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A Reinterpretation of the Gordon and Barro Model in Terms of Financial Stability

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Abstract

A government bailout model based on the framework of time-consistent monetary policy of Barro and Gordon (1983) is developed. In the model, the banking sector and the government play a game where the former chooses a bailout expectation whereas the later reacts by choosing its optimal bailout policy. The banking sector is assumed to be perfectly competitive, aiming only at anticipating the bailout policy. An excess of credit ensues and firms over-invest, which can be amended by an appropriately chosen reserve requirement. The government faces a trade-off between efficiency and stability in trying to minimize the costs of intervention.

Keywords: Government intervention; bailout; real investment.

JEL Classification: G1; G2; G3.

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1 Introduction

The government bailout of the banking sector during the financial crisis of 2007-2009 brought again the question: what are the unintended consequences that come along with such a policy? The main focus of the literature has been on the creation of moral hazard, i.e., banks, by anticipating government's intervention in bad states, tend to behave in a way less prudential that otherwise would be reckoned (Farhi and Tirole (2012)).

Though important, moral hazard might not be the only side effect to harm the economy following a bailout. The aim of the present paper is to show that a bailout might have pervasive effects even when one abstracts from moral hazard considerations. For that, the time-consistent monetary policy model developed in Barro and Gordon (1983) is slightly modified and given another interpretation.

The main idea is that the banking sector and the government play a simultaneous game where banks form an expectation of government bailout and the government in turn has to choose what the effective bailout policy will be. The critical assumption is that banks live in a perfectly competitive world, and their only objective is to anticipate correctly the government's bailout policy. The role of the government is to safeguard the depositors' money lent to the banking sector, which might be endangered whenever firms fail to repay to the banking sector the money borrowed to invest in projects - the very money of depositors.

The implication of the above modeling is that the government is a passive entity whenever firms' projects succeed, being called upon action only when the bad state happens, i.e., when firms' investments fail. In the bad state the banking sector's assets fall short of total liabilities, and a crisis takes place since depositors cannot be repaid in full. The government then tries to minimize the crisis by injecting money on banks so that the repayment rate to depositors is increased. Such a bailout is costly, though, and the government cannot abide by a policy that eliminates the risk of a crisis.

The size of the bailout is shown to depend on the reserve requirement that the government imposes on banks, by the mere fact that it limits the total amount that can be lent to firms. The trade-off that emerges is then between efficieny and stability: an efficient level of investment requires a positive bailout level, whereas the government would be better-off by committing to a zero bailout policy.

The analysis of the model suggests two ways by which the government could pursue a

policy of minimum bailout, namely (i) a strong secondary market for the assets of firms in distress, making the occurrence of the bad state less disruptive from the point of view of banks' payoff, and (ii) making the bailout policy to be prohibitively costly so that banks would not expect it to happen in the first place.

1.1 Related Literature

An approach consisting of a simultaneous game similar to the one considered here is developed in Della'Riccia and Ratnovski (2013). In a framework with the possibility of moral hazard, their main insight is that government's commitment to stop contagion might be a disciplining device leading banks to invest more cautiously. Differently from us, the optimal policy is not of a zero bailout type but instead one that leaves minimum rents for banks.

The model to be presented assumes that bailouts take the form of a direct assistance to the banking sector, and does not allow for interventions of the type of changes in the interest rate. Consensus about which of the two would be more effective is yet to be achieved in the literature. For instance, whereas Diamond and Rajan (2012) show that changes in the interest rate can help banks without undermining the disciplinary role of deposits, Farhi and Tirole (2012) argue that under such a policy banks' leverage choices are strategic complements, leading to collective moral hazard.

In the analysis of Keister (2014), prohibiting bailouts is not necessarily desirable, though not by the same reason presented here, i.e., that it would lead to underinvestment by firms. However, if the government would dispose of the reserve requirement, the suggestion of Keister of taxing short-term liabilities would be an effective solution to decrease bailouts without distorting investments.

Lorenzoni (2008) shows that the combination of limited commitment in financial contracts (borrowers and lenders) and assets prices being determined in a spot market is what leads to excessive borrowing. Although not explicitly considered here, there is lack of commitment in our model due to the fact that firms cannot repay the banking sector in full in the bad state, and this is not internalized by banks since they just try to anticipate correctly the bailout policy of the government. Hence, at least as far as the source of the inefficiency leading to overinvestment is concerned, the paper agrees with the model of Lorenzoni.

Another interpretation is along the lines of Freixas and Rochet (2008). As they put it, more competition leads banks to increase their riskiness. In the model of the present paper, competition is modeled in a reduced form by assuming that banks' objective is only to correctly anticipate the bailout policy of the government: they survive as long as that is achieved. Under perfect competition, however, bankshave charter value equal to zero, i.e., they are not endowed with any positive continuation value whatsoever. This could be yet another reason behind banks overlending, and the government could try to amend that by restricting competition in the banking sector.

