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The Fiscal Footprint of Macroprudential Policy

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Monetary policies leave a fiscal footprint. When the central bank cuts the policy interest rate, this footprint comes through multiple channels: The demand for currency rises, so the central bank prints more banknotes to accommodate it, and this creates seignorage revenues. Inflation unexpectedly rises and this lowers the real value of public debt. Rolling over this debt is cheaper as the price of newly issued debt rises. And finally, economic activity rises, so tax revenues increase and social spending falls.

A central result of the Ramsey literature on optimal monetary and fiscal policy under commitment is that inflation should be volatile and serially uncorrelated. This way, monetary policy can exploit its fiscal footprint and obtain fiscal revenues with minimal distortions. In turn, an important argument for the independence of a central bank is the potential (mis)use of the footprint, which leads to unpleasant monetarist arithmetics. When the fiscal authority does not collect enough revenues to pay for spending, then a monetary authority that wants to prevent sovereign default must sacrifice the control of inflation in favour of creating the needed fiscal footprint. One of the tell tales of an independent central bank is that it can focus on inflation while ignoring the fiscal footprint of its policies.[1]

This paper asks whether similar unpleasantries affect macroprudential policies in a simple model that characterizes their fiscal footprint. It focuses on three channels: first, macroprudential policies affect the

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For the channels of the fiscal footprint of monetary policy, see Reis (2019); for the Ramey optimal policy they imply, see Chari and Kehoe (1999); and for unpleasant monetarist arithmetics see Sargent and Wallace (1981).

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price at which government bonds sell, and thus the cost of rolling over the government debt; second, macroprudential policies affect lending in the economy, which impacts real activity and fiscal surpluses; third, macroprudential policies prevent financial crises or alleviate their fiscal costs when they occur.

Given these channels, the paper first studies the interaction of macroprudential policy with both conventional and unconventional monetary policy. All these policies have effects on bond prices, as well as on inflation and on the dividends that the central bank distributes to fiscal authorities. Because monetary policy will tend to have a larger fiscal footprint, all else equal, fiscal authorities would turn first to the central bank in search of fiscal relief. However, because their fiscal channels are similar, in practice one would expect to see both policies used together during fiscal crises. The fiscal footprint of macroprudential policy on the constraint of the monetary policymaker is significant. When the balance sheet of the central bank is large, this provides a fiscal argument for having the central bank set both monetary and macroprudential policies.

The paper then studies the interaction between fiscal and macroprudential authorities, by describing when they will have their interests aligned, clashing, or feeding off each other's actions to amplify shocks. It turns out to depend on whether the economy is going through a fiscal crisis, a financial crisis, neither, or both. Sometimes interests are aligned, and fiscal authorities are happy to interact with an independent macroprudential regulator. Other times, the two authorities are in a conflict, and an unpleasant macroprudential arithmetic can take over whereby regulation becomes active repression aiming at maximizing the fiscal impact. Some other times, the interaction is more subtle, with politicians wanting a loose macroprudential policy well before the elections, that reverts into tight macroprudential policy near the elections, to minimize the fiscal burden. The different cases shed light on a few instances in the history of financial regulation (or repression), from Latin America in the 1980s, to the barriers to a European banking union, or the independence of the Reserve Bank of India. This provides building blocks to study the independence of macroprudential policy and the scope for it to become fiscally dominated.

Macroprudential policy is a wide umbrella under which fall many, often disparate, policies. The direct focus of this paper is on policies that affect the share of government bonds that banks must hold. I denote this by β_t. Strictly speaking, policies that most directly affect

β_t are liquidity policies, such as liquidity coverage ratios or reserve requirements. These policies require banks to hold a share of their assets in liquid instruments, which invariably consist of government liabilities. More broadly, many macroprudential policies try to make the banking system safer by increasing its holdings of safe assets, which regulators invariably interpret as government bonds. In times of fiscal crisis, fiscal authorities often take over financial regulation to place the government debt. From this broader perspective,β_t is a proxy variable for the effects of several macroprudential policies. For instance, tighter capital requirements combined with zero-risk weights given to national government bonds, in practice often raise β_t. From the opposite perspective, limits on leverage lower the demand for all assets by banks, including government bonds. Many macroprudential policies have in common that they affect β_t, and this link is central to the fiscal footprint of these policies.

The other distinguishing focus of this paper is on the fiscal burden. This is defined as the resources the government must raise in order to satisfy the government budget constraint. Changes in β_t change either the tax rates in the present or the public debt that is left for the future. Macroprudential policy has a positive fiscal footprint if it increases the fiscal burden, so it tightens the resource constraint of the government and forces it to either leave more debt or raise taxes.

These two focuses—on β_t and on the fiscal footprint—distinguish this paper from much of the literature studying macroprudential policy. A large strand of it—Farhi and Werning (2016), Bianchi and Mendoza (2018), Jeanne and Korinek (2019)—studies macroprudential policies as Pigouvian taxes and subsidies that correct externalities. The resulting fiscal footprint of these policies is then set to zero through offsetting lump-sum transfers. This paper instead focuses on the macroprudential-derived demand for safety, and on measuring their fiscal footprint. Another strand of the literature—Svensson (2018), Peydro and others (2019)—focuses on the redistributive effects of macroprudential policies, with an emphasis on housing markets. It typically ignores tax revenues as policies are implemented through quotas rather than taxes.

The model builds on three strands of literature. The demand for government bonds and their liquidity (or safety) premium follows Krishnamurthy and Vissing-Jorgensen (2015). The interaction between fiscal and financial crises creating a diabolic loop follows Bolton and Jeanne (2011) and Balloch (2015), and is inspired by the facts reported in Benetrix and Lane (2015) and Bordo and Meissner

(2016). The justification for bailouts and the need for regulation is akin to that in Farhi and Tirole (2018).

The paper is organized as follows. Section 1 introduces a simple partial equilibrium model of the government-bond market. This provides the first channel for the fiscal footprint of macroprudential policy: its effect on bond prices. Section 2 introduces a central bank and compares its fiscal footprint with that of macroprudential policy. The two channels considered work through inflation and through the net income of the central bank. Section 3 has a general-equilibrium model of bank credit, investment, real activity, tax revenues, and bailouts. Macroprudential policy now has an effect on the tax base and on bailout costs, new channels for its fiscal footprint. With these channels described, section 4 considers the interaction between fiscal and macroprudential authorities, and shows when their interests are aligned or not. This depends on whether there is a fiscal or a financial crisis, or neither, and different cases can be applied to shed light on specific policy episodes in history. Section 5 studies the particularly interesting case where there are both crises, fiscal and financial, in which case the model generates a diabolic loop where the two crises amplify each other. Section 6 concludes.

1. The Fiscal Footprint via the Bond Market

A study of the fiscal footprint of policies must start by defining the footprint. Consider a government that collects real fiscal surpluses of s_t together with real dividends from the central bank z_t. It issues nominal bonds B_t which sell for a price q_t, where the price level is p_t. Bonds pay one unit if there is no default, otherwise, they pay only a fraction of their face value: $0 < \delta_{t+1} < 1$. The government budget constraint at date $t+1$ determines how much it needs to borrow this period:

$$\frac{q_{t+1}B_{t+1}}{p_{t+1}} = \delta_{t+1}\left(\frac{B_t}{p_{t+1}}\right) - z_{t+1} - s_{t+1} \equiv \Phi_{t+1}. \tag{1}$$

The left-hand side is the debt left for the future, so the right-hand side is the fiscal burden, denoted by Φ_{t+1}. The fiscal footprint of a macroprudential policy is its effect on the right-hand side: $\frac{\partial \Phi_{t+1}}{\partial \beta_t}$. The footprint of a policy is positive if the fiscal burden on the

fiscal authorities increases as a result of the policy. It is negative if the policy loosens the fiscal constraint, making the job of the fiscal authority easier in terms of the surpluses that it will have to raise in the future to repay the lower debt.[2]

1.1 The Demand for Bonds: Households

A representative household maximizes utility subject to a sequence of budget constraints:

$$\sum_{t=0}^{\infty} \psi^t u\left(c_t + \ell\left(\frac{b_t}{p_t}\right)\right) \text{ subject to:} \tag{2}$$

$$p_t c_t + d_t + q_t b_t \leq \left(1 + i_{t-1}^d\right) d_{t-1} + b_{t-1}\delta_t + w_t. \tag{3}$$

The household receives utility from both consumption c_t and the liquidity benefits provided by the holdings of government bonds b_t through the increasing concave function $\ell(.)$. Deposits in banks d_t earn an interest rate i_t^d. Finally, the household receives dividends from firms, banks, and the financial sector w_t.

