbank market and overcome the frictions in the banking sector. Instead, our government chooses restrictions on the bank portfolios in order to change the cost of financing a path of government spending and taxes. Formally, these restrictions are given by equation (D.3), which says that government can potentially restrict both bank leverage and asset portfolios. If the government sets $\kappa = 1/2$ and $\alpha = 1$, then the regulatory constraint restricts bank leverage but allows perfect substitution between government bonds and capital to satisfy the regulatory constraint. As the government increases κ above $1/2$, it increases pressure on the banking sector to hold government debt, which we refer to as "financial repression".

The banks have two variables they can choose in order to respond to withdraw shocks and the government's regulatory constraints: (i) their asset portfolio between government debt and capital and (ii) the extent to which they default on deposits. How they make this choice will end up determining the extent to which morning market prices or bank default changes in response to the aggregate shocks.

To highlight the different forces at play in the interbank market equations, we characterize equilibrium progressively for increasingly more complicated environments. We start by considering an environment without financial regulation to explain how the interbank market frictions lead to "cash-in-the-market" or "fire-sale" pricing that complicates the banking sector's capacity to handle withdrawal shocks. We then introduce financial repression and show that it generates "captive" bank demand for government debt in bad times and so changes the price process to make government debt a good hedge against the problems arising from withdrawal shocks. Finally, we study fiscal policy that devalues government debt in bad times and show that erodes the "captive" bank demand.

D.3.1 No Financial Regulation

We start without regulatory constraints ($\varrho = 0$, $\mu^r = 0$) to highlight how the interbank market frictions appear in the asset pricing. In this case, because there is no regulation and no shocks between morning and afternoon, capital and government bonds are perfect substitutes with equal returns between morning and afternoon $\breve{R}^k(\mathbf{s}) = \breve{R}^b(\mathbf{s})$.

The banking sector's inability to raise extra resources to supplement their reserves implies that the morning asset markets are characterized by 'fire-sale" pricing: capital and government bonds are traded below their fundamental value. To see this, observe that because there is no regulation and no shocks between morning and afternoon, capital and government bonds are perfect substitutes with equal returns between morning and afternoon $\breve{R}^k(\mathbf{s}) = \breve{R}^b(\mathbf{s})$. In addition, the equity raising constraints mean that the marginal value of resources is greater inside the bank than outside the bank so $\breve{\mu}^e(\lambda, \mathbf{s}) \geq 1$, where the lower bond comes from the storage option. Consequently, the return on assets between morning and afternoon is greater than one:

$$\breve{R}^k(\mathbf{s}) = \breve{R}^b(\mathbf{s}) = \breve{\mu}^e(\lambda, \mathbf{s}) \geq 1,$$

which is the mathematical statement that the market intertemporal rate of substitution, $\breve{R}^i(\mathbf{s})$ for $i \in (k, b)$ between morning and afternoon is greater than the households' intertermporal rate of substitute, 1. This implies that there could be "cash-in-the-market" (Allen and Gale, 1994) or "fire-sale" (Gale and Gottardi, 2020) pricing in the sense that prices in the morning market are less than their afternoon payoffs even though there is no risk or discounting between morning and afternoon:

$$\breve{q}^b(\mathbf{s}) \leq x^b(\mathbf{s}), \qquad\qquad \breve{q}^k(\mathbf{s}) \leq x^k(\mathbf{s})$$

These pricing wedges restrict the banking sector's ability to reallocate resources to distressed banks, which, in turn, leads to higher rates of default on deposits.

The interbank market problems are more severe in the low TFP state of the world when the aggregate reserves of the banking sector are low. To see this, from the good market clearing condition, we have:

$$\frac{\breve{z}(\mathbf{s})m}{d} = \sum_{\lambda} \lambda \Big(1 - \left[\partial_{\breve{x}^d} \Psi\right]^{-1} \Big(\lambda \breve{R}^i(\mathbf{s}) + (1-\lambda)\Big)\Big)\pi(\lambda) \qquad i \in \{b, k\}$$

which implies that, in the bad state, as $\breve{z}$ decreases, the return on assets increases so we have fire-sale pricing: $\breve{R}^k(\mathbf{s}') = \breve{R}^b(\mathbf{s}') > 1$, $\breve{q}^b(\mathbf{s}) < x^b(\mathbf{s})$, and $\breve{q}^k(\mathbf{s}) < x^k(\mathbf{s})$. We collect these results in Corollary 2.