2 Model

The model follows the seminal paper of Barro and Gordon (83) on time-consistent monetary policy. The idea is that the government will choose a probability of bailing out the banking system based on banks' expectation of government bailout, and the probability chosen by the government will be such that a bailout trades-off benefits and costs.

The economy consists of a competitive banking sector, firms, depositors and the government in a two period world, $t = 0, 1$. The unique good is a numeraire of which depositors are initially endowed with L units. Depositors are risk neutral and lend their resources to the banking sector at a zero interest rate. Banks in turn lend $I \leq L$ resources from depositors to firms, which in turn invest in projects. The aggregate payoff of firms' projects, for an aggregate investment of I, is:

$$Y(I) = \begin{cases} \overline{y} = IR, & \text{with probability } \ p, \\ \underline{y} = bL + (\gamma - \gamma^e) RI, & \text{with probability } \ 1 - p. \end{cases} \tag{1}$$

where $R \geq 1$, the parameter $b \in (0, 1)$ captures the fact that in the bad state the payoff to firms is not large enough to allow banks to repay their depositors and γ and γ^e are the actual and expected bailout of the banking sector, respectively.

The banking sector is competitive so that banks only want to anticipate the corrected level of bailout, i.e., their aggregate payoff is represented by:

$$U_B(\gamma^e; \gamma) = -(\gamma - \gamma^e)^2. \tag{2}$$

The government's payoff in turn includes the cost of a bailout and the spillover of a crisis from the banking to real sector, i.e., how much banks' assets would fall short to

banks' liabilities with depositors:

$$U_G\left(\gamma;\underline{y}\right) = -c\gamma^2 - \left(\underline{y} - L\right)^2, \tag{3}$$

where $c \geq 1$ is a measure of the cost of funds for the government and the second term captures the cost a banking sector either with too high or too low assets vis-a-vis its liabilities.

The payoff of firms, banks and the government implicitly assume that when firms' investment succeed, banks are not better-off since they live in a competitive environment where all the profits accrue to the firms. On the other hand, banks automatically fail whenever the investment by firms do not succeed. The bill is then assumed by the government, who has to bailout the banking sector and guarantee that depositors get their money back.

By plugging $\underline{y}$ from (1) into (3), the government's objective function as a function of the expected level of the banking sector bailout can be written as:

$$\max_{(\gamma)} \quad U_G\left(\gamma;\gamma^e\right) = -c\gamma^2 - \left[\left(b-1\right)L + \left(\gamma - \gamma^e\right)RI\right]^2, \tag{4}$$

with first order condition given by:

$$\gamma = \frac{RI}{c + \left(RI\right)^2}\left[\left(1-b\right)L + \gamma^e\left(RI\right)\right] =: \gamma\left(\gamma^e\right). \tag{5}$$

Therefore, $\gamma\left(\gamma^e\right)$ is the optimal bailout level chosen by the government when the expectation of bailout from the banking sector is γ^e. Upon that, the bailout expectation of the banking sector is chosen as a solution to:

$$\max_{(\gamma^e)} \quad U_B\left(\gamma^e;\gamma\left(\gamma^e\right)\right) = -\left(\gamma\left(\gamma^e\right) - \gamma^e\right)^2, \tag{6}$$

or equivalently, by using (5), as:

$$\max_{(\gamma^e)} \quad U_B\left(\gamma^e;\gamma\left(\gamma^e\right)\right) = -\left\{\frac{RI}{c + \left(RI\right)^2}\left[\left(1-b\right)L + \gamma^e\left(RI\right)\right] - \gamma^e\right\}^2. \tag{7}$$

The first order condition of the maximization problem in (7) is:

$$\gamma^e = \frac{RI\left(1-b\right)L}{c}, \tag{8}$$

which is the optimal bailout level expected by the banking sector. From the characterization of the banking sector maximization problem in (6), it should be clear that γ^e is merely a fixed point of the reaction function of the government, $\gamma(\gamma^e)$, and hence it follows that $\gamma = \gamma^e$ as given by (8).

From (3) and the fact that $\gamma = \gamma^e$, the payoff to the government is written as:

$$U_G(\gamma; \gamma^e) = -c\gamma^2 - [(b-1)L]^2, \tag{9}$$

and, therefore, the government would be better-off if it could commit to a no-bailout policy where $\gamma = 0$.

3 Analysis

The model of the previous section is in a very reduced form and considers only a stylized scenario where banks are not affected by the amount they borrow from depositors and lend to firms. In other words, L and I do not enter the expression representing the payoff of the banking sector, (2).