The more uncommon part of this problem is the liquidity benefits from bonds. A recent literature[3] has made this assumption in order to make sense of the observed downward-sloping relation between outstanding U.S. Treasury bonds and the difference between their yield and the yield on corporate bonds. This is also the reason why the assumption is made here.

Optimal behaviour implies a no-arbitrage condition between the two forms of savings:

$$q_t = \ell'\left(\frac{b_t}{p_t}\right) + \frac{\delta_{t+1}}{1 + i_t^d}. \tag{4}$$

2. An intertemporal definition of the fiscal burden and footprint would rely instead on the intertemporal budget constraint of the government. I focus on the period-version of the constraint because it allows for studying how short-sighted authorities may view the footprint.

3. For example, see Krishnamurthy and Vissing-Jorgensen (2012).

Government bonds earn a premium over the yield on deposits through two channels. First, insofar as the government defaults on its bonds, their price is lower. With uncertainty, there would also be a risk premium associated with it. Second, because of their liquidity benefits, bonds command a premium over deposits.

Importantly for this paper, this premium falls as the household holds more bonds because of diminishing marginal utility for the liquidity they provide. Thus, the demand function for government bonds by households is downward-sloping, as the empirical literature has found.[4]

1.2 The Net Supply of Bonds: Banks and Central Banks

Macroprudential policy forces banks to hold an amount of bonds that is at least β_t. Because the marginal source of funds for banks are deposits and the yield on bonds is lower, banks would not want to hold any bonds at all. Therefore, macroprudential policies directly set the amount of bonds they hold, β_t.

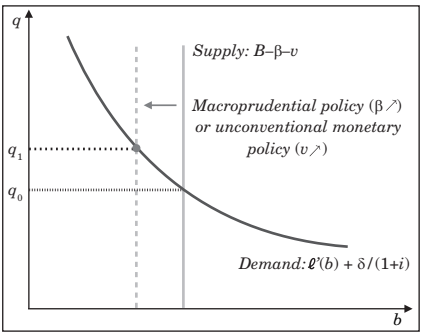
In reality, of course, the effect of policy on banks' bond holdings is surely not so precise. Even in the case of liquidity regulations, regulators often cannot use β_t as a direct policy tool, and at best only indirectly target it. But this stark result in a simple model is consistent with treating β_t as a proxy for macroprudential policies as a whole.

Besides households and banks, central banks are the third holder of government bonds, in the amount ν_t. Market clearing defines the supply curve of bonds:

$$b_t = B_t - \beta_t - \nu_t. \tag{5}$$

4. This downward-sloping demand curve is the key result, and the only one of substance, for the model that follows. A more complete comparison between deposits and bonds would also include a liquidity benefit to deposits, so that the premium could be positive or negative. As long as q_t falls with an increase in b_t, the results below will follow.

Figure 1. The Market for Government Bonds



Source: Authors' calculations.

1.3 Macroprudential Policy and the Price of Bonds

Figure 1 plots the supply and demand for government bonds. The supply curve comes from equation (5) and the demand curve, from equation (4).

A tighter macroprudential policy, by raising β_t, shifts the supply to the left. It therefore raises the price of bonds q_t by increasing the liquidity premium. More bonds are now held by banks, and fewer are held by households.

1.4 The Fiscal Footprint via the Bond Market

The first effect of macroprudential policy on the fiscal footprint is through this rise in the price of bonds. This works through the first term on the right-hand side of equation (1): $\frac{\delta_{t+1} B_t}{p_{t+1}}$.

From the budget constraint of the previous period, $\Phi_t = \frac{q_t B_t}{p_t}$ depends on δ_t, s_t, z_t. Macroprudential policy β_t is an *ex ante* policy, set at date t, so it should not affect any of these variables. Therefore we assume that it does not affect this term (or, equivalently, it is kept fixed in the partial derivatives that will follow). In turn, fiscal policy determines the future surpluses (s_{t+1}) and the repayment on bonds (δ_{t+1}), while monetary policy determines the inflation rate $\pi_{t+1} = \frac{p_{t+1}}{p_t}$ and the central bank's dividends (z_{t+1}). Differentiating equation (1) with respect to β_t while keeping these other policies fixed, then tighter macroprudential policy has a fiscal footprint of:

$$\frac{\partial \Phi_{t+1}}{\partial \beta_t} \Big|_{s_{t+1},\delta_{t+1},\pi_{t+1},z_{t+1}} = -\left(\frac{\delta_{t+1} B_t}{q_t p_{t+1}}\right) \frac{\partial q_t}{\partial \beta_t} < 0. \tag{6}$$

Macroprudential policy raises the price of government bonds. By making banks hold more government bonds, the financing needs of the government are partially met. This allows the government to roll over its debt at a better price, and so it loosens the constraint facing the fiscal authority, leaving a direct negative footprint.

2. Comparing Macroprudential and Monetary Policies

The monetary authority takes deposits from some banks in the amount ν_t / q_t in order to buy the bonds. Bonds pay back δ_{t+1}, while reserves at the central bank pay an interest rate i_t^{ν}. Therefore the net income of the central bank is:

$$p_{t+1} z_{t+1} = \left[\delta_{t+1} - \left(1 + i_t^{\upsilon}\right) q_t\right] \upsilon_t. \tag{7}$$

This assumes that the central bank follows a net-income dividend rule, so that its solvency is always guaranteed and all fiscal consequences are immediately transmitted to the government.[5]

Dividends can be positive or negative depending on whether reserves earn a positive or negative premium. Usually, on average, this premium is positive for two reasons. First, reserves provide extra liquidity services over bonds, as they are the unit of account in the economy and can be used to settle any interbank debt. Second, the average duration of government bonds held by central banks is above one year, while reserves are overnight, and there is typically a positive term premium. Modelling this premium is beyond the scope of this paper, so I simply assume that it equals a function $\mathcal{L}(\beta_t, \nu_t)$. It depends on the relative holdings of reserves and government bonds by banks, insofar as this affects the liquidity services they provide.

Conventional monetary policy targets the inflation rate π_{t+1} by varying the interest rate on deposits. There are many different ways of modelling the link between inflation and interest rates. All of them share the prediction (which fits the facts) that, in order to raise

5. See Hall and Reis (2015).

inflation in the short run, the central bank must target a lower interest rate: $\partial\pi_{t+1} / \partial i_t^d < 0$. Before 2008, this was partly done by varying the amount of reserves, but in the past decade the major central banks have kept the reserves market satiated, varying instead the interest on reserves. I assume they will continue to do so, so conventional monetary policy is understood here as varying inflation while keeping reserves fixed.

Unconventional monetary policy, as a complement, is then understood as choosing ν_t while keeping inflation π_{t+1} fixed. This can be described as a pure form of quantitative easing: an increase in the size of the balance sheet of the central bank while adjusting conventional tools to keep inflation unchanged. Most actual monetary policies will therefore have both a conventional and an unconventional component. The separation is useful because it will lead these two policies to affect the fiscal burden through two separate channels: inflation and the central bank's net income.

