On the Optimality of Financial Repression

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When is financial repression—namely, policies that force banks to hold government debt—optimal? With commitment, such policies are never optimal because they crowd out banks' productive investments. Without commitment, they are optimal when governments need to issue unusually large amounts of debt, such as during wartime. In such times, repression allows governments to credibly issue more debt. Repression increases credibility because when banks hold government debt, defaults dilute net worth, reduce investment, and are thus costly ex post. Forcing banks to hold debt endogenously increases these ex post costs but has ex ante costs because doing so crowds out investments.

I. Introduction

Financial repression generally refers to a wide array of government policies that restrict the activities of financial intermediaries. Here we focus on implicit or explicit government policies that require banks and other

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financial intermediaries to hold more government bonds than they would absent such policies. In this paper, we refer to these particular policies as *financial repression*.

We present evidence that governments are most likely to engage in financial repression when their fiscal needs are exceptionally high, such as during wartime. During such times, governments issue exceptionally large amounts of debt. After such needs subside, governments run down their accumulated debt, reduce the extent of repression, and eventually cease it altogether when the level of debt is sufficiently low.

Here we ask when, if ever, this pattern is optimal. The idea animating our two main results is that repression is a costly way to purchase credibility, in that it has ex ante costs but increases ex post credibility about not defaulting. Our first main result is that financial repression is never optimal with commitment because it is costly and credibility is not an issue. Our second main result is that without commitment, credibility is particularly valuable in abnormal times with exceptionally high fiscal needs and less valuable in normal times. Thus, incurring the costs of purchasing credibility is worthwhile only in exceptional times, so the pattern described above is optimal.

To address the evidence on financial repression, we need a model in which banks play an essential role. We use a version of the model of Gertler and Kiyotaki (2010) because in that model, banks play an essential role in channeling funds from households to firms. Banks face a collateral constraint so that the funds they can allocate to government debt and to new investment is limited by their net worth. The key feature of the model that we use is that reductions in bank net worth reduce household welfare by reducing investment.

We consider a closed-economy model in which a government maximizes household welfare by smoothing tax distortions over time in order to finance fluctuating government expenditures. The instruments available to the government include the standard ones: proportional taxes on labor income and capital and government debt. To these standard instruments we add that the government can practice financial repression by forcing banks to hold a certain fraction of their assets as government debt, that it can default on the debt it issues, and—if it does default—that it can restore banks' net worth through a bailout. Note that these bailouts effectively allow the government to practice *discriminatory default* by defaulting on debt held by households but not on that held by banks.[1]

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[1] We follow a long tradition in the Ramsey literature of restricting the instruments of the government to exclude either direct or indirect forms of lump-sum taxes. In particular,

In our model, the return on investing in capital is higher than the return on investing in government debt, so banks will not hold government debt unless forced to do so. Forcing banks to hold debt through financial repression has *ex ante crowding-out costs* because, for a given amount of net worth, this policy distorts the portfolios of banks by diverting scarce funds from investment to government debt. Repression is also a potential source of revenue: forcing banks to hold government debt at low interest rates, such as rates below those on deposits, lowers the cost of government debt.

With commitment, financial repression is not optimal regardless of fiscal needs, and all government debt should be held by households. The revenues raised by forcing banks to hold government debt at low interest rates can be raised more efficiently by simply taxing banks on their assets and having all debt held by households. This latter policy does not require an inefficient portfolio allocation and thus avoids ex ante crowding-out costs.

Without commitment, the commitment policy is not feasible when the debt level is high. The reason is that when the currently issued debt is held solely by households, then in the next period the government is tempted to default because a default on household debt is equivalent to an ex post lump-sum tax. If instead the debt is held partly by banks, this incentive to default is reduced. To understand how it enhances credibility, let us contrast the temptation to default in the next period when the government forces banks to hold part of the currently issued debt to the temptation when the government does not do so. This temptation is measured by the ex post gains to default.[2]

Consider first the ex post gains to default without bailouts. When some of the debt is held by banks, these gains are smaller than when none is, because default reduces the net worth of banks, which in turn reduces investments. This *net worth dilution* channel from default reduces the temptation to default and reduces it even more as the fraction of total debt held by banks becomes greater.

Consider next these ex post gains with bailouts. When some of the debt is held by banks, bailing out this debt means that the government effectively ends up defaulting on only part of the total debt and thus reduces distorting taxes by a smaller amount than when all debt is held by households. This *partial default channel* also implies that the temptation to default is smaller when some debt is held by banks.

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whereas we allow the government to force banks to hold government debt at below-market rates, we do not allow the government to force households to hold government debt at below-market rates since doing so is obviously equivalent to a lump-sum tax.

[2] Note that while the temptation to default is central to the analysis, default does not occur in equilibrium. We deliberately formulated a model with no default in equilibrium because defaults rarely occurred in the developed economies during the time period on which we focus.

In either case, by reducing the temptation to default, repression allows the government to purchase credibility and thereby raise more revenues from issuing debt. Purchasing this credibility is costly because repression has ex ante crowding-out costs. In determining how much credibility to purchase, the government balances the tax-smoothing gains made possible from issuing additional debt against the crowding-out costs of practicing repression. When spending needs are exceptionally high, tax-smoothing gains are large relative to the crowding-out costs, so the government would like to issue a large amount of debt and can do so only by practicing repression. For the same tax-smoothing reasons, once spending returns to normal levels, the government chooses to reduce debt and hence reduce repression slowly over time. When the debt level falls to a sufficiently low level, tax-smoothing gains are small relative to the crowding-out costs, and the government ceases to practice financial repression altogether.

Formally, we allow for standard reputational concerns in the form of trigger strategies. These concerns allow the government to credibly issue a positive but limited amount of debt and achieve modest tax smoothing without financial repression. We model reputational concerns using the concept of sustainable equilibrium of Chari and Kehoe (1990). In the sustainable equilibrium we consider, any deviations of the government from its prescribed path of policy lead private agents to expect that the government will revert to its Markov strategies. That is, any deviation by the government triggers a switch to the Markov equilibrium, in which the government defaults on debt in every period and may or may not bail out banks.

These expectations of reversion to the Markov equilibrium impose a *sustainability constraint* on the government: any plan it chooses must be such that at each date, the continuation value under that plan is higher than that from reverting to the Markov equilibrium. If the inherited debt is sufficiently small, the gains from reducing distorting taxes associated with a default outweigh the losses from the inability to sell debt to households in the future. Financial repression relaxes the sustainability constraint by reducing the value of the Markov equilibrium relative to that of the continuation of the sustainable equilibrium.

To keep the exposition simple, we focus mostly on the case of deterministic cycles in government spending but then show that our results generalize to the stochastic case. Also, we show in the appendix (available online) that if we replace the cycles in spending with cycles in productivity, all of our results go through.

Our simple model abstracts from any reason for banks to willingly hold debt other than its rate of return. Hence, in our model when the return on government debt is lower than the return on other assets, such as capital, banks never willingly hold debt. In practice, of course, even in

such circumstances, banks may willingly hold government debt when this debt has other benefits, such as greater liquidity. In the appendix, we show that our main results continue to hold when we introduce liquidity reasons for banks to hold debt.

We also abstract from taxes on deposits. In particular, we do not let the government tax away the payments of a bank to its depositors and return the proceeds to that bank, so that the bank is effectively defaulting on its depositors. In the appendix, we extend our model to give the government such a policy and provide sufficient conditions for our results to hold.

Throughout, we focus attention on public finance considerations in determining the extent of financial repression. Of course, governments might force banks to hold government debt for other reasons, including safety and soundness considerations. Our model should be thought of as determining the extent of financial repression above and beyond such considerations. We conjecture that introducing these other considerations will not alter the basic thrust of our results. An alternative interpretation, emphasized by Reinhart and Sbrancia (2011), Allen (2014), and Reinhart, Reinhart, and Rogoff (2015), is that many regulations that are ostensibly intended to promote safety and soundness are primarily a form of disguised financial repression.

Note that in this model, the lack of commitment by the government gives rise to a free-rider problem. In our model, each bank is owned by a household, and all households are made better off if all banks hold the appropriate amount of government debt. Each household, however, would prefer that its bank hold no government debt and earn higher rates of return by devoting more of its net worth to funding lucrative investment rather than holding low-yielding government bonds. Compelling all banks to hold government debt solves this free-rider problem.