Corollary 2. *Without any regulatory constraints ($\varrho = 0$, $\mu^r = 0$), government debt and capital are perfect substitutes in the interbank market. They have the same return, $\breve{R}^k(\mathbf{s}) = \breve{R}^b(\mathbf{s}) \geq 1$, with a strict inequality in the low aggregate state due to "fire-sale" pricing.*

We show these observations for a numerical example in Figure 13, which depicts asset prices as function of productivity $\breve{z}$. The black line shows that, without regulation, both government debt and capital prices decrease when productivity decreases.

D.3.2 Financial Regulation and Captive Demand

We now introduce regulatory constraints ($\varrho > 0$, $\kappa \in [0, 1]$) to highlight how the government can influence the morning price process. The regulatory constraint means that banks are no longer indifferent between government debt and capital in the morning market. Instead, they choose both asset holdings and deposit default in order to balance the need to manage withdrawals, the need to satisfy regulatory constraints, and the desire to earn a high return. Formally, let $\breve{a} := \breve{z}(\mathbf{s})m + \breve{q}^k(\mathbf{s})k + \breve{q}^b(\mathbf{s})b$ denote the wealth that a bank brings into the morning sub-period. Let $\breve{\theta}^b := \breve{q}^b(\mathbf{s})b/\breve{a}$ and $\breve{\theta}^x := \breve{x}\breve{q}^b(\mathbf{s})b/\breve{a}$ denote government debt purchases and value of deposits honored as a share of bank wealth. Rearranging the equations in

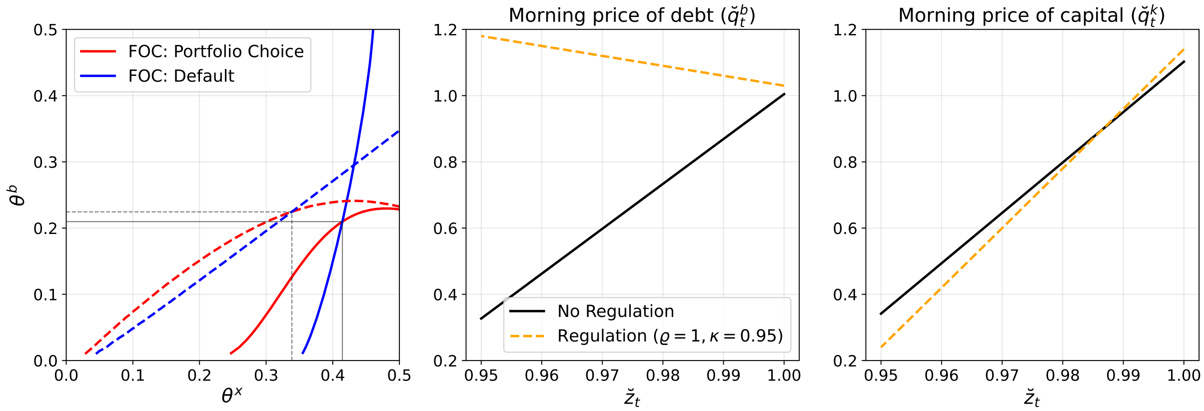

Figure 13: Morning Asset Prices With and Without Financial Repression.

Black line shows the morning market prices in an environment without regulation. The orange line shows the morning market asset prices in an environment with repression.