2.1 The Fiscal Footprint of Macroprudential Policy

With the description of monetary policy above, the fiscal burden becomes:

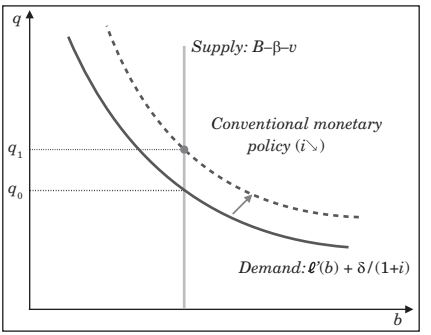
$$\Phi_{t+1} = \left(\frac{\delta_{t+1}}{q_t \pi_{t+1}}\right)\left(\frac{q_t B_t}{p_t}\right) - \mathcal{L}\left(\beta_t, \upsilon_t\right)\left(\frac{\frac{\upsilon_t}{p_t}}{\pi_{t+1}}\right) - s_{t+1}. \tag{8}$$

The fiscal footprint of macroprudential policy (β_t) when keeping fiscal policy (s_{t+1}, δ_{t+1}) and monetary policy (π_{t+1}, ν_t) both fixed is:

$$\frac{\partial \Phi_{t+1}}{\partial \beta_t}\Big|_{s_{t+1}, \delta_{t+1}, \pi_{t+1}, \upsilon_t} = -\left(\frac{\delta_{t+1} B_t}{q_t p_{t+1}}\right)\left(\frac{\partial q_t}{\partial \beta_t}\right) - \left(\frac{\upsilon_t}{p_{t+1}}\right)\left(\frac{\partial \mathcal{L}\left(\beta_t, \upsilon_t\right)}{\partial \beta_t}\right). \tag{9}$$

Relative to the previous section, the last term on the right-hand side is new. If tighter macroprudential regulation lowers the return earned on bonds relative to the return earned on reserves (so $\mathcal{L}(.)$ falls), then the fiscal footprint through this term is positive. In this case, macroprudential regulation lowers the net profits of the central bank.

Figure 2. Effect of Conventional Monetary Policy



Source: Authors' calculations.

From the perspective of the fiscal authority, the revenues that come from central bank dividends have typically been small, so the extra fiscal footprint from this term is not significant relative to the first one. However, from the perspective of the central bank, this fiscal footprint of macroprudential policy is indeed significant, especially if its balance sheet is sizeable. That is, the impact of β_t on z_{t+1} can be proportionately large, and it is larger the higher ν_t is. The actions of the macroprudential authority can have a substantial effect on the central bank's net income, its solvency, and correspondingly its own independence from fiscal authorities.[6]

2.2 The Fiscal Footprint of Conventional Monetary Policy

Conventional monetary policy that aims at lowering inflation will lower the interest rate on deposits. In the market for government bonds, this shifts the demand curve to the right, just as in figure 2. It raises the price of bonds just like tighter macroprudential policy did. However, now there is no change in the bond holdings of banks or households, so there is no effect on liquidity premia.

Using the formulae derived so far, the fiscal footprint of conventional monetary policy is:

6. See Hall and Reis (2015) on the link between net income, solvency, and independence.

$$\frac{\partial \Phi_{t+1}}{\partial \pi_{t+1}} \Big|_{s_t, \delta_{t+1}, \upsilon_t, \beta_t} = -\left(\frac{\delta_{t+1} B_t}{q_t p_{t+1}}\right)\left(\frac{\partial q_t}{\partial i_t^d}\right)\left(\frac{\partial i_t^d}{\partial \pi_{t+1}}\right) \tag{10}$$

$$+ \mathcal{L}(\beta_t, \upsilon_t)\left(\frac{\upsilon_t}{p_{t+1}\pi_{t+1}}\right) - \left(\frac{\delta_{t+1} B_t}{p_{t+1}}\right)\left(\frac{1}{\pi_{t+1}}\right).$$

The first term in equation (10) is similar to the footprint left by macroprudential policy in equation (6) highlighted in the previous section. In fact, if the two policies have the same impact on bond yields, they are identical.

The second term measures the impact that higher inflation has by lowering the real value of any positive profits of the central bank. This effect is likely quantitatively small.

The third term is more interesting as it distinguishes conventional monetary policy from macroprudential policy. It comes from inflating away some of the public debt, which produces a negative fiscal footprint. This effect can be large or small depending on how the increase in inflation persists over time and how it interacts with the maturity of the debt.[7] Either way, it always contributes to making the fiscal footprint more negative.[8]

2.3 The Fiscal Footprint of Unconventional Monetary Policy

Unconventional policy raises ν_t. Just like macroprudential policy in figure 1, this raises the price of bonds by shifting the supply to the left and raising the liquidity premium. Differently to macroprudential policy, the bond holdings of banks are unchanged, as it is the central bank that holds the extra bonds. This leads to a difference in its fiscal footprint.

7. See Hilscher and others (2014).

8. Left out of the analysis is seignorage from printing banknotes that pay no interest. It would show up as another source of net income of the central bank and add another negative fiscal footprint of conventional monetary policy, as higher inflation comes with higher seignorage revenues.

The fiscal footprint of unconventional monetary policy is:

$$\frac{\partial \Phi_{t+1}}{\partial \upsilon_t}\Big|_{s_{t+1},\delta_{t+1},\pi_{t+1},\beta_t} = -\left(\frac{\delta_{t+1}B_t}{q_t p_{t+1}}\right)\left(\frac{\partial q_t}{\partial \upsilon_t}\right) - \frac{\mathcal{L}(\beta_t,\upsilon_t)}{p_{t+1}} - \frac{\upsilon_t}{p_{t+1}}\left(\frac{\partial \mathcal{L}(\beta_t,\upsilon_t)}{\partial \upsilon_t}\right). \tag{11}$$

The first term is again the same as with macroprudential policy, so that if the policies have the same impact on bond prices, they leave the same footprint. The second term reflects the fact that with a larger balance sheet and a fixed profit margin, the central bank's net income will rise.[9]

The third term captures the change in this profit margin, which mirrors the change in the reserves-bonds return premium. If neither reserves nor bonds provide any liquidity services, then the Modigliani-Miller result of Wallace (1981) would hold and this term would be zero. Otherwise, it is likely small from the perspective of the fiscal authority since the net income of the central bank may not be so large to start with it. However, comparing this term with the similar term in equation (9) shows the interaction between unconventional monetary policy and macroprudential policy when it comes to the net income of the central bank. These two different policies will affect the reserves-bonds premium, which likely mirrors the term premium. In the last decade, central banks have gone long by targeting this premium as part of monetary policy. An independent macroprudential regulator can, if mis-coordinated with monetary policy, make these policies ineffective. Because this has a direct impact on the net income of the central bank, it can leave a significant fiscal footprint on the central bank.

2.4 General Lessons

From the perspective of the fiscal authority, both types of monetary policy have an extra negative footprint as compared to macroprudential policy. Usually, these extra terms are relatively small when compared to the common term relating to the price of debt. Thus, the model suggests that a government that is solely focused on the fiscal footprint

9. If there is an unexpected default of the government on its bonds, then the net income of the central bank may be negative and a larger balance sheet makes this worse. This is an extra positive footprint of a larger central-bank balance sheet.

would turn to monetary policy more often than to macroprudential policy when it comes to generating needed revenues. Yet, since both policies have their major fiscal footprint working through the price of the debt, the model suggests that they will be more likely used in conjunction with that target in mind.

In 1959 the Radcliffe Report made its recommendations on how the Bank of England should conduct policy. It guided monetary and macroprudential policy for the next decade and influenced debates about their role across the world for many years. At the time, the stock of public debt was very large, and the main goal of policy was to keep unemployment low with fiscal policy seen as the major tool to achieve it. Aside from controlling inflation, the task of the Bank of England was to manage the public debt, and especially to assist the Treasury in its goal of extending the maturity of the outstanding debt.[10]

To achieve this explicitly fiscal goal, the report recommended the use of a combination of setting interest rates, managing the balance sheet of the central bank, and a series of credit policies that today we would call macroprudential policy. The target of all of them was to keep the price of government bonds high. These tools worked through the functioning of the bond market, similar to the model in this paper. The conclusion that a combination of these tools was best is what these results suggest. The second lesson from the analysis above is that macroprudential policy has an impact on the spread between the return on government bonds and the return on central bank reserves and, as a result, on the net income of the central bank. This fiscal footprint of macroprudential policy on the central bank can be large, even if it seems small from the perspective of the government budget as a whole. It is particularly visible when central banks have a large balance sheet, when they are targeting long-term government bond rates, and when fiscal authorities are less supportive of fluctuations in central banks' dividends and less willing to recapitalize the central banks after losses.

Arguably, all these conditions were present after the 2008 financial crisis. During this period, most major central banks around the world gained responsibility over macroprudential tools. Where they existed, some independent financial regulators were absorbed into the central bank. Monetary and macroprudential policy became more integrated.

10. See the original report Committee on the Working of the Monetary System (1959), Goodhart (1999) or, more recently, Aikman, Bush and Taylor (2016).

The analysis above suggests that this is consistent with the fiscal footprint of these policies.