II. Evidence for Our Model Ingredients

The key building block of our model is that reductions in bank net worth reduce aggregate investment. This idea dates back to at least Fisher (1933) and was formalized by Bernanke and Gertler (1989), Carlstrom and Fuerst (1997), and Bernanke, Gertler, and Gilchrist (1999). More recently, Gertler and Kiyotaki (2010), Gertler, Kiyotaki, and Queralto (2012), Pei (2014), Bocola (2016), and Farhi and Tirole (2016) show that shocks that reduce the net worth of financial intermediaries such as banks lead to output downturns by affecting the ability of these intermediaries to intermediate funds.

In our model, one important force is that ex post default on debt held by banks is costly. Bocola (2016) provides empirical support for this force by estimating a version of the Gertler and Kiyotaki (2010) model without

optimizing governments and showing that reductions in the value of government debt induced by expectations of future default lead to output downturns by reducing the net worth of banks. Baskaya and Kalemli-Ozcan (2015) provide empirical support by showing that banks that are more exposed to government debt curtail their lending more when faced with unanticipated shocks to the value of this debt. Gennaioli, Martin, and Rossi (2014b) use a panel of developed and emerging economies to show that declines in private credit after a default are stronger in countries where banks hold more public debt. Finally, Gennaioli, Martin, and Rossi (2014a) use data from 20,000 banks in a large panel of countries to show that, even within the same country, banks that hold relatively more government debt reduce their lending relatively more following defaults.

A second important force in our model is that repression has ex ante crowding-out costs because it crowds out private investment. Becker and Ivashina (2014) provide empirical support for this force by showing that in Europe, in the wake of the recent Great Contraction, increased government bond holdings by banks crowded out corporate lending.

III. Financial Repression in Practice

Consider some evidence for the patterns of debt and financial repression that we study. We begin by considering evidence for the patterns of debt after periods of exceptional fiscal stress and the associated need to issue large amounts of debt brought on by large government expenditures during wars. The left panel of figure 1 shows that in the United States, the fraction of government debt held by banks was very high immediately after World War II and then gradually fell over the next few decades. The right panel of figure 1 shows that US government debt relative to GDP and the bank holdings of government debt relative to bank assets fell gradually in the decades following World War II. Reinhart and Rogoff (2009), Reinhart (2010), and Reinhart and Sbrancia (2011) show that government debt relative to GDP in the Allied countries fell gradually in the wake of World War II.

Consider next the evidence that this pattern of debt was accompanied by a corresponding pattern of financial repression. Reinhart, Reinhart, and Rogoff (2015, 34) argue that "the widespread system of financial repression that prevailed worldwide from 1945 to the early 1980s likely played an instrumental role in reducing or liquidating the massive stocks of debt accumulated in many of the advanced countries during World War II, the United States inclusive." Reinhart and Sbrancia (2011) argue that after World War II, many of the Allied countries undertook regulatory measures that required financial institutions to hold government debt in their portfolios and limited the ability of consumers and financial intermediaries to invest in substitutes for their own government's debt.

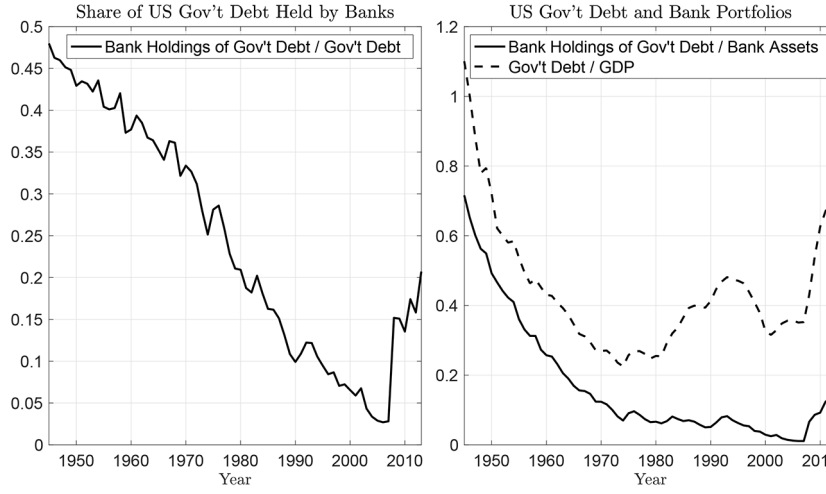

FIG. 1.—Share of US federal government debt held by banks. Sources: government debt from US Flow of Funds, table L106; bank holdings from US Flow of Funds, table L110 (https://www.federalreserve.gov/apps/fof/FOFTables.aspx).

For complementary evidence of this pattern of financial repression in the post–World War II era, Allen's (2014) comprehensive study of monetary and financial policy in Britain documents the specific policies used by the government and the Bank of England to carry out financial repression: an excessive minimum ratio of liquid reserves to deposits, a Special Deposits scheme, and Serial Funding stocks. Allen argues that most of the forms of financial repression were not legislated but rather were implemented by recommendations from the Bank of England. Banks followed these recommendations because of Clause 4 of the Bank of England Act of 1946, which allowed the Bank of England to "make recommendations to bankers" to take actions in the public interest and, if these recommendations were not followed, to "issue directions to any banker for the purpose of securing that effect" with the approval of the Treasury.

For more recent evidence, Reinhart, Kirkegaard, and Sbrancia (2011) document that in the wake of the recent Great Contraction, in the face of severe fiscal stress, numerous countries have issued substantial amounts of debt and reinstituted various measures of financial repression. Becker and Ivashina (2014) and Broner et al. (2014) show that banks in the periphery countries of the European Union sharply increased their holdings of their own governments' debts. Finally, Acharya and Steffen (2015), De Marco and Macchiavelli (2015), Horvath, Huizinga, and Ioannidou (2015), and Ongena, Popov, and Van Horen (2019) present evidence that a significant fraction of the buildup of their own country's government debt by banks in the periphery countries of Europe during the

Great Recession was due to political pressure by periphery country governments.

We discuss other related literature in section VIII, and in the appendix, we discuss evidence from economic historians that financial repression dated back to the beginning of the banking systems in England, France, and the United States and was especially pervasive in times of fiscal stress.

IV. Environment

Consider an infinite horizon economy that blends elements of Lucas and Stokey (1983) with those of Kiyotaki and Moore (1997), Gertler and Kiyotaki (2010), Gertler and Karadi (2011), and Gertler, Kiyotaki, and Queralto (2012). The economy is composed of a household that works, saves, consumes, and operates financial intermediaries, referred to as *banks*, together with firms and a government. Households save by holding deposits in banks and government debt. Banks raise deposits from households and use these deposits, together with retained earnings, to invest in government debt and capital as well as to pay dividends to households. The government finances an exogenous stream of government spending with taxes on labor and capital, sells government debt, and can practice financial repression by requiring that banks must hold at least a certain fraction of their assets in government debt. The government can also engage in bailouts to banks in the event that it defaults on the debt.

The resource constraint is given by

$$C_t + \frac{K_{t+1}}{R_K} + G_t \leq F(K_t, L_t), \tag{1}$$

where $F(K, L) = K + L$, C_t is aggregate consumption, K_{t+1} is the capital stock, G_t is government spending, and L_t is aggregate labor. Note that one unit of goods invested in capital at t produces R_K units of goods at $t + 1$. We assume that investment in capital is worthwhile in that $\beta R_K > 1$, where β is the discount factor of the household. Throughout, we focus on interior equilibria in which consumption and capital are positive in all periods.

The representative household is composed of a measure 1 of consumers, all of whom supply labor and return their wages to the household. The household has a utility function given by $\Sigma_{t=0}^{\infty}\beta^t U(C_t, L_t)$, where C_t and L_t denote the household's consumption and labor supply and $U(C, L) = C - v(L)$. The assumption that the utility function is linear in consumption ensures that the equilibria we consider take particularly simple forms and allows us to characterize the equilibria analytically.

Given initial asset holdings B_{H0} and D_0, each household maximizes utility by choosing consumption, labor, government debt, and deposits $\{C_t, L_t, B_{Ht+1}, D_{t+1}\}$, subject to the budget constraint

$$C_t + \frac{B_{Ht+1}}{R_{t+1}} + \frac{D_{t+1}}{R_{Dt+1}} \leq (1 - \tau_t)L_t + \delta_t B_{Ht} + D_t + X_t - \frac{1 - \sigma}{\sigma}\bar{n}, \quad (2)$$

the constraint that $B_{Ht+1} \geq 0$ so that consumers cannot borrow from the government, and the no-Ponzi-scheme constraint $D_{t+1} \geq \bar{D}$, where $\bar{D}$ is a large negative constant.