Proposition 2, we can see that the bank's choices are governed by the equations:

$$R^k(\mathbf{s}) - R^b(\mathbf{s}) \approx \frac{\breve{\mu}^r(\lambda, \mathbf{s})}{(\Upsilon(\lambda, \mathbf{s})\breve{a}^{-1})^{\alpha-2}} \left(\frac{\kappa}{\varrho} \left(\breve{\theta}^b\right)^{\alpha-1} - \frac{1-\kappa}{\varrho} \left(1 - \breve{\theta}^x - \breve{\theta}^b\right)^{\alpha-1} \right) \tag{D.27}$$

$$\partial\Psi \left(1 - \breve{\theta}^x\right) \approx \frac{\breve{\mu}^r(\lambda, \mathbf{s})}{\lambda^{\varpi^r - 1}} \left(\lambda \left(\frac{\kappa}{\varrho}\right) \Upsilon(\lambda, \mathbf{s})^{1-\alpha} \left(\breve{\theta}^b \breve{a}\right)^{\alpha-1} + (1-\lambda)\frac{\varrho}{2} \right) + \lambda R^b(\mathbf{s}) + 1 - \lambda \tag{D.28}$$

where the Lagrange multiplier on the regulatory constraint is

$$\breve{\mu}^r(\lambda, \mathbf{s}) \approx \left(\frac{(1-\lambda)\breve{\theta}^x(\lambda, \mathbf{s})\breve{a}}{\Upsilon(\lambda, \mathbf{s})} \right)^{\varpi - 1} > 0,$$

which is strictly positive because the regulatory constraint binds. We refer to the first equation as the bank asset portfolio FOC because it says a bank chooses its share of wealth in government bonds to balance the return difference between bonds and capital (the LHS) against the strength of the regulatory constraint (the first term on the RHS) and the relative marginal usefulness of government debt in satisfying the regulatory constraint (the second term on the RHS). We refer to the second equation as the bank deposit default FOC because it says that a bank balances the marginal cost of default (the LHS) against the marginal value of relaxing the budget constraint and regulatory constraints in the interbank market through deposit default (the RHS).

We depict the bank's choice equations (D.27) and (D.28) graphically in the left plot of Figure 13 for the case that $R^k > R^b$. To illustrate how repression distorts the asset market, we consider the comparative static when κ is increased. Evidently, the portfolio FOC contour (the red line) shifts left and up while the default FOC contour (the blue line) rotates clockwise. Together this leads to an increase in fraction of wealth the bank holds in bonds, θ^b, and an increase in deposit default, $1 - \theta^x$. This is because financial repression skews the bank's morning portfolio choice to create "captive demand" for government bonds. Because government bonds have the lower return, this tightens the regulatory constraint and so leads to banks defaulting more.

Rearranging the portfolio FOC implies that (after some substitution):

$$\frac{\breve{q}^b(\mathbf{s})}{\breve{q}^k(\mathbf{s})} = \frac{x^b(\lambda,\mathbf{s})}{x^k(\lambda,\mathbf{s})}\left(\frac{1-\frac{\breve{\mu}^r(\lambda,\mathbf{s})}{\breve{\mu}^e(\lambda,\mathbf{s})}\left(\frac{1-\kappa}{\varrho}\right)(1-\breve{\theta}^x-\breve{\theta}^b)^{\alpha-1}}{1-\frac{\breve{\mu}^r(\lambda,\mathbf{s})}{\breve{\mu}^e(\lambda,\mathbf{s})}\frac{\kappa}{\varrho}(\breve{\theta}^b)^{\alpha-1}}\right)$$

If government debt is sufficiently privileged in the regulatory constraint ($\kappa > 1/2$) and so $\frac{\kappa}{\varrho}(\breve{\theta}^b)^{\alpha-1} > \frac{1-\kappa}{\varrho}(1-\breve{\theta}^x-\breve{\theta}^b)^{\alpha-1}$, then the regulatory constraint inflates the price of government debt in the interbank market and so the return on government debt is lower than the return on capital: $\breve{R}^k(\mathbf{s}) > \breve{R}^b(\mathbf{s})$. In this case, we can also see that $\breve{\mu}^r(\lambda,\mathbf{s})$ is higher for low $\breve{z}$ states and so the distortion from the regulatory constraint is higher following negative TFP shocks. This ultimately means that the price ratio $\frac{\breve{q}^b(\mathbf{s})}{\breve{q}^k(\mathbf{s})}$ is higher in bad states of the world and government debt becomes a good hedge against aggregate shocks. Conceptually, the government can exploit the fire-sale pricing in the morning market to skew the price of government debt high in bad states of the world.