3. The Fiscal Footprint via Fiscal Surpluses

Having understood the effect of monetary policy, from now onwards this paper abstracts from it. It assumes a central bank with a minimal balance sheet (of $\nu_t = 0$) that is entirely committed to price stability, so $\pi_{t+1} = 1$, and $p_t = 1$ as a normalisation. The Fisher equation implies that $1 + i_t^d = \psi^{-1}$, so bond prices are $q_t = \ell'(.) + \psi\delta_{t+1}$ and the fiscal burden from before $\Phi_t = q_t B_t$. The fiscal burden is the simpler expression:

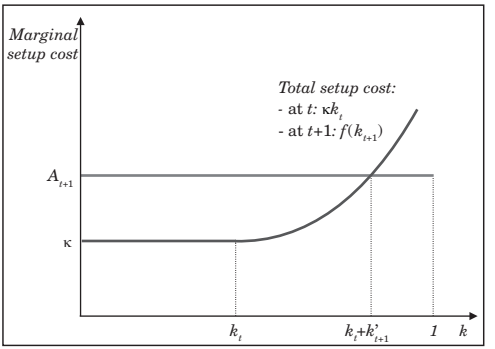
$$\Phi_{t+1} = \left(\frac{\delta_{t+1}}{\ell'(.) + \psi\delta_{t+1}} \right) \Phi_t - s_{t+1}. \tag{12}$$

We have already studied the first term on the right-hand side. This section integrates the model of households and bonds into a general-equilibrium model of banks, firms, and real activity to study the impact of macroprudential policy on the fiscal surpluses.

3.1 Model of the Real Economy: Firms and Production

There is a measure one of atomistic entrepreneurs. They maximize profits, which are then returned to the households. They have access to a production technology that will produce the goods that households can consume. Each firm's net output of goods is A_{t+1}.

Figure 3. Investment Costs



Source: Authors' calculations.

Production requires setting up a firm, which takes a capital investment. If the firm is set up in period t to engage in production at $t+1$, this capital is a fixed amount κ. Therefore, the profits from having k_t firms set up is: $(A_{t+1} - \kappa)k_t - 0$.

Were it not for financial constraints, then all resources available would be employed in this investment technology. Given financial constraints, some entrepreneurs are unable to secure financing at date t. They can make up for it, and still produce, by investing capital at $t+1$, right before production takes place. The set-up costs of this make-do investment are higher, and they rise convexly with the amount of make-do investment in the overall economy, due to aggregate decreasing returns to scale in matching capital to these firms. Letting k'_{t+1} denote make-do investment in setting up these firms, then the profits from it are: $A_{t+1}k'_{t+1} - f(k'_{t+1})$ where the function $f(.)$ has the properties: $f'(0) = \kappa$ and $f''(.) > 0$.

Figure 3 plots the marginal cost of production. As all firms are equally productive, a social planner would choose $k_t = 1$ and every entrepreneur would produce, with no need for make-do investment. With financial frictions, k_t will be lower, and some firms will still seek finance next period, so that $k'_{t+1} > 0$. The constrained optimal amount of make-do investment is: $f'(k^*_{t+1}) = A_{t+1}$, as long as $k_t + k^*_{t+1} < 1$, so not every single firm is financed. I assume this is always the case. However, entrepreneurs have no capital: they must get it as credit from banks.

3.2 Model of the Real Economy: Banks and Credit

A representative bank has a monitoring technology that allows it to collect payments from credit to firms. If depositors lent to firms directly, they would not be repaid, so banks are the only way to have access to the returns from production. For simplicity I assume that, in the relation with the entrepreneurs, the bank has all of the bargaining power and so collects all the profits, but this is immaterial to the results.

The representative bank has access to two sources of funding: its net worth n_t and the deposits it collected from the household d_t. The use of funds is either to give credit to firms to fund their investment or to hold government bonds. The resource constraint of the banking sector therefore is:

$$\kappa k_t + q_t \beta_t = n_t + d_t. \tag{13}$$

In attracting depositors, the banker suffers from a commitment problem. Before paying depositors, it can abscond with part of the payoff from the loan paid by the entrepreneurs. However, absconding implies losing a fraction γ of the loans payoff, as well as all of the bonds being held by the bank, which can be captured by the depositors. The incentive constraint for the banker not to abscond with the deposits, after paying taxes at rate τ_{t+1}, is therefore:

$$\begin{aligned}&(1-\gamma)(1-\tau_{t+1})(A_{t+1}-\kappa)k_t \leq (1-\tau_{t+1}) \\ &(A_{t+1}-\kappa)k_t + \delta_{t+1}\beta_t - \left(1+i_t^d\right)d_t.\end{aligned} \tag{14}$$

On the left-hand side is the bank's payoff from absconding, retaining a share $1-\gamma$ of loan repayments. On the right-hand side is the payoff from paying depositors and keeping the residual profit from credit and from the payout on government bonds. Holding with equality, this puts a constraint on the leverage of the bank. I assume throughout that $1 < \psi(A_{t+1}/\kappa - 1) < [\gamma(1-\tau_{t+1})]^{-1}$, so that production is always profitable and the financial friction is not too extreme, and so the leverage constraint holds with equality.

3.3 Model of the Real Economy: Financial Markets and Bailouts

The final agent is a representative financier. It received capital n' at date t, but was unable to match with a firm to become a bank. In period $t+1$, its capital can only be used to lend to the bank in a financial market before it gets returned to the household at the end of the period. The bank prefers to use its own net worth and deposits to finance regular investment, so it has no capital of its own left. Through the financial market, it can get an additional x_{t+1} of capital with which to fund make-do investment.

Financiers are senior creditors relative to depositors. As in the real world, on account of being better informed, wholesale funders of banks are quicker to run on the banks than depositors. Moreover, make-do investment cannot be absconded with by the banker making the loans, since the financier can also perfectly monitor and seize the projects if the bank does not repay them. Therefore, the financier captures all of the payoff from the financial market and thus from make-do investment. However, when the financier seizes the loan, a fraction $1-\xi$ of it gets destroyed. As a result, the bank has to post a margin in

the form of government loans, the only traded financial asset in the economy that can be fully seized with no loss.

The incentive constraint for the financial investments to be paid by the banker then is:

$$(1-\xi)x_{t+1} \leq \beta_t \delta_{t+1}. \tag{15}$$

I assume this will always bind or, equivalently, that financiers have enough capital: $n' > \beta_t \delta_{t+1} / (1-\xi)$.

Recall that it is socially optimal to undertake k^* of make-do investment. If the bankers do not have the capital to do so, the government will want to cover the missing capital by bailing out the banks so that investment is optimal. The government cannot commit not to bail out the banks. Letting T_{t+1} denote the bailout funds, they therefore equal:

$$T_{t+1} = \max\{f(k^*_{t+1}) - x_{t+1}, 0\}, \tag{16}$$

thus covering the gap between the capital needs of firms and the investment made by banks financed by financiers.

This is the fundamental moral hazard problem in the model: banks prefer to hold no bonds, thus being unable to use capital markets to finance make-do investment, and later be bailed out by the government. The model, in a stark form, captures this important driver of financial regulation. Macroprudential policies force banks to hold liquid government bonds so that they can perform their role of channelling credit from the financial system into firms. When banks hold too little liquidity, the financial system grinds to a halt, with capital locked in with potential creditors in spite of the profitable use it could have in financing ideas.

3.4 The Fiscal Surplus and Fiscal Policy

Tax revenues are given by the function

$$R(\tau_{t+1}, \beta_t, \delta_{t+1}) = \tau_{t+1}(A_{t+1} - \kappa)k_t + \tau_{t+1}\left(A_{t+1}k^*_{t+1} - f\left(k^*_{t+1}\right)\right). \tag{17}$$

The first term captures the taxes collected on the returns from set-up investment; the second, the tax revenues on make-do investment. Because the government always provides for the social optimum amount of make-do investment, $A_{t+1}k^*_{t+1}$ is independent

of macroprudential (or tax) policy. Set-up investment, on the other hand, will depend on macroprudential policy, as well as on tax rates and default.[11]

In turn, government bailouts are given by:

$$T\left(\beta_t,\delta_{t+1}\right)=\max\left\{f\left(k^*_{t+1}\right)-\frac{\beta_t\delta_{t+1}}{1-\xi},0\right\}. \tag{18}$$

Macroprudential policy affects this by changing the likelihood that defaults happen and the size of the bailout they require if they happen.