In the budget constraint, R_{t+1} and R_{Dt+1} are the gross rates of return on government debt and deposits. Buying one unit of government debt at t at price $1/R_{t+1}$ entitles the household to δ_{t+1} units of goods at $t + 1$, where $\delta_{t+1} \in \{0, 1\}$, $\delta_{t+1} = 1$ signifies that the government repays its debt to households at $t + 1$, and $\delta_{t+1} = 0$ signifies that it defaults. Notice that the *effective return to households* of holding government debt from period t to period $t + 1$ is $\delta_{t+1}R_{t+1}$. Buying one unit of deposits at t at price $1/R_{Dt+1}$ entitles the household to one unit of goods paid by the bank at $t + 1$. Also, τ_t is the labor income tax, the real wage is 1, and X_t are the aggregate dividends paid by banks. A measure $(1 - \sigma)/\sigma$ of newly formed banks are created in each period, each of which receives $\bar{n}$ in initial equity, so $(1 - \sigma)\bar{n}/\sigma$ is the total equity given to new banks.

Since households can use deposits to save or borrow, and since we focus on interior equilibria in which consumption is positive in all periods, the rate of return on deposits is $R_{Dt+1} = 1/\beta$. Since households can use government debt to save but not to borrow, the rate of return on government debt cannot exceed that of deposits, so that the inequality $\delta_{t+1}R_{t+1} \leq R_{Dt+1}$ must hold and must hold with equality if $B_{Ht+1} > 0$. Moreover, if households expect the government to default, then they will hold no government debt; that is, if $\delta_{t+1} = 0$, then $B_{Ht+1} = 0$. We refer to the last two conditions as the *complementary slackness conditions*. The first-order condition for labor is

$$v'(L_t) = 1 - \tau_t. \quad (3)$$

Next, consider the banks. In each period t, each bank chooses capital, k_{t+1}; government debt, b_{Bt+1}; deposits, d_{t+1}; and dividends, x_t. Whenever the government defaults on its debt by setting $\delta_t = 0$, it can choose to bail out the banks. Let $\iota_t = 1$ indicate a bailout and $\iota_t = 0$ indicate no bailout. In the event of a bailout, each bank receives its promised payments b_{Bt+1}. Notice that allowing bailouts effectively allows for discriminatory default; that is, the government can default on debt held by households but then effectively not default on bank debt by bailing out banks.

At the beginning of each period, an idiosyncratic random variable is realized at each existing bank that indicates whether it will survive to the next period. With probability σ, the bank will continue in operation until the next period. With probability $1 - \sigma$, the bank ceases to exist and pays out all of its accumulated net worth as dividends to the household. Since only a fraction σ of the $(1 - \sigma)/\sigma$ newborn banks survive until the

end of the period, the measure of surviving banks is always constant at 1. This device of having banks die is a simple way to ensure that they do not build up enough equity to make the financial constraints we next introduce irrelevant.

Now consider the problem of a bank. A bank that ceases to operate in period t pays out its accumulated net worth n_t as dividends. Banks that continue to operate in t choose the amount of dividends x_t to pay. The problem of a bank born in period s is

$$v_s(\bar{n}) = \max_{\{x_t, k_{t+1}, b_{Bt+1}, d_{t+1}\}} \sum_{t=s}^{\infty} (\beta\sigma)^{t-s}[\sigma x_t + (1-\sigma)n_t], \tag{4}$$

subject to the *budget constraint*

$$x_t + (1+\tau_{Kt})\frac{k_{t+1}}{R_K} + \frac{b_{Bt+1}}{R_{t+1}} - \frac{d_{t+1}}{R_{Dt+1}} \leq n_t, \tag{5}$$

the *collateral constraint*

$$d_{t+1} \leq \gamma\{k_{t+1} + [\delta_{t+1} + \iota_{t+1}(1-\delta_{t+1})]b_{Bt+1}\}, \tag{6}$$

where $0 < \gamma < 1$, the *regulatory constraint* $b_{Bt+1} \geq \phi_t(k_{t+1} + b_{Bt+1})$, and nonnegativity constraints on dividends and bond holdings. Here the tax on capital is τ_{Kt}; the net worth for a newborn bank at s is $n_s = \bar{n}$; and for $t > s$, the net worth of an ongoing bank is $n_t = k_t + [\delta_t + \iota_t(1-\delta_t)]b_{Bt} - d_t$. Note that households and banks discount the future in the same way. We can write the continuation value of a surviving bank at t with inherited net worth n_t in a similar fashion.[3]

The regulatory constraint requires the bank to hold at least a fraction ϕ_t of its assets in government debt. Here, ϕ_t measures financial repression: whenever $\phi_t > 0$, we say that the government is practicing financial repression, and the higher the ϕ_t, the greater the degree of such repression. The most useful way to think about a binding regulatory constraint is to write it as $b_{Bt+1} = [\phi_t/(1-\phi_t)]k_{t+1}$, which means that the government is forcing each bank to acquire $\phi_t/(1-\phi_t)$ units of additional government debt whenever that bank increases k_{t+1} by one unit.

We assume throughout that $\gamma\beta R_K < 1$. This assumption will imply that the bank's collateral constraint is binding. Inspection of the bank's problem shows that it is linear in net worth. The following lemma characterizes key features of the solution to a bank's problem, where $R^e_{t+1} \equiv [\delta_{t+1} + \iota_{t+1}(1-\delta_{t+1})]R_{t+1}$ is the *effective rate of return for banks* from holding government debt. The proof is immediate.

[3] We have assumed that banks do not offer deposit contracts with payoffs that depend on whether the government defaults. As we show below, there are no defaults along the equilibrium path, and hence banks have no incentives to offer such contracts. Thus, if there is any cost to offering such contracts, no bank will do so.

LEMMA 1 (Characterization of the bank's problem). Ongoing banks prefer not to pay dividends. If $k_{t+1} > 0$, the after-tax return on capital must be at least as large as the return on deposits in that $R_K/(1 + \tau_{Kt}) \geq R_{Dt+1}$. If this inequality is strict, then the collateral constraint must be binding. If the after-tax return on capital exceeds the effective rate of return on debt—namely, $R_K > R^e_{t+1}$—then banks will hold government debt only if the government practices financial repression.

Finally, the *budget constraint of the government* is

$$G_t + \delta_t(B_{Ht} + B_{Bt}) + \iota_t(1 - \delta_t)B_{Bt} \leq \tau_t L_t + \tau_{Kt}\frac{K_{t+1}}{R_K} + \frac{B_{Ht+1} + B_{Bt+1}}{R_{t+1}}, \quad (7)$$

where B_{Bt} is the aggregate amount of debt held by banks. We assume that B_{Ht+1} and B_{Bt+1} are bounded by some large positive constant $\bar{B}$. We assume that the levels of government spending and the initial debt are small enough so that it is always feasible to finance any government debt by the present discounted value of tax revenues from labor and capital.

The competitive equilibrium starting in any period t is defined in the standard fashion. In it, the period t policy of the government is $\pi_t = (\delta_t, \iota_t, \tau_t, \tau_{Kt}, B_{Ht+1}, B_{Bt+1}, R_{t+1}, \phi_t)$, and the period t allocations are $Y_t = (C_t, L_t, K_{t+1}, D_{t+1})$.

We next turn to characterizing the set of allocations and prices that can be implemented as a competitive equilibrium. For any period $t \geq 1$, substituting the household first-order condition for labor (eq. [3]) into the government budget constraint (eq. [7]) implies that an equilibrium must satisfy an equilibrium version of the budget constraint of the government,

$$G_t + \delta_t(B_{Ht} + B_{Bt}) + \iota_t(1 - \delta_t)B_{Bt} = (1 - v'(L_t))L_t + \tau_{Kt}\frac{K_{t+1}}{R_K} + \frac{B_{Ht+1} + B_{Bt+1}}{R_{t+1}}, \quad (8)$$

along with the bound $B_{t+1} \leq \bar{B}$. Next, adding the budget constraints of newborn and continuing banks, using $R_{Dt+1} = 1/\beta$ and the result from lemma 1 that we can set bank dividends to zero yields the *aggregate budget constraint for banks*:

$$(1 + \tau_{Kt})\frac{K_{t+1}}{R_K} + \frac{B_{Bt+1}}{R_{t+1}} - \beta D_{t+1} \leq \sigma N_t + (1 - \sigma)\bar{n}, \quad (9)$$

where $N_t = K_t + [\delta_t + \iota_t(1 - \delta_t)]B_{Bt} - D_t$ is the aggregate net worth of ongoing banks. Adding across the collateral constraints gives the *aggregate collateral constraint for banks*:

$$D_{t+1} \leq \gamma\{K_{t+1} + [\delta_{t+1} + \iota_{t+1}(1 - \delta_{t+1})]B_{Bt+1}\}. \quad (10)$$

Next, since consumption is positive in each period, the complementary slackness conditions from the household's problem must hold.