Yet, as shown in (9), the government faces harsh consequences even without banks strategically choosing the amount of borrowing and lending. Upon the expression for γ, the payoff of the government can be written as:

$$U_G(\gamma; \gamma^e) = -[L(b-1)]^2 \left[1 + \frac{(RI)^2}{c}\right]. \tag{10}$$

Since the amount lent must be less or smaller the amount borrowed, i.e., $I \leq L$, the payoff to the government is minimized for $I = L$. Hence, the government would like to ensure that $I = I^* < L$, for a suitable I^* left to be determined and that would represent the efficient level of investment by the firms in the economy. Else, the government would like to crowd-out some banks and have money from depositors turned to itself, decreasing L borrowed by banks.

The question that arises then is (i) what is the efficient level of investment by firms, I^*, and (ii) what policy should be implemented so that banks have incentives to commit lending only I^*. Starting with the first question, assume that r is the cost of capital for the firms in the economy. The expected payoff of a firm in the economy, for an investment of I, is given by, following (1):

$$\overline{Y}(I) = (IR)\,p + bL\,(1-p)\,. \tag{11}$$

The efficient level of investment, I^*, is therefore the one such that the expected rate of return on total investment equals the cost of capital, $\overline{Y}(I^*)/I^* = 1 + r$, or:

$$I^* = \frac{bL\,(1-p)}{(1+r) - Rp}. \tag{12}$$

Turning to the question of how to implement I^*, one possible way to achieve that would be by imposing reserve requirements on the amount that can be lent by the banking sector to the firms. Let α denote the reserve requirement imposed by the government on banks. Government's choice of α will be such that $(1-\alpha)\,L = I^*$, or:

$$\alpha = 1 - \frac{b\,(1-p)}{(1+r) - Rp}. \tag{13}$$

A few remarks are in place regarding the efficient level of investment, I^*, and the reserve requirement, α. Clearly, the efficient level of investment is increasing in the amount of deposits received by banks, L, and the probability of success, p. On the other hand, a higher cost of capital, r, should lead to a decrease in the amount invested by firms. The parameter that capture the scrap value of the investment when it fails, b, has also a positive impact on I^* when it increases.

Looking at the reserve requirement, the effect of the variables affecting I^* is opposite when it comes to α, from the mere fact that, by definition, the reserve requirement diminishes the amount that can be lent by banks and hence the total investment by firms.

Another aspect of the model is the relationship between the government's bailout level and the reserve requirement. From (8) and (13), the bailout level can be written as:

$$\gamma = RL\,(1-\alpha)\,\frac{(1-b)\,L}{c}. \tag{14}$$

Therefore, the bailout level is a decreasing function of the reserve requirement. As discussed previously, the government would be better-off if it could commit to $\gamma = 0$, which could be achieved by setting $\alpha = 1$. However, this is equivalent to banks being forbidden to lend, which would in turn preclude firms from investing. Since $I^* > 0$, government would have to sacrifice efficiency to achieve stability.

There are interesting implications in terms of what kind of policies the government could try to follow that, differently from the reserve requirement, could decrease the bailout level and yet would not distort the efficient level of investment. By looking again at (8), two variables would make γ to vanish: $b = 1$ and $c \to \infty$. Recalling that b captures the scrap value of firm's investments when they do not succeed, a unitary b represents a well developed secondary market where firm's assets could be redeployed in another activities without leading significant losses to banks. A significantly large c, on the other hand, the fact that it is too expensive for the government to provide a bailout, in a way that banks would not reasonably expect them to do so. Both are institutional changes that could prevent the government being trapped in rescuing the banking sector when it would be better-off not doing so.

4 Concluding Remarks

This paper presents a model following the Barro and Gordon (1983) work on time-consistent monetary policy. In the model proposed, banks face perfect competition, which leaves them only trying to correctly anticipate the bailout policy of the government. Government's policy is implemented in the case of a crisis, which happens in the bad state of the world where firms cannot pay back the banking sector, which in turn must default on its depositors. The government then implements its policy, which trades-off the cost of injecting money on banks and the cost of letting depositors born losses.

The main result of the paper is that, even without moral hazard, the presence of the government leads to overinvestment by firms. To counterbalance this effect, the government can adopt a reserve requirement, which basically puts a cap on the amount that the banking sector can lend out of the money it captures from depositors. Overall, the government would be better-off if it could commit to a zero bailout policy, but this would entail setting a unitary reserve requirement. Since the efficient level of investment is positive, a trade-off between efficiency of firms' investment and stability of the banking sector emerges. The way around this problem would be for the government to invest in institutional changes that (i) guarantee a strong secondary market for firms assets in case their investments fail, and (ii) make it credibly unaffordable the possibility of a bailout, e.g., excluding that by law.

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