Therefore, the primary surplus, allowing for some exogenous public spending (g_{t+1}), is:

$$s_{t+1}=R\left(\tau_{t+1},\beta_t,\delta_{t+1}\right)-T\left(\delta_{t+1},\beta_t\right)-g_{t+1}. \tag{19}$$

Fiscal policy is now understood as the choice of the tax rate and of the repayment rate on the bonds.

3.5 The Impact of Macroprudential Policy

The bank holds as few bonds as it can. Financing regular investment is more lucrative than make-do investment, so it wants to employ all of its net worth and deposits in regular credit to firms. The financier will not want to give the bank a side payment to convince it to hold bonds, since it can just let the government finance the make-do investment later on. Moreover, because of the liquidity premium of bonds, raising deposits to hold bonds is a loss-making activity. As a result, β_t is chosen by the macroprudential authority.

The benefit of tighter macroprudential policy is that it allows for the make-do investment to be borne by the financiers, as opposed to relying on bailouts from the government. It follows from equation (18) directly that:

$$\frac{\partial T(.)}{\beta_t}=\begin{cases}-\dfrac{\delta_{t+1}}{1-\xi} & \text{if}\ \beta_t<\overline{\beta},\\ 0 & \text{otherwise.}\end{cases} \tag{20}$$

11. A simple extension of the model would have the government only partially bail out the banks, and instead make-do investment being too low: $k'_{t+1}<k^*_{t+1}$. Since this would lower the tax revenues from the resulting output, it would leave a similar footprint as the cost of bailouts.

Thus, tighter macroprudential policy weakly raises fiscal surplus and so has a negative fiscal footprint because it reduces bailouts.

The costly side of macroprudential policies is that banks investing in bonds provide less credit to firms. Combining equations (13) and (14), and replacing for the price of bonds, credit and investment become:

$$\kappa k_t = \underbrace{\left(\frac{1}{1-\psi\gamma\left(\frac{A_{t+1}}{\kappa} - 1 \right)\left(1-\tau_{t+1}\right)} \right) n_t}_{\geq 1 \text{leverage}} - \underbrace{\left(\frac{\ell_t'}{1-\psi\gamma\left(\frac{A_{t+1}}{\kappa} - 1 \right)\left(1-\tau_{t+1}\right)} \right) \beta_t}_{\leq 0 \text{leveraged safety premium}}. \quad (21)$$

The term multiplying β_t is negative through two economic channels. The first is that, for a fixed amount of deposits, more of them being used to extend credit to the government means fewer funds are available to give credit to the entrepreneurs. The second is that the holding of more bonds lowers banks' profits and also lowers their ability to raise deposits to make loans. Combined, the overall effect of macroprudential policy on investment is negative.

As a result, the impact of tighter macroprudential policy on fiscal revenues is:

$$\frac{\partial R(.)}{\partial \beta_t} = -\tau_{t+1}\left(\frac{A_{t+1}}{\kappa} - 1 \right)\left(\frac{\ell_t' - \beta_t \ell_t''}{1-\psi\gamma\left(\frac{A_{t+1}}{\kappa} - 1 \right)\left(1-\tau_{t+1}\right)} \right) \leq 0. \quad (22)$$

Tighter macroprudential policy lowers credit, which lowers tax revenues and so leads to smaller fiscal surpluses through the two channels just described. At the same time, it raises the price of bonds, which works in the opposite direction.

Combining the two results in equations (20) and (22), the fiscal footprint of macroprudential policy through the fiscal surplus may be positive if $-\partial R(.)/\partial \beta_t > -\partial T(.)/\partial \beta_t$, or negative otherwise. Which case prevails depends on whether there is a financial crisis or not.

I define an economy as being in a financial crisis if $T_{t+1} > 0$ so that a bailout is needed. If there is no financial crisis, then macroprudential policy lowers lending, lowers investment, lowers production, and so lowers tax revenues. The fiscal footprint is positive. With a financial crisis, tighter macroprudential policy lowers not only tax revenues, but

also the chances and extent of a bailout. Of course, a crisis happens when macroprudential policy is too lax to start with, so there are not enough bonds to provide as collateral for the optimal level of make-do investment.[12]

4. The Interaction between Fiscal and Macroprudential Policies

If the main objective of macroprudential authorities is to avoid a financial crisis, they will want to set a high β_t, high enough to make sure there is enough make-do investment in the economy so that a bailout is never needed. However, such a tight policy may have a large impact on economic activity, lowering fiscal revenues, and having a large positive fiscal footprint.

Such a large footprint would require either a large amount of future borrowing by the government or an increase in tax rates this period to offset the lost revenue. A third possibility is that such tight policy causes a default on the government bonds. I define an economy as being in a *fiscal crisis* if $\delta_{t+1} < 1$ so government bonds do not repay in full. The fiscal authority may want to avoid this happening. However, there is a limit on the taxes it can charge: $\tau \leq \overline{\tau} \leq 1$, understood as a limit on the ability to collect taxes and get the economic agents to comply, after which point default may be inevitable. In turn, government default affects the profits of banks, the functioning of financial markets, and thus the chances and extent of a financial crisis.

This section studies these interactions between fiscal and macroprudential policy. Going back to the definition of the fiscal burden in equation (12), and combining it with the definition of fiscal surpluses in equation (19), the fiscal burden in the model when there is price stability and a minimal central bank is:

$$\Phi_{t+1} = \left(\frac{\delta_{t+1}}{\ell'(.) + \psi \delta_{t+1}} \right) \Phi_t - R(.) + T(.) + g_{t+1}. \tag{23}$$

This section assumes that the fiscal burden is kept constant, so no extra debt is left to the future as a result of policy today. Therefore,

12. In a stochastic model, this tradeoff might show up as a mean-variance tradeoff. On the one hand, macroprudential policies may lower the expected mean of tax collections, but, on the other hand, they lower the incidence and severity of the tail events when bailouts are needed.

any fiscal footprint of macroprudential policy must be offset by higher taxes or, if tax rates are at their maximum, by a decline in the recovery of the face value of the debt. There are two types of crisis possible, and so four possible scenarios to consider.

4.1 The Present-bias for Tighter Macroprudential Policy in Quiet Times

In quiet times, when there is no default on government bonds and no bailouts, tighter macroprudential policy on the one hand raises the price of government bonds, which makes rolling over the debt cheaper. On the other hand, it represses economic activity, which lowers tax revenues. Which effect prevails determines whether the fiscal footprint is positive or not, and so whether taxes must rise or not. By using the results previously derived, the following result ensues:

Proposition 1. *If there is no fiscal or financial crisis, then tighter macroprudential policies (higher* β*) leads taxes to rise (higher* τ*) to keep the fiscal burden fixed if the crowding-out of lending is larger than the price impact, which happens if the elasticity of the safety premium is small enough:*

$$\frac{\tau_{t+1}\left(\frac{A_{t+1}}{\kappa}-1\right)}{1-\psi\gamma(1+\tau_{t+1})\left(\frac{A_{t+1}}{\kappa}-1\right)} > \left(-\frac{\ell_t''(.)}{\ell_t'(.)-\beta_t\ell_t''(.)}\right)\frac{B_t}{q_t}. \tag{24}$$

There is a subtle interaction of the footprint with time. A tighter macroprudential policy (β_t) raises bond prices (q_t) right away, which immediately makes rolling over the debt easier for the fiscal authority. Yet, it lowers credit and capital today, which are only felt in lower output next period, thus lowering revenues ($R(.)$) only one period after. The negative fiscal footprint is realised right away, while the positive one comes with the delay of production.