For investment to be positive in each period, the return to holding the composite portfolio of capital and debt must be weakly greater than the return on deposits, so that the following condition must hold:

$$\frac{1+\tau_{Kt}}{R_K}+\frac{B_{Bt+1}}{K_{t+1}}\frac{1}{R_{t+1}} \leq \beta\left\{1+\frac{B_{Bt+1}}{K_{t+1}}[\delta_{t+1}+(1-\delta_{t+1})\iota_{t+1}]\right\}. \quad (11)$$

Here we used the implication of the regulatory constraint that $\phi_t/(1-\phi_t) = B_{Bt+1}/K_{t+1}$. Since repression forces banks to hold $\phi/(1-\phi)$ units of debt for every unit of capital, the left side of condition (11) is the total cost in period t of a portfolio with one unit of capital and the minimum bond holdings needed to satisfy the regulatory constraint, and the right side is the total payments to that portfolio discounted back to period t.

We refer to the resource constraint (eq. [1]), together with the constraints $R_K \geq R^e_{t+1}$ (eqq. [8]–[11]) and the complementary slackness constraints, as the *implementability constraints*. Clearly, the implementability constraints are necessary for a competitive equilibrium. In the next lemma, we show that they are also sufficient.

LEMMA 2 (Characterization of competitive equilibrium). A set of aggregate allocations and policies is part of a competitive equilibrium if and only if it satisfies the implementability constraints.

To prove sufficiency, we need to construct the tax rate on labor and the regulatory policy and show that we can construct profit-maximizing allocations for individual banks from the aggregate allocations. The tax rate on labor and the regulatory policy can be constructed immediately. The linearity of the banks' policy functions makes it possible to construct such individual bank allocations.

V. Equilibrium with Commitment

We now turn to characterizing the best equilibrium under commitment—namely, the *Ramsey equilibrium*. This equilibrium is defined as the competitive equilibrium that yields the highest utility for households. We can think of this equilibrium as one in which the government chooses its policies for all periods once and for all in period 0. In this equilibrium, the government uses all of its instruments in an optimal way to raise the needed revenue with minimum distortions.

The Ramsey problem for this economy is to maximize household utility subject to the implementability constraints. The Ramsey outcome is the solution to this problem. (See Chari and Kehoe 1999 for an introduction to Ramsey problems.)

PROPOSITION 1 (Financial repression not optimal with commitment). The Ramsey outcome has no financial repression; that is, $\phi_t = 0$ for all t. Furthermore, for all t, the aggregate collateral constraint on banks binds, banks hold no government debt, and $R_{t+1} = R_{Dt+1} = 1/\beta$.

The proof of this result and other results, except where noted, are in the appendix. This result is not obvious, because one might think that whether a given tax is used depends on the usual elasticity considerations, which in turn depend on the details of technology and preferences. One might therefore think that for at least some parameter values for our economy, these considerations would imply that financial repression is desirable. As our proposition shows, this logic is incorrect.

Indeed, one might think that financial repression is useful because it helps to raise revenues: the government can force banks to hold its debt at below-market rates and therefore fund its debt cheaply. While it is true that such repression helps to raise revenues, it also introduces two distortions: it effectively taxes banks' assets, and it crowds out capital by diverting net worth from investment in capital to investment in government debt. An alternative instrument, a tax on capital held by banks, dominates financial repression because it taxes banks' assets without diverting funds away from investment. We conjecture that this logic is very general.[4] Hence, it is not optimal for the government to force banks to hold its debt at below-market rates.

It is also not optimal for the government to force banks to hold its debt at market rates—namely, when $R_{t+1} = R_{Dt+1} = 1/\beta$. The basic idea of the proof in this case is that since the collateral constraint is binding, financial repression has *crowding-out costs* for the economy as a whole: when banks are forced to hold debt, they cannot simply raise more deposits and hence must decrease their investments. Indeed, we can improve upon an allocation in which banks are forced to hold debt by the following variation: reduce repression by requiring that banks hold one less unit of debt, reduce deposits by one unit, and increase household holdings of debt by one unit. This variation relaxes the collateral constraint by decreasing the left side of it by more than its right side. It otherwise leaves the unaffected original allocations since it keeps unaffected the total savings of households, the total resources of banks available for investment, and the total government debt. Since the collateral constraint is now slack, we can alter this variation to strictly improve welfare. A similar argument applies when the interest rate on government debt is either higher or lower than the return on deposits.

Next, we set up and then establish the following further characterization of the Ramsey problem under a sufficient condition developed below

[4] A related literature, including McKinnon and Mathieson (1981), Brock (1989), and Bencivenga and Smith (1992), shows that financial repression is optimal if the government has access to only a limited set of fiscal instruments. In particular, this literature does not allow for a tax on the total assets of banks. We argue that in the context of financial repression, a tax on bank assets is a natural one for the government to be able to use; to exercise financial repression, the government needs to be able to monitor banks' total assets. Once total assets can be monitored, clearly levying a tax on these assets is possible.

that we call the *high marginal value of net worth* condition, which ensures that capital taxes are zero.

PROPOSITION 2 (Initial default and tax smoothing). The Ramsey outcome has default on initial debt and perfect tax smoothing. Under the high marginal value of net worth condition, capital taxes are zero. Moreover, if B_{B0} is below a critical level B_{B0}^{*}, it is optimal to initially bail out banks and not otherwise.

That the Ramsey outcome has default on initial debt and tax smoothing is completely standard (see Barro 1979; Lucas and Stokey 1983). Here, the presence of the collateral constraint implies that optimal taxation must take into account the effects of taxes on net worth. For example, whether it is optimal to initially bail out banks depends on the magnitude of the distortions from diluting net worth relative to those from taxing labor income.

To prove this proposition, we show that the Ramsey problem is simply to solve

$$\max_{\{T_t\},\delta_0,\iota_0} \sum_{t=0}^{\infty} \beta^t (W(T_t) - G_t) + A_R + K_0 + A_N N_0, \tag{12}$$

subject to the present-value version of the government budget constraint,

$$\sum_{t=0}^{\infty} \beta^t G_t + \delta_0 B_0 + (1 - \delta_0)\iota_0 B_{B0} \leq \sum_{t=0}^{\infty} \beta^t T_t, \tag{13}$$

where in the objective function, the initial net worth $N_0 = K_0 + \delta_0 B_{B0} + \iota_0(1 - \delta_0)B_{B0} - D_0$. Here, T_t denotes tax revenues from labor taxation. The function W and the constants A_R and A_N are developed below.

To show that the objective function reduces to problem (12), we use our form for utility and production together with the resource constraints to decompose the value of the objective function of the Ramsey planner into three terms,

$$\sum_{t=0}^{\infty} \beta^t (C_t - v(L_t)) = \sum_{t=0}^{\infty} \beta^t \left(K_t - \frac{K_{t+1}}{R_K} \right) + \sum_{t=0}^{\infty} \beta^t (L_t - v(L_t)) - \sum_{t=0}^{\infty} \beta^t G_t. \tag{14}$$

Using the result that the Ramsey equilibrium has no financial repression, the provisional assumption that capital taxes are zero, and the result that in a competitive equilibrium the collateral and regulatory constraints both bind, we can combine the implementability constraints to derive simple laws of motion for aggregate net worth and aggregate capital—namely,

$$\begin{aligned} \left(\frac{1}{R_K} - \gamma\beta \right) K_{t+1} &= \sigma N_t + (1 - \sigma)\bar{n}, \\ N_{t+1} &= (1 - \gamma)K_{t+1}. \end{aligned} \tag{15}$$