The orange lines in the center and right plots in Figure 13 depict the equilibrium price outcomes for a particular numerical experiment. Evidently, with regulation, the price of government debt increases in bad times whereas the price of capital decrease further. In this sense, the government can use regulation to choose which asset appreciates in bad times. We summarize these results in Corollary 3 below.

Corollary 3. *With regulatory constraints that favor government debt ($\varrho > 0$, $\kappa > 1/2$), government debt and capital are imperfect substitutes in the interbank market. In the bad state of the world, the return on capital is higher $\breve{R}^k(\mathbf{s}_B) > \breve{R}^b(\mathbf{s}_B)$ and the relative morning price of government debt appreciates: $\breve{q}^b(\mathbf{s}_B)/\breve{q}^b(\mathbf{s}_B) > \breve{q}^b(\mathbf{s}_G)/\breve{q}^b(\mathbf{s}_G)$.*

D.3.3 Debt Devaluation and Financial Repression

Finally, we consider the impact of a government policy that devalues government debt in the bad aggregate state $x^b(\mathbf{s}_B) < x^b(\mathbf{s}_G)$ (e.g. setting $\sigma_z > 0$ so the government issues debt in bad states) in an environment with financial repression. The impact of such a policy on bank decisions is shown in the left plot of Figure 14 below. A decrease in $x^b(\mathbf{s}_B)$ shifts the portfolio choice curve down and to the right because it lowers the return on government debt. The default choice curve rotates slightly clockwise because default has become more valuable. The result is that demand for government debt falls (θ^b decreases) and the banks default more (θ^x decreases). The relative size of the adjustment through demand versus the relative size of the adjustment through bankruptcy is governed by the relative slope of the two FOCs. A higher default cost means that the default FOC is steeper and so more adjustment comes through θ^b. By contrast, a lower α makes debt and capital less substitutable so more adjustment comes through θ^x.

Conceptually, the combination financial repression and government devaluation in bad states of the world lead to these outcomes because they put the banking sector in a difficult position. If they don't purchase government debt, then they violate the regulatory penalty. If they purchase government debt, then the government's fiscal policy devalues their debt in the afternoon and forces losses onto the equity holders. The banks respond to this lose-lose situation by defaulting on depositors and effectively "exiting" the deposit market.

The center and right plots show how the bank behavior translates to the equilibrium prices in the morning market. The combination of repression and debt devaluation in bad states means that price of government debt once again becomes pro-cyclical. That is, so many banks default that the government loses their captive demand.

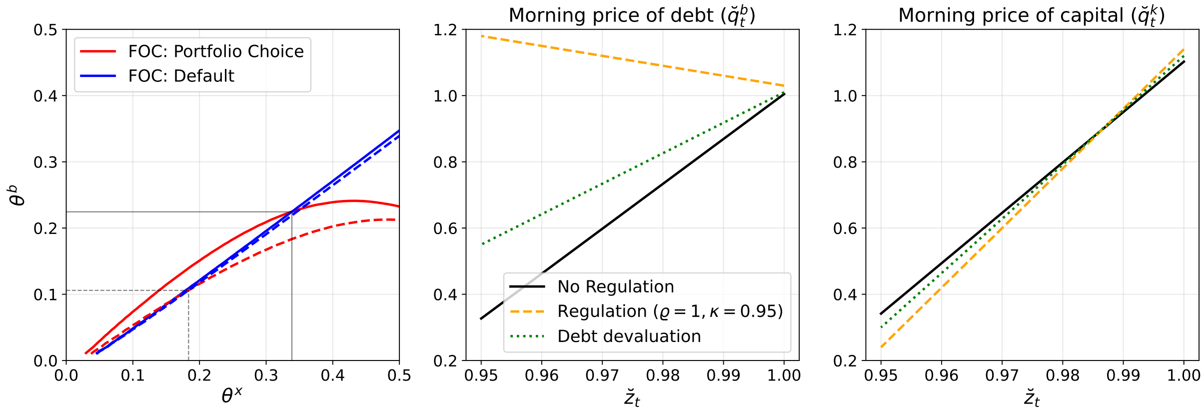

Figure 14: Morning Asset Prices With and Without Debt Devaluation.