A present-biased politician that, in the extreme, cares only about taxes at date t, will therefore be biased towards tighter macroprudential policy, as the negative effects on financial and real activity are only felt in the future. The positive effects of being able to sustain lower taxes while leaving the same fiscal burden are felt today. Tighter macroprudential policy becomes a tool of financial repression that a present-biased fiscal authority would be tempted to

use so as to place its bonds more easily. Countries with short-horizon politicians due to coalition government and high electoral turnover are associated in the data with higher public debt.[13] In these countries, the government also actively uses tools of financial repression to be able to roll over public debt.[14]

More sophisticated politicians that are focused on winning elections can sequence these decisions. One period before the elections, they will want to have loose macroprudential policy to boost credit and investment during the election year. In the period of the elections, they will shift to favour tighter policy that raises bond prices and eases the financing of the government debt. In 2018, almost one year before the Indian elections, the government of India "...urged the Reserve Bank of India to make it easier for financially troubled banks to lend more, despite their bad debt problems."[15]

These results provide some justification for an independent macroprudential regulator that has a long horizon and avoids these temptations, following arguments similar to those used in discussions of central bank independence.

4.2 The Present Absence of Conflict

Consider now the case where there is still no fiscal crisis, but instead a financial crisis, so government bonds pay in full ($\delta_{t+1} = 1$), but the financial system requires a bailout ($T_{t+1} > 0$).

Proposition 2. *If there is a financial but no fiscal crisis, then tighter macroprudential policies (higher* β*) lead taxes to rise (higher* τ*) to keep the fiscal burden fixed if the crowding-out of lending* exceeds *the price impact plus the lowering of the bailout size:*

$$\frac{\tau_{t+1}\left(\frac{A_{t+1}}{\kappa}-1\right)}{1-\psi\gamma\left(1+\tau_{t+1}\left(\frac{A_{t+1}}{\kappa}-1\right)\right)} > \left(-\frac{\ell_t''(.)}{\ell_t'(.)-\beta_t\ell_t''(.)}\right)\frac{B_t}{q_t}+\frac{1}{(1-\xi)\left(\ell_t'(.)-\beta_t\ell_t''(.)\right)}. \quad (25)$$

In a financial crisis, the negative fiscal footprint of macroprudential policy through bailouts becomes active. Tighter policy lowers the size

13. See Alesina and Tabellini (1990), and Grilli and others (2014).
14. See Reinhart and Sbrancia (2015).
15. See Financial Times (2018).

of the needed bailout, thus lowering the fiscal burden. Whether this is enough for tighter policy to lower or raise taxes depends on the condition in the proposition, but $\partial\tau/\partial\beta$ is unambiguously lower relative to the previous proposition. Tighter policy is more likely to be fiscally beneficial than before because it lowers the costs of financial resolution.

Following the financial crisis of 2008–10, macroprudential policies became tighter in most financial centres. Policies such as the introduction of liquidity coverage ratios were introduced, capital requirements were raised, and new macroprudential authorities were created while existing ones were expanded. In the United Kingdom, the Financial Services Act of 2012 gave the independent Bank of England an explicit statutory objective to achieve financial stability. It created both a subsidiary of the central bank, the Prudential Regulation Authority, and a new policy committee within the central bank, the Financial Policy Committee, that had a wide toolkit of microprudential and macroprudential policies at their disposal, respectively. In the European Union, a new supra-national regulator independent from national authorities was created, the Single Supervisory Mechanism, to supervise systemic institutions. All combined, national fiscal authorities across developed countries were willing to give more independence, power, and tools to independent macroprudential policymakers.

Proposition 2 rationalizes this movement of power. The prospect of a new financial crisis might have driven these changes. The fiscal footprint of these tighter policies was smaller and maybe even negative during these times. Thus, there was no conflict between fiscal and macroprudential policymakers. Both agreed with tighter policies since financial and fiscal goals coincided.

4.3 Unpleasant Macroprudential Arithmetics

In a fiscal crisis, taxes are at their limit ($\tau = \bar{\tau}$), and yet default happens ($\delta < 1$).

Proposition 3. *If there is a fiscal but no financial crisis, then tighter macroprudential policies (higher* β*) make the fiscal crisis more severe (lower* δ*) if the price impact is smaller than the crowding-out of lending.*

$$\frac{\bar{\tau}\left(\frac{A_{t+1}}{\kappa}-1\right)}{1-\psi\gamma\left(\frac{A_{t+1}}{\kappa}-1\right)\left(1+\bar{\tau}\right)} > \left(-\frac{\ell_t''(.)}{\ell_t'(.)-\beta_t\ell_t''(.)}\right)\frac{\delta_{t+1}B_t}{q_t}. \tag{26}$$

The channels at play are the same as in quiet times, but now a positive fiscal footprint of macroprudential policy no longer raises taxes, but instead makes default worse. If condition (26) holds, then tighter macroprudential policy tightens the budget constraint of the government and leads to a lower recovery rate on the government bonds.

A broader mandate of macroprudential policy could interpret financial stability as avoiding not just a crisis and bailouts in financial markets, but also a crisis in the government bond market. In this case, tighter macroprudential policy is contributing to creating a financial crisis in the government bond market.

Imagine now a situation where the fiscal authority commits to cause a fiscal crisis. One scenario in which this happens is when a fiscally irresponsible politician raises government spending g_t. Another is when a small-government politician purposefully lowers the upper limit on taxes by making it legislatively harder to approve tax increases. This can also come about through a crisis in the collection of fiscal revenues as a result of civil unrest or other institutional failures. More indirect, but with similar effects, would be a sudden realisation that the amount of inherited debt to pay is higher than was previously anticipated. All of these scenarios are typical of countries going through severe fiscal crises.

The macroprudential policymaker will then face a dilemma. Avoiding a banking crisis may require some relatively high β_t. But avoiding a sovereign debt crisis calls for a lower β_t if the condition in the proposition is met and the total fiscal footprint is positive. The policymaker then faces unpleasant arithmetics, much like the central bank did in Sargent and Wallace (1981). Preventing a government default requires it to have looser macroprudential policy than it might have wanted, even if this gets it closer to potentially causing a financial crisis. Macroprudential policy can unpleasantly become financial repression under the justification of fighting the crisis in the government bond market.

The experience of Latin America in the 1980s illustrates this tradeoff. At the time, reserve requirements were high and would vary in response to expansionary fiscal policies. Moreover, as Morris and others (1990) write: "In addition to required reserves, Latin American governments also very often have requirements that banks invest a percentage of their deposits in bonds issued by the government..." They report that in Argentina in 1987, reserve requirements were 16 percent of deposits, and forced investments took another 50 percent. Via the

central bank and the power of regulation, governments subordinated the banking sector to a primary role of generating a negative direct fiscal footprint as needed. An evaluation by the Bank of International Settlements of the time concludes: "Banks thus became 'quasi-fiscal' agents for the government."[16]

The data show a positive association between financial repression and inflation, with both combining to explain low growth, especially in Latin America.[17] It is well understood that fiscal crises activate unpleasant arithmetics on the monetary side. Less appreciated is that, at the same time, unpleasant arithmetics in financial regulation are also present. Under pressure to generate fiscal revenues, central banks lose their independence, and this reflects itself as much in high inflation as it does in using regulatory tools to leave a negative footprint. Taxing the financial system, directly or indirectly through regulation, is a source of revenue that can be as effective as, and generate more revenue than, surprise inflation. More generally, the line that separates macroprudential policies from financial repression is a thin one.

5. The Diabolic Loop

The final case is when there is both a financial and a fiscal crisis. The extent of the crisis comes from the solution of a system of two equations, the government budget constraint, and the financing needs for make-do investment:

$$\left(\frac{\delta_{t+1}}{\ell'(.)+\psi\delta_{t+1}}\right)\Phi_t = R\left(\tau_{t+1},\beta_t,\delta_{t+1}\right) - T_{t+1} - g_{t+1} + \Phi_{t+1}, \tag{27}$$

$$T_{t+1} = f\left(k^*_{t+1}\right) - \frac{\delta_{t+1}\beta_t}{1-\xi}. \tag{28}$$

The two endogenous variables to solve for are T_{t+1} and δ_{t+1}, which measure the extent of the financial and fiscal crises, respectively. The exogenous variables are macroprudential policy β_t and government spending g_t. The first equation features a negative relation between

16. See Goldstein and Turner (1996).
17. See Roubini and Sala-i-Martin (1992).

T_{t+1} and δ_{t+1}: a larger bailout increases fiscal spending, which lowers the recovery rate on government bonds. The second equation also shows a negative relation: a worse default lowers the available collateral for financial markets, which leads to less private make-do investment and raises the extent of the bailout. A worse financial crisis makes the fiscal crisis worse and *vice versa*.