Notice that given an initial condition on N_0, these conditions recursively define the entire sequence of capital stocks. Using this recursive characterization, the first term in equation (14), called the *capital and net worth component of consumption*, is given by

$$\sum_{t=0}^{\infty}\beta^t\left(K_t - \frac{K_{t+1}}{R_K}\right) = A_R + K_0 + A_N N_0, \tag{16}$$

where A_R and A_N are positive constants derived in the appendix. The term A_R is the present value of output that emanates from the continual injection of net worth to newborn bankers $\bar{n}$. The term $A_N N_0$ is the present value of output that emanates from initial net worth N_0 and arises because with a binding collateral constraint, an additional unit of net worth allows firms to invest more in capital that yields a strictly higher return than the cost of capital. Thus, we refer to A_N as the *marginal value of net worth.*

It is convenient to express the second term in equation (14) using a change of variables. Let the *net utility from labor* $L_t - v(L_t)$ be the part of current output that is produced by labor minus the disutility of labor. Let the government directly choose the revenues from labor $T_t = \tau_t L_t$ rather than the tax rate τ_t itself. Using equation (3), we find that the tax revenue from labor satisfies $T = \tau L = (1 - v'(L))L$, so we can let $\ell(T)$ denote the labor supply associated with labor tax revenues T, where this solution is on the upward-sloping part of the Laffer curve. Hence, the net utility from labor is given by $W(T) = \ell(T) - v(\ell(T))$. From now on, we will assume that W is strictly concave, a sufficient condition for which is that v is convex and v'' is decreasing (see result 1 in the appendix). Thus, we have shown that the Ramsey problem reduces to equation (12). Note that since there is no financial repression and $\beta R_K > 1$, then condition (11) is automatically satisfied.

To characterize the solution to this problem, note first that the first-order condition for labor tax revenues—namely, $W'(T_t) = W'(T_0)$—implies that labor tax revenues are set at a constant level T in all periods.

Consider next the determination of the initial default δ_0 and the initial bailout ι_0. Clearly, defaulting on initial household debt always improves welfare because such default is equivalent to a lump-sum tax on households. Whether a default is accompanied by a bailout of banks depends on the benefits from the reduced need to levy distorting taxes and the costs from lowering bank net worth and thus crowding out capital. Let $T_N = (1 - \beta)\Sigma_{t=0}^{\infty}\beta^t G_t$ be the constant taxes needed to finance its spending when it defaults on all debt and does not conduct a bailout, and let $T_B = T_N + (1 - \beta)B_{B0}$ denote analogous taxes with a bailout. Let the cutoff level of initial bank debt B_{B0}^* be the positive solution to

$$\frac{W(T_N)}{1-\beta} = \frac{W(T_B)}{1-\beta} + A_N B_{B0}. \tag{17}$$

The left side is the present value of net utility from raising the constant level of taxes T_N in each period. The first term on the right side is the present value of net utility of raising the higher level of constant taxes T_B needed to also bail out initial bank debt. The second term on the right side is the present value of the consumption flow that occurs from incrementing the net worth of banks by a bailout. From the concavity of W, it follows that if $B_{B0} \leq B^*_{B0}$, it is optimal to initially bail out banks and not otherwise.

Finally, the *high marginal value of net worth condition*, given by $-W'(T_B) \leq A_N/\sigma$, is sufficient to ensure that the Ramsey equilibrium has no taxes on capital. This condition implies that even at the higher level of constant taxes T_B, the marginal cost of raising another unit of labor taxes is lower than the marginal cost of raising the first unit of capital taxes, which arises from the crowding-out cost of lowering net worth. We have thus proved proposition 2.

In what follows, we assume that it is not optimal to tax capital along the equilibrium path in that a modified version of this high marginal value of net worth condition holds. Since it is not optimal to tax capital directly, it is also not optimal to tax capital indirectly by forcing banks to hold debt at a rate below $1/\beta$. Thus, $R^e_{t+1} \geq 1/\beta$, so that condition (11) is automatically satisfied and is dropped in what follows. In the appendix, we consider the more general case when it may be optimal to tax capital.

VI. Sustainable Equilibrium

We have shown that financial repression is not optimal under commitment. Here, we provide conditions under which such repression is optimal without commitment.

We consider an economy in which standard reputational considerations alone allow a government to issue a positive but limited amount of debt to households. Formally, we model reputational concerns using the concept of sustainable equilibrium of Chari and Kehoe (1990). In the sustainable equilibrium we consider, any deviations of the government from its prescribed path of policy lead private agents to expect that the government will revert to its Markov strategies. That is, any deviation by the government triggers a switch to the Markov equilibrium in which the government defaults on debt in every period and may or may not bail out banks.

These expectations of reversion to the Markov equilibrium impose *sustainability constraints* on the government: any plan it chooses must be such that at each date, the continuation value under that plan is better than reverting to the Markov equilibrium. The best sustainable outcomes maximize utility subject to the implementability constraints and the sustainability constraints. We show that the best sustainable outcome solves

a near-recursive problem. For any period $t \geq 1$, the problem is recursive. The problem in the initial period differs from the recursive continuation problem because it is possible to have an unanticipated default on inherited debt in period 0, whereas for all $t \geq 1$ it is not.

For financial repression to be used in equilibrium, such repression must make it both feasible and desirable for the government to issue more debt. Repression makes more debt feasible by relaxing the sustainability constraint. To understand why, consider moving one unit of debt from households to banks. Doing so lowers the ex post gains in the next period of defaulting, regardless of whether these gains arise from either the net worth dilution channel or the partial default channel. In terms of desirability, the marginal benefits of tax smoothing are increasing in current fiscal needs, whereas the marginal costs of repression are constant. Thus, if current fiscal needs are sufficiently high, repression is both feasible and desirable and hence is used in equilibrium.

We consider an economy that starts in a period of exceptionally large spending needs and thereafter follows a cyclical pattern. We think of this formulation as capturing the effects of transitory periods of high expenditures, such as wartime. We show that the government optimally responds by issuing an exceptionally large amount of debt in the first period and then practices financial repression for some length of time after that. During the repression phase, the government gradually reduces its debt. Eventually, the government ceases practicing financial repression, and reputation concerns alone allow the government to sustain tax-smoothing outcomes in the face of cyclical expenditures. This pattern is reminiscent of the behavior of repression and public debt we have discussed, namely, that in many of the Allied countries after World War II as well as that in the periphery states in Europe following the Great Recession.

A. *Definition of Equilibrium*

Consider now a sustainable equilibrium. Let $H_t = (S_0, \pi_0; \ldots; S_{t-1}, \pi_{t-1}; S_t)$ be the history of allocations and policies at the beginning of period t, where $S_t = (K_t, D_t, B_{Bt}, B_{Ht}, G_t)$ are the physical state variables at the beginning of period t and π_t is the policy chosen in period t. The history of allocations at the end of period t when private agents choose their actions is (H_t, π_t).

A *sustainable equilibrium* is a collection of rules for policies and allocations $\{\pi_t(H_t), Y_t(H_t, \pi_t)\}_{t=0}^{\infty}$ such that for all histories H_t, (1) the associated outcomes constitute a competitive equilibrium starting in each period t for all H_t and π_t; and (2) in each period t, given the history H_t and taking as given future policy functions, allocation rules, and pricing rules, the current policy $\pi_t(H_t)$ is optimal for the government.

We focus on sustainable equilibria that can be supported by reversion to Markov equilibria. A Markov equilibrium consists of policy rules $\{\pi_{Mt}(S_t)\}_{t=0}^{\infty}$ that depend on the current state S_t, together with allocations $\{Y_{Mt}(S_t)\}_{t=0}^{\infty}$ that depend on the current state and current policy that satisfy the same conditions 1 and 2 that the sustainable equilibrium satisfies. Specifically, we focus on sustainable equilibria for which the value of the government's problem for all histories H_t both on and off the equilibrium path satisfies the *sustainability constraint*

$$\sum_{r=t}^{\infty}\beta^{r-t}U(C_r, L_r) \geq J_{Mt}(S_t), \tag{18}$$

where the allocations $\{C_r, L_r\}_{r=t}^{\infty}$ are those induced by the equilibrium strategies from any arbitrary history H_t for all $t \geq 1$, and $J_{Mt}(S_t)$ denotes the value of the Markov equilibrium given the state S_t.

A *sustainable outcome* $\{\pi_t, Y_t\}_{t=0}^{\infty}$ is the outcome that arises along the equilibrium path induced by such an equilibrium. Standard arguments imply that an outcome $\{\pi_t, Y_t\}_{t=0}^{\infty}$ is sustainable if and only if (1) it is a competitive equilibrium in period 0, and (2) the value of the government's objective along the equilibrium outcome path in period t satisfies the sustainability constraint in period t.