Black line shows the morning market prices in an environment without regulation. The orange line shows the morning market asset prices in an environment with repression.

D.4 Afternoon Markets and Policy Variant Government Funding Advantage

We now return to the afternoon market to study how the frictions and regulation in the morning market can generate or erode a funding advantage for the government. To calculate the funding advantage of the government, we need to define a "synthetic" reference bond: a bond issued by the private sector and held by the banking sector that has the same payout as government debt (i.e. the same ω) but has no regulatory benefit in the morning market and is in zero-net supply. We index the bond by h and let $(\breve{q}_t^h, q_t^h)$ denote its price in the morning and afternoon markets. We define the treasury premium as $q^b(\mathbf{s}) - q^h(\mathbf{s})$ and private-public borrowing spread as:

$$\begin{aligned}\chi(\mathbf{s}) &:= -\omega \log(q^h(\mathbf{s})) - (-\omega \log(q^b(\mathbf{s}))) \\ &= \omega \log\left(\mathbb{E}\left[\xi(\mathbf{s}')\breve{M}(\mathbf{s}')\frac{\breve{q}^b(\mathbf{s}')}{\breve{q}^h(\mathbf{s}')}\breve{q}^h(\mathbf{s}') \mid \mathbf{s}\right]\right) - \omega \log\left(\mathbb{E}\left[\xi(\mathbf{s}')\breve{M}(\mathbf{s}')\breve{q}^h(\mathbf{s}') \mid \mathbf{s}\right]\right) \end{aligned} \tag{D.29}$$

where we have expanded the terms using the bank first order conditions. We interpret $\chi(\mathbf{s})$ as the model counterpart to our empirical measure of government funding advantage in Section **??**.

In our model, government funding advantage arises from the special role that government debt plays in the financial sector in the morning market. We can see this by expanding (D.29) to get the approximate expression:

$$\chi(\mathbf{s}) \approx \omega \log\left(\mathbb{E}\left[\frac{\breve{q}^b(\mathbf{s}')}{\breve{q}^h(\mathbf{s}')}\right] |\mathbf{s}\right) + \omega \mathrm{Cov}\left(\frac{\xi(\mathbf{s})\breve{M}(\mathbf{s})\breve{q}^h(\mathbf{s}')}{\mathbb{E}[\xi(\mathbf{s}')\breve{M}(\mathbf{s}')\breve{q}^h(\mathbf{s}')]}, \frac{\breve{q}^b(\mathbf{s})/\breve{q}^h(\mathbf{s}')}{\mathbb{E}\left[\breve{q}^b(\mathbf{s}')/\breve{q}^h(\mathbf{s}')\right]}\right)$$

So, the government's funding advantage arises from the average appreciation of government debt in the next period's morning markets and the covariance between government debt appreciation and the bank's marginal valuation of additional resources. By introducing regulation that ensures that re-trading government debt is valuable in bad times, the government introduces a positive covariance and so introduces a government borrowing cost advantage. That is, regulation makes government debt a particularly "good-hedge" for mitigating the banking sector's frictions in the morning market and so earns a premium.

D.5 Impact of Government Policy Changes

In this section, we use our model to return to the question of how government policy interacts with government funding advantage. This allows us to make precise the reduced form analysis of policy changes. Figure 15 reconstructs the analogous plots using an uncalibrated version of our model. The left plots show the equilibrium relationship between spreads and debt-to-GDP while the right plots show the equilibrium relationship between debt-to-GDP and convenience revenue. The black line show a baseline case with $\kappa = 0.8$ (a moderate incentive to hold government debt) and $\sigma^z = 0$ (no covariance between debt issuance and the business cycle).

The top panel shows the impact of an increase in regulatory incentives to hold treasuries (an increase in κ from 0.8 to 0.95). As discussed in the previous sections, this induces a positive feedback loop in our model: introducing financial repression that makes government debt a good hedge leads to banks issuing more deposits and taking more leverage, which in turn means that the banks are dependent on having a good hedge. In this sense, the government can use the frictions in the interbank market to create additional demand for government debt. Ultimately, this increases government fiscal capacity by shifting up the equilibrium relationships between χ and debt-to-GDP and convenience revenue and debt-to-GDP.