Both equations are plotted in the top panel of figure 4 for the relevant case where frictions in the financial market are not too severe (ξ is small enough). The intersection of the two lines—the budget line corresponding to the first equation above and the bailout line corresponding to the second one—gives the equilibrium extent of the two crises.

5.1 The Effect of Macroprudential Policy

Keeping T_{t+1} fixed, a higher β_t lowers the recovery rate δ_{t+1} from Proposition 3. Graphically, this shows as a shift inwards in the budget line. It is depicted in the bottom panel of figure 4. If there was no financial crisis, then the increase in the extent of the financial crisis would be given by the vertical dislocation of the budget line. The new equilibrium, keeping the financial crisis fixed, would be at point B.

However, for a fixed bailout line, the new equilibrium would move from point A to point C instead, so the fall in δ_{t+1} would be larger. The intuition is that a deeper fiscal crisis lowers the value of the bonds that are being used to make the capital market function. Thus, make-do investment falls shorter of the optimal level and bailouts rise. Since higher bailouts make the fiscal crisis worse, this mechanism amplifies the initial shock. Point C implies a larger fall in the recovery rate of government bonds than what Proposition 3 would have suggested. This amplification has been called the diabolic loop in the literature, linking fiscal crises to financial crises.

However, macroprudential policy has a second effect. It also makes the bailout line flatter for the same horizontal intercept. This is because, for a fixed extent of default, more bank holdings of bonds mean more collateral, more financial market activity, and so lower public bailouts. Considering this effect alone, if the budget line had not shifted, the new equilibrium would be at point D. Since macroprudential policy makes the financial crisis less severe, through the diabolic loop this means that the fiscal crisis is less severe as well.

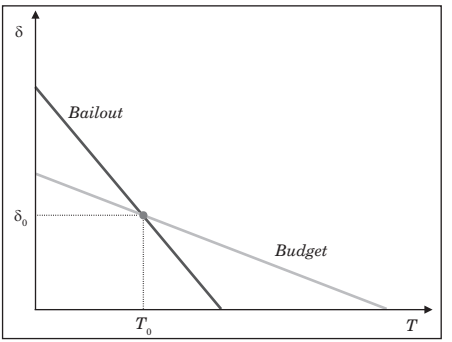
There are then two forces at play relative to the case of no financial crisis: on the one hand, the diabolic loop amplifies the fiscal impact, while on the other hand lower bailouts attenuate it. Combining the

two, the new equilibrium is instead at point E. The figure plots the case where the first effect is larger than the second, so that the impact on δ_{t+1} of a higher β_t is larger than the one given in Proposition 3. In general the effect may be larger or smaller depending on the interaction of these two forces.

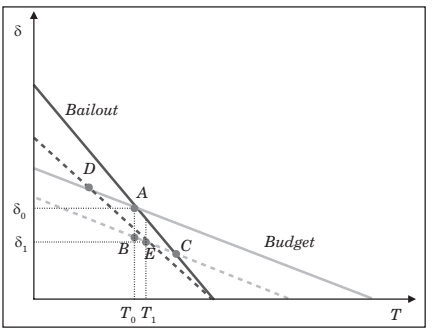
With a twin crisis, the model suggests that the macroprudential authority faces a difficult challenge. If it ignores its fiscal footprint, it might believe that tighter policy lowers the extent of both the financial and fiscal crises, aiming for point D. But, taking into account the footprint, tighter macroprudential policy instead makes the fiscal crisis worse and may even make the financial crisis worse as well, ending up in point E instead. The fiscal footprint becomes relevant even for an independent macroprudential authority solely focused on avoiding a financial crisis. It can no longer operate ignoring its fiscal footprint.

Figure 4. The Diabolic Loop and Macroprudential Policy

(a) Equilibrium extent of the fiscal and financial crises



(b) The effect of tighter macroprudential policy



Source: Authors' calculations.

5.2 Macroprudential Policy and the Amplification of Shocks

Figure 5 considers what happens when there is an increase in public spending g. This shifts the budget constraint curve inwards, towards the origin. Without a financial crisis, then the fiscal impact would be on default δ_{t+1} and could be read from the difference in intercepts of the budget line with the vertical axis. With a financial crisis, the new equilibrium implies instead a larger fall in δ_{t+1} or a larger fiscal footprint. The reason is again the diabolic loop: a worsening of public finances lowers the recovery rate on government bonds, which hurts financial markets, lowers private investment, and increases the size of bailouts, thus amplifying the initial fiscal footprint. This is shown in the top panel of the figure as the economy moves from point A to point B.

The bottom panel repeats the experiment when β_t is higher. Starting from the same point A, the bailout line is flatter, so it rotates counterclockwise relative to the one with looser macroprudential policy. Tighter macroprudential policy makes the amplification of the diabolic loop larger. The equilibrium is now in point C, which involves a larger extent of both crises. Because banks hold more bonds, the link connecting the financial health of banks and the financial health of the government is tighter.

If the g_t shocks dominate the variation in the data, then tighter macroprudential policy would raise volatility in fiscal outcomes and in the yield on government bonds. If macroprudential policy is slow to adjust, then the diabolic loop provides an argument for looser policy if the economy is likely to experience twin crises driven by fiscal spending shocks.

5.3 Discussion

The European sovereign debt crisis of 2010–12 had the diabolic loop at its centre.[18] Discussion of the reform of the euro architecture has therefore focused on whether to introduce concentration limits on the amount of national debt a bank can hold and on whether national government debt should stop receiving a zero risk weight in banking

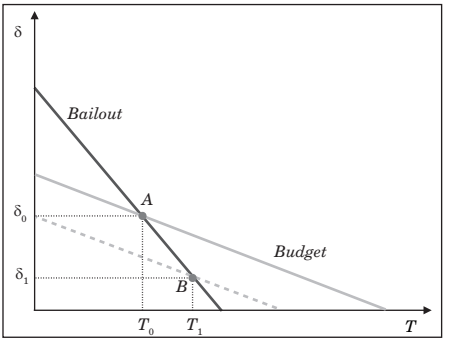
18. See Brunnermeier and others (2011, 2016).

regulation. Three arguments are often raised in these policy debates, which match the different cases captured in this section.

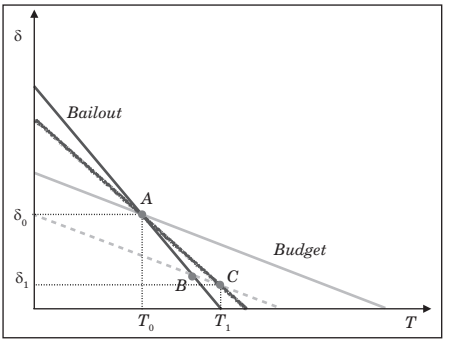
The argument for the policy reforms is captured by figure 5. Lowering β_t would reduce the diabolic loop, and stabilize these economies, especially in countries that are prone to pro-cyclical fiscal spending causing frequent fiscal crises. Replacing this risky national debt with a safe euro-wide alternative would break the diabolic loop and the amplification that is captured in the figure.

Figure 5. Government Spending Shocks

(a) The diabolic loop after a shock to government spending



(b) Amplification of spending shocks



Source: Authors' calculations.

Critics of the policy reform instead focus on figure 4 and argue for continuing the practice of letting national regulators use direct macroprudential policy, or indirect "moral suasion", in order to raise β_t of national government bonds during a crisis. From a fiscal perspective, one argument that is related to the present-bias discussed before highlights the negative fiscal footprint of macroprudential policy. It argues for using macroprudential policy in a fiscal crisis since forcing banks to hold more government bonds will right away raise their price and make the rollover of debt easier. Seeing such policy as shifting the budget line outwards, as opposed to inwards, the diabolic loop can be perceived as being beneficial. After all, it amplifies the fiscal footprint and thus gives extra leverage for fighting the fiscal crisis. This fiscal argument might be popular with debt management offices, for whom the immediate negative fiscal footprint of macroprudential policy is salient.

A second distinct argument comes from financial regulators that ignore the fiscal footprint of their actions. This argument for keeping national regulators with the power to affect bank holdings of government bonds during a crisis relies on the bottom panel of figure 4. From the perspective of a financial regulator who worries about financial crises exclusively, while ignoring the fiscal footprint of its policies, tightening policy will lower the extent of the financial crisis. The focus will be on achieving point D in the figure. A focus that would prove misguided during a crisis as the fiscal footprint of the policy leads to point E, with deeper financial and fiscal crises.