Since we can summarize the competitive equilibrium by the implementability constraints, the *best sustainable outcome* solves

$$\max_{\{\pi_t, Y_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty}\beta^t U(C_t, L_t), \tag{19}$$

subject to the implementability constraints and the sustainability constraints for all $t \geq 1$.

Let $J_{S0}(S_0)$ denote the value of the best sustainable equilibrium starting from period 0. Given the best sustainable outcomes, let V_{St} denote the continuation value of these outcomes from period $t \geq 1$ onward—namely, $\Sigma_{r=t}^{\infty}\beta^{r-t}U(C_r, L_r)$.

B. Recursive Characterization of Sustainable Equilibrium

We show that the problem in equation (19) can be written as a near-recursive problem. To do so, we use one key idea: in the continuation of the best sustainable equilibrium, the value of a plan in which the government is restricted to not defaulting in all periods except the initial one, so that $\delta_t = 1$ for all $t \geq 1$, coincides with the value of a plan without this restriction.

To understand this key idea, note that in period t there are three possibilities for anticipated policies in period $t + 1$: the government will not default, will default and bail out the banks, or will default and not bail out the banks. In either case with default, households will hold no government debt, so we can simply set $B_{Ht+1} = 0$. Next, from the banks' point

of view, defaulting and bailing out is equivalent to not defaulting in the first place. Hence, in both of these cases, it is without loss of generality to restrict attention to allocations with no default in the continuation problem.

The only subtle case is when the government defaults and does not bail out the banks, which means that the government is raising revenue from the banks. In this case, for reasons similar to those discussed under commitment, even if the government wanted to raise revenues from the banks, it would prefer to do so by directly taxing capital and not defaulting rather than through repression followed by defaults and no bailouts. Hence, in this case it is also without loss of generality to restrict attention to allocations with no default in the continuation problem. We have shown that the solution to equation (19) coincides with the solution to a restricted problem in which $\delta_t = 1$ for all $t \geq 1$.

Given this result, standard dynamic programming arguments imply that from period $t \geq 1$, the continuation of equation (19) solves a recursive problem, the *continuation problem*,

$$V_{St}(S_t) = \max_{\tilde{\pi}_t, Y_t} U(C_t, L_t) + \beta V_{St+1}(S_{t+1}), \tag{20}$$

subject to the implementability constraints in period t and a recursive sustainability constraint $V_{St+1}(S_{t+1}) \geq J_{Mt+1}(S_{t+1})$, where the policy $\tilde{\pi}_t$ is restricted to have $\delta_t = 1$.[5] The best sustainable problem (eq. [19]) is then given by the solution to a near-recursive problem, the *sustainable problem*,

$$J_{S0}(S_0) = \max_{\pi_0, Y_0} U(C_0, L_0) + \beta V_{S1}(S_1), \tag{21}$$

subject to the implementability constraints in period 0 and a recursive version of the sustainability constraint $V_{S1}(S_1) \geq J_{M1}(S_1)$. Note that problem (21) is not fully recursive because policies chosen in period 0 do not have anticipation effects, whereas policies chosen in subsequent periods do have them.

LEMMA 3 (Best sustainable outcomes). The best sustainable outcomes solve problem (21). Moreover, the value in period 0 satisfies

$$J_{S0}(S) = \max\{V_{S0}(K, D, 0, 0, G), V_{S0}(K, D, B_B, 0, G)\}. \tag{22}$$

It is immediate that equation (22) holds because the first term in the max is the value of defaulting and not bailing out, whereas the second term is the value of defaulting and bailing out.

Next, assuming that it is not optimal to tax capital, we show that the continuation problem has a form similar to that in the Ramsey problem.

[5] In the continuation problem, we need to record only the physical state variables because utility is linear in consumption; otherwise, we would need to record the promised marginal utility of consumption as well.

To do so, substitute from the implementability constraints, as we did in the Ramsey problem, and conjecture that the continuation problem can be written as

$$V_{St}(S) = A_R + K + A_N N + H_{St}(B, G), \tag{23}$$

where the tax distortion function for the sustainable equilibrium, H_{St}, is defined below. We show below that the value of the Markov equilibrium is given by

$$J_M(S) = A_R + K + A_N(K - D) + \max\{H_{Mt}(0, G), A_N B_B + H_{Mt}(B_B, G)\}, \tag{24}$$

so that under our conjecture, the sustainability constraint can be simplified to be

$$A_N B'_B + H_{St+1}(B'_B + B'_H, G') \geq \max\{H_{Mt}(0, G'), A_N B'_B + H_{Mt}(B'_B, G')\}. \tag{25}$$

The *tax distortion function* H_{St} is the largest fixed point of a Bellman equation, defined by

$$H_{St}(B, G) = \max_{T, B'_B, B'_H, R'} W(T) - A_B(R')B'_B + \beta H_{St+1}(B'_B + B'_H, G'), \tag{26}$$

subject to the government budget constraint $G + B \leq T + (B'_B + B'_H)/R'$; the simplified sustainability constraint (eq. [25]); the restriction that $R' \leq R_K$; and the complementary slackness condition that if $R' \neq 1/\beta$, then $B'_H = 0$.[6] To understand this complementary slackness condition, note that if the face rate offered on government debt $R' > 1/\beta$, the government must be defaulting so that the effective rate $\delta' R' = 0 \leq 1/\beta$, whereas if $R' < 1/\beta$, households strictly prefer not to hold debt. We then have the following lemma.

LEMMA 4 (Value function for the best sustainable equilibrium). The best sustainable equilibrium has the form of equation (23), where H_{St} is the largest fixed point of the Bellman equation (26).

To understand this representation, recall from our derivation of equation (16) that, as long as the collateral constraint binds in each period and banks hold no debt, then the capital and net worth component of consumption is given by $A_R + K + A_N N$, where A_R and A_N are identical to those in the Ramsey equilibrium. Here, unlike in the Ramsey problem, banks may be forced to hold debt. To accommodate this feature, we need to adjust the tax distortion function to capture the cost from forcing banks to hold debt. Specifically, the function $A_B(R')$ measures the crowding-out cost from forcing banks to hold one unit of debt at an

[6] Note that the observation that the best sustainable equilibrium is the largest fixed point of the Bellman equation is similar to observations by Abreu, Pearce, and Stacchetti (1990) and Atkeson (1991).

interest rate of R' and is given in the appendix. This cost arises because with a binding collateral constraint, forcing banks to hold debt reduces the amount of capital they can hold.

C. *Recursive Characterization of Markov Equilibrium*

We next show that the value of the Markov equilibrium takes the form described above. Since policies do not depend on histories except through the state, it is clearly optimal for the government to always default and perhaps to bail out banks. Knowing this, households will hold no government debt, and we can set household debt to zero when constructing the continuation value. Paralleling our discussion of the sustainable equilibrium, the option to bail out or not implies that the value of the Markov equilibrium has the same form as equation (22) for any t—namely,

$$J_{Mt}(S) = \max\{V_{Mt}(K, D, 0, 0, G), V_{Mt}(K, D, B_B, 0, G)\}. \tag{27}$$

The continuation value is given by $V_{Mt}(S) = A_R + K + A_N N + H_{Mt}(B_B, G)$, where the *tax distortion function for the Markov equilibrium* H_{Mt} satisfies the Bellman equation

$$H_{Mt}(B_B, G) = \max_{B'_B, T, R'} W(T) - A_B(R')B'_B + \beta H_{Mt+1}(B'_B, G'), \tag{28}$$

subject to the government budget constraint $G + B_B \leq T + B'_B/R'$, the *no-effective-default* on banks constraint

$$A_N B'_B + H_{Mt+1}(B'_B, G') \geq H_{Mt+1}(0, G'), \tag{29}$$

and the constraint on the return on bank debt $R' \leq R_K$.

To understand this problem, note that the left side of the no-effective-default on banks constraint is the value associated with defaulting and bailing out banks and the right side is the value associated with defaulting and not bailing out banks. Note that the constant A_N, earlier referred to as the marginal value of net worth, appears both in the value function and in the no-effective-default constraint. It appears in the no-default constraint because not bailing out banks is equivalent to reducing net worth in the next period by B'_B and hence has a cost $A_N B'_B$. Hence, A_N is also the *marginal direct default cost.*

Note that the form of the value of the Markov equilibrium that we posited in equation (24) can be obtained by substituting the form of the continuation value function $V_{Mt}(S)$ into equation (27).