The bottom panel shows the impact of an increase in σ^z, which means that the government issues additional debt during bad states of the world and so devalues afternoon prices in bad states of the world. This induces the negative feedback loop in our model: introducing financial repression and while running fiscal policy that devalues government debt in bad states of the world forces banks to take losses. Instead of crowding into the government debt market, the banks default on deposits and essentially exit the market. In this sense, the additional demand for government debt collapses under fiscal policies that do not protect the long-run value of debt. Ultimately, this decreases government fiscal capacity by shifting down the equilibrium relationships between χ and debt-to-GDP and convenience revenue and debt-to-GDP.

Taken together, we can see that our model gives the government both the strength to create a funding advantage but also makes the funding advantage fragile—the government must run fiscal policy that supports the longer term value of government debt.

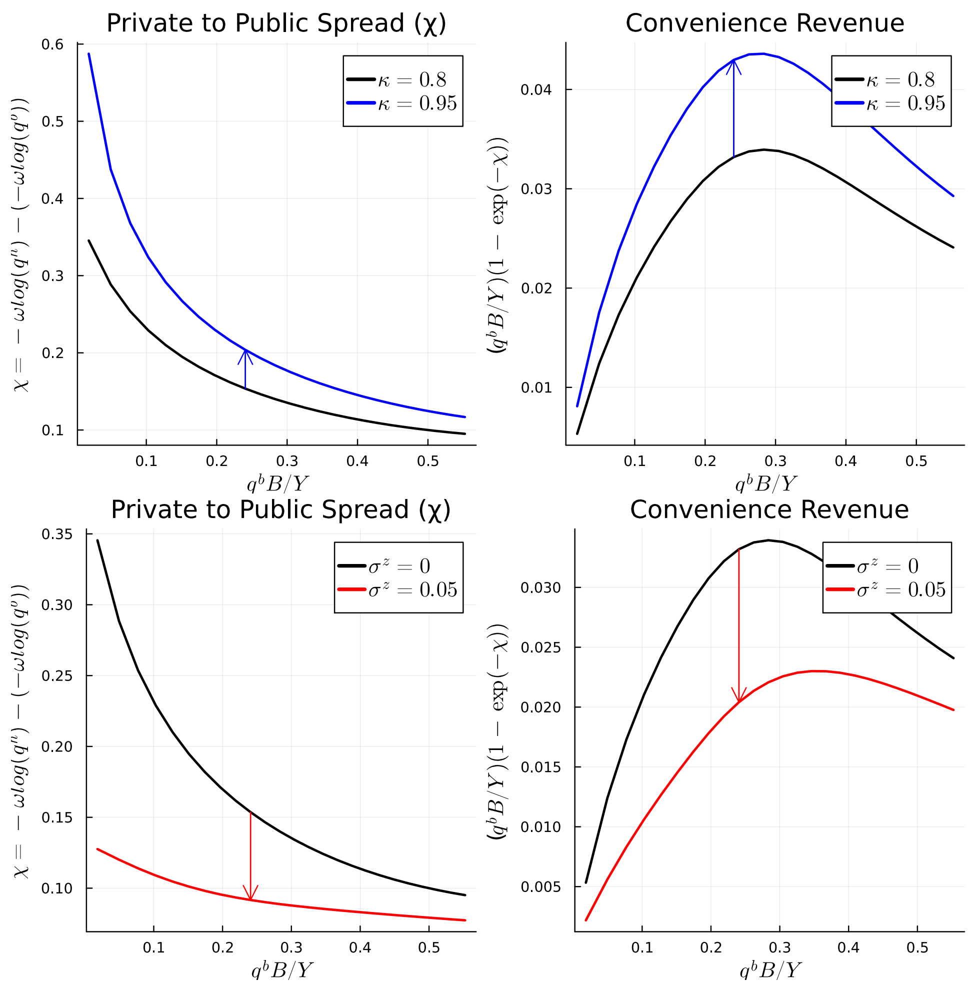

Figure 15: Policy Experiments in Our Model