6. Conclusion

The model in this paper developed three fiscal footprints of macroprudential policy. First, tighter policy makes rolling over the public debt easier by raising the price of government bonds. Second, tighter policy reduces bank lending, investment, real activity, and future tax collections. Third, tighter policy lowers bailout costs, or their likelihood.

These channels suggested two facets of the fiscal interaction between macroprudential and monetary policy. From the perspective of the fiscal policymaker, the footprint from both policies is likely quantitatively similar and relies mostly on both achieving lower yields on government bonds. This provides some justification for using both when generating fiscal revenues becomes a government priority. From

the perspective of the central bank, the choices of macroprudential policy can have a large impact on its net profits, especially when the balance sheet of the central bank is large. This provides an argument for having the central bank take charge of both policies so that it internalizes these effects.

The interaction between macroprudential policy and fiscal policy takes different shapes inside or outside of a crisis. If there is neither a financial nor a fiscal crisis, the analysis suggests that politicians focused on winning elections and, judged by their fiscal legacy, may alternate between tight and loose macroprudential policy, depending on how far the election is. This can provide an argument for an independent macroprudential authority that is immune to the political cycle.

If a financial crisis is in the horizon, instead there is no conflict between fiscal and macroprudential goals, which rationalizes the movement in the last decade of fiscal authorities giving increasing power to independent macroprudential policymakers. If instead it is a fiscal crisis that dominates attention, unpleasant macroprudential arithmetics sets in: to avoid a sovereign debt crisis, the macroprudential authority will be induced to use macroprudential policy to exploit its fiscal footprint, turning it effectively into financial repression. The use of financial regulation in Latin American in the 1980s illustrates this outcome.

When there is a twin crisis, a diabolic loop between banks and the government amplifies the fiscal impact of macroprudential policy and spending shocks. If macroprudential authorities ignore their fiscal footprint and focus solely on the financial sector, then they may actually set policies that worsen both crises. In economies subject to frequent fiscal spending shocks, tighter macroprudential policy may contribute to raising the volatility of these economies, and their proclivity to enter a crisis. These two insights provide some understanding of different points of view in the eurozone debate on how to complete the banking union.

Altogether, this rich set of interactions can serve as the foundation for future work to study the adequate institutional design of macroprudential policy. Should this policy be part of the mandate of the Treasury, the central bank, or an independent authority? If the latter, how much coordination should it have with these authorities, or how should its independence be designed? How would other links between these policies interact with the ones discussed in this paper?

For each individual macroprudential policy, what is its quantitative effect on the share of government liabilities held by banks, and how does it compare with its effect on lending, output, and tax revenues? Future research can build on this paper to answer these questions.

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Appendices

This appendix contains proofs and additional derivations.

Appendix A

Derive Pricing Equation (4) for Bonds

The Euler equations associated with the optimal choices by the household are:

$$u_t'(.) = \frac{\psi\left(1+i_t^d\right)u_{t+1}'(.)\,p_t}{p_{t+1}}, \tag{A1}$$

$$u_t'(.)\left(\ell'\left(\frac{b_t}{p_t}\right)-q_t\right) = \frac{\psi u_{t+1}'(.)\,p_t\delta_{t+1}}{p_{t+1}}. \tag{A2}$$

The first Euler equation captures indifference with depositing one more unit in the banks. The second one reflects the indifference with holding one more government bond. Relative to deposits, bonds may not pay in full because of default, but they provide liquidity benefits. Combining the two gives equation (4).

Appendix B

Proof of Equation (21)

Rearranging equation (14) gives:

$$-\psi\gamma\left(1-\tau_{t+1}\right)\left(\frac{A_{t+1}}{\kappa}-1\right)\kappa k_t = \psi\delta_{t+1}\beta_t - d_t. \tag{A3}$$

Similarly, equation (13) can be rewritten as:

$$\kappa k_t = n_t + d_t - l_t'(.)\beta_t - \psi\delta_{t+1}\beta_t. \tag{A4}$$

Adding up those two equations and rearranging gives equation (21).

Appendix C

Proof that Banks Only Hold Bonds if Required

The payoff of a bank from regular investment is given by:

$$\left(1-\tau_{t+1}\right)\left(A_{t+1}-\kappa\right)k_t+\delta_{t+1}\beta_t-\psi^{-1}d_t. \tag{A5}$$

Replacing out for k_t given equation (21) and for d_t given equation (13) gives profits as a function of β_t and n_t:

$$\left(\frac{1-\gamma}{\frac{1}{\left(1-\tau_{t+1}\right)\left(\frac{A_{t+1}}{\kappa}-1\right)}-\gamma\psi}\right)n_t-\left(\frac{\left(1-\gamma\right)\ell_t'}{\frac{1}{\left(1-\tau_{t+1}\right)\left(\frac{A_{t+1}}{\kappa}-1\right)}-\gamma\psi}\right)\beta_t. \tag{A6}$$

The term multiplying β_t is strictly negative. Thus, raising bond holdings lowers the payout and the bank will never choose to voluntarily hold bonds.

On make-do investment, the lower the β_t, the lower the cost of investment x_t, for a fixed payout $\left(1-\tau_{t+1}\right)\left(A_{t+1}k_{t+1}^{*}-f\left(k_{t+1}^{*}\right)\right)$ and thus the higher the profits as well.

Appendix D

Proof that Higher Tax Rates Raise Tax Revenues

Differentiating the expression for revenue in equation (17) yields:

$$\frac{\partial R(.)}{\partial\tau_{t+1}}=\left(\frac{A_{t+1}}{\kappa}-1\right)\left(\frac{1-\gamma\psi\left(\frac{A_{t+1}}{\kappa}-1\right)}{1-\gamma\psi\left(\frac{A_{t+1}}{\kappa}-1\right)\left(1-\tau_{t+1}\right)}\right)+A_{t+1}k_{t+1}^{*}-f\left(k_{t+1}^{*}\right). \tag{A7}$$

From here, if $A_{t+1} > k$ we have that revenue rises with tax rates.

Appendix E

Proof of Proposition 1

Keeping fixed the left-hand side of equation (23), then the derivative of the right-hand side with respect to β_t must be zero. Doing so and keeping $T = 0$ and $\delta = 1$ gives:

$$\frac{\partial R(.)}{\partial \tau_{t+1}} \frac{d\tau_{t+1}(.)}{d\beta_t} = \ell_t'' \Phi_t - \frac{\partial R(.)}{\partial \beta_t}. \tag{A8}$$

Since the term $\partial R(.)/\partial \tau_{t+1}$ is strictly positive, taxes increase if and only if the left-hand side of equation (A8) is positive. Rearranging equation (22) gives the desired result.

Appendix F

Proof of Proposition 2

Again differentiating the right-hand side of equation (23) with respect to β_t, but now using the expression for $\partial T(.)/\partial \beta_t$ in equation (20) with $\delta_{t+1} = 1$ gives:

$$\frac{\partial R(.)}{\partial \tau_{t+1}} \frac{\partial \tau_{t+1}(.)}{\partial \beta_t} = \ell_t'' \frac{B_t}{q_t} - \frac{\partial R(.)}{\partial \beta_t} - \frac{1}{1+\xi}. \tag{A9}$$

As before, the sign of $\partial\tau/\partial\beta_t$ is the same as the sign on the right-hand side and, therefore, replacing for $\partial R(.)/\partial\beta_t$ and rearranging gives the desired result.

APPENDIX G

Proof of Proposition 3

Differentiating equation (23) with respect to β_t while keeping $T = 0$ but now with $\delta_{t+1} < 1$ and rearranging gives:

$$-\frac{\partial \delta_{t+1}}{\partial \beta_t}\left(1-\frac{1}{\frac{\ell_t'}{\psi \delta_{t+1}}+1}\right)=\delta_{t+1}\ell_t''\frac{B_t}{q_t}-\frac{\partial R(.)}{\partial \beta_t}. \tag{A10}$$

Since the sign of $-\partial\delta/\partial\beta$ is the same as the sign on the right-hand side, replacing for $\partial R(.)/\partial\beta$ yields the desired expression.