D. *An Economy with Exceptional Fiscal Needs*

To make our points in the simplest possible manner, we assume that period 0 is an *abnormal time* during which fiscal needs, as measured by initial

government spending, are exceptionally high, and after that, fiscal needs are in *normal times* during which government spending deterministically fluctuates between high and low levels over time.

In particular, we assume that in period 0, there is an initial level of spending G_0, zero inherited debt, and some given initial deposits and capital stock. In all subsequent periods, government spending has a simple cyclical pattern: in odd periods it is low, at G_{L}; and in even periods it is high, at G_{H}. This pattern captures the idea that period 0 is a time of exceptional fiscal needs, and after that time, there are standard fluctuations. Moreover, the continued pattern of fluctuating spending captures the idea that, even in the long run, tax smoothing by issuing and retiring debt is valuable. This feature implies that reputational concerns can support some tax smoothing and debt issue.

In the next proposition, we assume that the discount factor β is above a critical value β^* defined in the appendix. At this critical value, if $G_0 = G_{\mathrm{H}}$, the Ramsey equilibrium is just sustainable. This value depends on the spread between G_{H} and G_{L} and does not have to be close to one.[7]

In the next proposition, we show that if initial fiscal needs, as represented by G_0, are sufficiently large, it is optimal to have financial repression in period 0, continue with that financial repression for some period of time, run down the debt, and then converge to a Ramsey equilibrium with no financial repression.[8]

PROPOSITION 3 (Repression in the best sustainable equilibrium). In the best sustainable equilibrium, there exists a value G^* of government spending such that if $G_0 > G^*$, there is a finite period T such that the government practices financial repression both in period 0 and in all high-spending states before period T and does not practice financial repression after period T. Furthermore, government debt is decreasing over each cycle in that $B_{t+2} \leq B_t$ for all t. In a finite period of time, the economy converges to a Ramsey outcome with perfect tax smoothing.

One key idea in the proof of this proposition is that financial repression increases credibility in the sense that it relaxes the sustainability constraint. To understand why, rewrite the sustainability constraint (eq. [25]) as

[7] We can prove a similar proposition under weaker conditions, but the proof is more complicated and is available upon request.

[8] It turns out that in each period, the best sustainable outcomes fall into one of two regimes. In the *household-debt* regime, in period t the government sets the return on debt $R'_B = 1/\beta$, both households and banks hold debt, and in period $t + 1$ the government does not default. In the *no-household-debt* regime, in period t the government subsidizes debt by having $R'_B = 1/\beta$, only banks hold debt, and in period $t + 1$ the government defaults and bails out the banks. In propositions S1 and S2 in the appendix, we show that if G_0 is below a critical value F_H with $F_H > G^*$, then the household-debt regime prevails in period 0. We also provide conditions under which the household-debt regime prevails in all subsequent periods. Given these conditions, the best sustainable outcome solves eq. (26) with $R'_B = 1/\beta$. In what follows, we assume that these conditions hold.

$$H_{St+1}(B'_B + B'_H, G') \geq \max\{-A_N B'_B + H_{Mt+1}(0, G'), H_{Mt+1}(B'_B, G')\} \quad (30)$$
$$\equiv h_{t+1}(B'_B, G').$$

Now, consider a variation that increases B'_B by one unit and reduces B'_H by one unit so that the sum, $B'_B + B'_H$, is unaffected. Clearly, this variation relaxes the sustainability constraint (eq. [30]) because the left side of this constraint is unaffected, whereas the right side falls since it is decreasing in B'_B.

Intuitively, this variation relaxes the constraint because it lowers the ex post gains to default through either the net worth dilution channel or the partial default channel. Suppose first that in the deviation to the Markov equilibrium, the government does not bail out banks. Then the default on bank debt dilutes net worth and reduces welfare in the Markov equilibrium because the term $-A_N B'_B$ in equation (30) is decreasing in B'_B. Suppose next that in the deviation, the government bails out banks. Then, it engages in partial default because it effectively defaults on a smaller fraction of the total debt. Here, welfare decreases in the Markov equilibrium because $H_{Mt+1}(B'_B, G')$ is decreasing in B'_B. Thus, in either case, substituting one unit of bank debt for one unit of household debt reduces the gain to a deviation and relaxes the sustainability constraint.

We now show that if G_0 is sufficiently high, it is desirable to incur the ex ante crowding-out costs of repression in period 0. Figure 2 illustrates the optimal policy. Suppose first that $G_0 = G_{\mathrm{H}}$. Since $\beta > \beta^*$, as discussed above, the sustainability constraint is slack. As G_0 increases above G_{H}, it is still feasible to support perfect tax smoothing by issuing more debt until a critical value $\underline{G}$ is reached. At this critical value, the sustainability constraint is just binding with no repression; namely, $H_{S1}(B_1^*, G_{\mathrm{L}}) = H_{M1}(0, G_{\mathrm{L}})$, where B_1^* denotes the amount of debt issued. Since the sustainability constraint is just binding, no additional debt can be issued without repression.

As we increase G_0 above $\underline{G}$, at first the government simply keeps the debt at B_1^* and raises more distortionary taxes up to the point G^* at which the marginal cost of raising another unit of distortionary taxes equals the net cost of financial repression. For any G_0 above that level, the government strictly prefers to practice financial repression.

Formally, G^* is the critical value of G_0 at which the government is just indifferent between practicing financial repression and not, given that it issues B_1^* in period 0. To construct G^*, we evaluate the first-order conditions to the problem defining the tax distortion function for the sustainable equilibrium (eq. [26]) at B_1^*, which imply that

$$-\beta W'(G^* - \beta B_1^*) = -(\beta + \mu^*) H'_{S1}(B_1^*, G_{\mathrm{L}}), \quad (31)$$

$$\mu^* = -\frac{A_B}{h'(0, G_{\mathrm{L}})}. \quad (32)$$

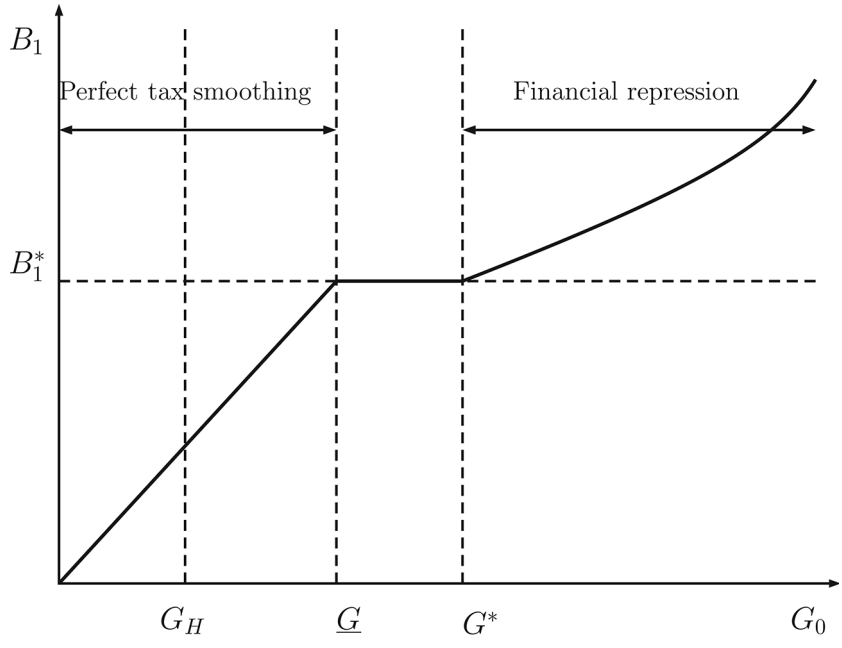

FIG. 2.—Optimal debt issued in model as a function of current fiscal needs.

These two equations define the critical value G^* and the associated multiplier μ^*.

Next, consider the transition results after period 0. Here, we discuss why taxes and hence debt fall over time and briefly discuss why repression stops in a finite amount of time. Using the envelope condition, the first-order conditions of the problem in equation (26) for B_{t+1} and B_{Bt+1} are

$$-\beta W'(T_t) = -(\beta + \mu_t)W'(T_{t+1}), \tag{33}$$

$$\mu_t \leq -\frac{A_B}{h'(B_{Bt+1}, G_{t+1})}, \tag{34}$$

with equality if $B_{Bt+1} > 0$, where μ_t is the multiplier on the sustainability constraint (eq. [30]).

Consider how the pattern of taxes over time and hence the pattern of debt are related to the multiplier on the sustainability constraint. From equation (33) and the concavity of W, we see that as long as the sustainability constraint is binding, $\mu_t > 0$, taxes strictly fall, in that $T_{t+1} < T_t$, whereas if the sustainability constraint is not binding, so that $\mu_t = 0$, then taxes are constant. Note that if the *no-repression* condition holds—namely, that $\mu_t \leq A_B/h'(0, G_{t+1})$—then there is no financial repression in

period t. From the present-value version of the government budget constraint, it is immediate that since taxes fall, debt must also fall over the cycle.

Thus, whenever the sustainability constraint is binding, it is optimal to *front-load* taxes. Such front-loading is desirable because raising taxes in the current period reduces the amount of debt that must be passed on and thus reduces the amount of crowding-out costs in the future. Now, since debt is falling over time, the need to practice repression to smooth taxes also falls over time. Eventually, the debt is small enough that the Ramsey policies are credible. The appendix shows that this process happens in a finite amount of time; that is, the multiplier on the sustainability constraint hits zero in a finite amount of time.

Financial repression plays an essential role in the slow running down of debt. To see why, consider the same economy as in proposition 3, but suppose that the government is prohibited from practicing repression. After period 0, government debt immediately jumps to the two-period cycle: the sustainability constraint is slack from period 1 and onward, and government debt and taxes from period 1 and onward are the Ramsey outcomes for the continuation equilibrium from period 1 (see result 2 in the appendix). In this sense, there is no slow running down of debt; rather, debt immediately jumps down to a stationary cycle. Allowing repression enables the government to sell more debt from the initial state G_0 and also makes it optimal for the government to run down the debt slowly over time.

VII. Stochastic Government Spending

We allow for stochastic government spending and, in the appendix, show that with complete markets and state-contingent regulation, all of our results go through virtually unchanged. The most interesting results for the stochastic case can be illustrated with a simple figure. In figure 3, we graph outcome paths for an economy that starts in period 0 with a large level of spending G_0 and, after period 0, follows a two-state Markov chain with $G_t \in \{G_L, G_H\}$. We focus on a path in which the realization of spending is always $G_t = G_L$ for $t \geq 1$. The figure shows the Ramsey outcomes and the best sustainable outcomes. The left panel shows the value of debt sold at t into the subsequent low- and high-spending states, and the right panel shows the fraction of total government debt that is held by banks.

Note that the Ramsey outcomes feature no repression and a constant value of debt sold from period 1 onward. In the best sustainable outcomes, the value of the debt declines and the government practices financial repression for a finite number of periods. Once the value of the debt has declined to a sufficiently low level, the government stops practicing

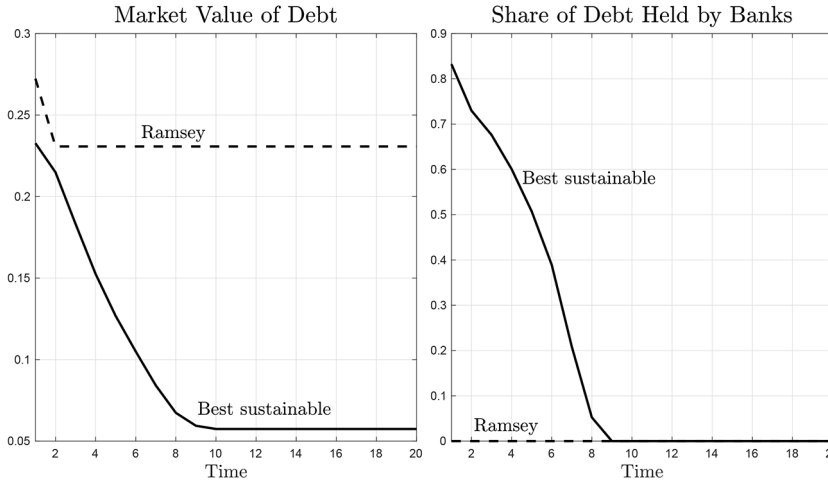

FIG. 3.—Optimal debt over time in model following one period of exceptional fiscal needs. *Left*, market value of debt. *Right*, fraction of debt held by banks.

repression. The patterns of debt and repression in the best sustainable outcomes resemble those in the United States following World War II.

VIII. Other Related Literature and Concluding Remarks

A large literature on financial intermediation develops the key building blocks of our model and uses these building blocks to address some issues in the data. With the exception of Perez (2015), discussed later, none of these papers have financial repression. Moreover, none of them, including Perez (2015), address the patterns of repression and debt that we document.

Our paper has costly default. A literature argues that defaulting on foreigners is costly because it worsens a government's reputation with its own citizens (see Cole and Kehoe 1998). The goal of these literatures is to model the reasons why defaulting on foreigners is costly rather than simply assuming that it is, as in the earlier literature on foreign default (for examples of the earlier literature, see Eaton and Gersovitz 1981; Cole and Kehoe 2000; Arellano 2008; Aguiar and Gopinath 2006). Our paper has no such spillover effects, so that our mechanism is completely different from the mechanism in this literature.

Our paper has discriminatory default. Another literature uses similar building blocks but assumes nondiscriminatory default in that the government is forced to treat all agents symmetrically both during and after default. The key mechanism in this literature is that otherwise costless

foreign default has spillover costs because, by assumption, such defaults are assumed to be accompanied by costly default on domestic debt (see Basu 2009; Broner and Ventura 2011, 2016; Acharya and Rajan 2013; Gennaioli, Martin, and Rossi 2014b; Perez 2015).

While Perez's model has financial repression, the forces driving it are very different from those in our model. In his model, the key reason for financial repression is that defaulting on foreigners forces a domestic default and, by assumption, leads the government to pursue suboptimal policies. Financial repression in the domestic economy then increases the spillover costs from such a foreign default and hence can enhance the ability to borrow from foreigners. In our model, no such spillover force is present, and the forces driving financial repression are very different.

Another literature has discriminatory default, as we do, but since it has voluntary holding of all debt, this literature is silent on financial repression. This literature focuses on models with foreign lending in which citizens of a given country hold their own government's debt voluntarily. Citizens choose to do so because, by assumption, after a default the government treats domestic citizens more favorably than foreign lenders (see Broner et al. 2010, 2014). A key prediction of this literature is that domestic citizens should disproportionately buy domestic debt when spreads on this debt are high, indicating that default is particularly likely. This prediction seems to be consistent with data from Europe during the recent crisis.

We think that adapting this mechanism to our analysis of repression in a closed economy is not a promising approach. In the natural adaptation, the model's key prediction is that banks disproportionately buy government debt when spreads on this debt are high, indicating that default is particularly likely. Krishnamurthy and Vissing-Jorgensen (2012) show that this prediction is inconsistent with the US data: spreads on US government debt were at their lowest in the aftermath of World War II when the debt-to-output ratio was at its highest. This observation casts doubt on the ability of this alternative mechanism to account for the patterns we focus on.

Our result that it is optimal to run down debt slowly over time from an initial high level is connected to some results in the sovereign default literature (see, e.g., Thomas and Worrall 1994; Aguiar, Amador, and Gopinath 2009; Aguiar and Amador 2011). This literature shows that governments have an incentive to run down their debt so as to reduce their temptation to expropriate foreign funds. In our paper, the government also runs down the debt, but in contrast, it does so to reduce the ongoing crowding-out costs that repression generates. In a commitment setting but with incomplete markets, Aiyagari et al. (2002) and Bhandari et al. (2015) show that debt is reduced slowly over time. Finally, for related analyses of the behavior of government policy that also introduce political

economy considerations, see Yared (2010) and Ales, Maziero, and Yared (2014).

In conclusion, financial repression has been widely practiced throughout history. In particular, it has been more likely when fiscal needs are exceptionally high. In this paper, we investigate when, if ever, financial repression is optimal. We find that under commitment, financial repression is never optimal. If, however, a government cannot commit to its policies—particularly, if it cannot commit to repaying its debt—then financial repression may be optimal. In particular, when a limited amount of government debt can be sustained with standard reputational arguments, we find that financial repression is practiced when fiscal needs are sufficiently high, as it is in the data.

Our findings have important policy implications. Policy makers have argued that financial institutions should be regulated so that they are allowed to hold only small amounts of their own country's government bonds (see Weidmann 2013). Our analysis implies that such a policy change could be costly because governments would be more tempted to default, and thus the amount of debt could not exceed that supported solely by reputation.

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