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Abstract

The standard macro(prudential) models focus on externalities and treat all prudential instruments as alternative, but equivalent, forms of Pigouvian taxes. This paper explicitly models individual banks' risk choices and

shows that different prudential instruments affect banks' risk-taking incentives differently. Thus, conflicts may arise between the micro and macro prudential stance.

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Macro Prudential Policies from a Micro Prudential Angle*

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1 Introduction

The active use of prudential instruments to control credit volumes and allocations fell into disgrace in the 1990s, when the regulatory pendulum swung toward financial liberalization.¹ Then, in 2008, the global financial crisis hit financially developed economies hard and exposed the limits of the existing prudential framework in dealing with systemic risk. This swung the pendulum back, and the active use of prudential instruments such as reserve requirements, loan-to-value ratios, taxes on credit, and capital requirements to smooth the credit cycle and avert major crises (macroprudential policies, according to the current jargon) gained momentum. The global financial crisis also uncovered the dangerous liaisons between micro and macro stability and forced macroeconomists to give a serious look at the interaction between business cycles and financial frictions.² The latter started being incorporated in standard DSGE models and with them the rationale for macroprudential policies became evident.³

However, in (necessarily) stylized DSGE models, taxes on debt, capital, and liquidity requirements end up being equivalent forms of Pigouvian taxation that can effectively deal with the negative overborrowing externalities.⁴ This raises the question of how robust such results are—that is whether in a more micro-founded model such equivalence results still hold.

This is the question we address in this paper. Using a very stylized model where a bank maximizes profits choosing lending rates and the riskiness of its portfolio, we show that, from a microprudential perspective, the choice of macroprudential instruments does indeed matter. It is true that capital requirements, liquidity requirements and taxes on debt all have an adverse effect on banks' incentives to lend, which means that all these instruments successfully address overborrowing externalities. However, while capital requirements, by increasing the banks' skin in the game, make banks more prudent, liquidity requirements and taxes on debt make banks engage in riskier behavior.

There are a number of studies discussing the purposes of macroprudential regulation in dealing with different kind of externalities, and a growing one looking at the effectiveness of macroprudential measures in smoothing the business cycle; Galati and Moessner (2011) and Hanson et. al. (2011) are excellent surveys. However, little is still known about how the choice of different prudential instruments affects the incentives of the single institutions to take on risk. This paper is an attempt to fill such a gap.

The model we present is similar to Dell'Ariccia et al. (forthcoming) who study the interaction between monetary policy and the capital structure of the bank. The questions we raise in this paper are similar to those in De Nicolò et al. (2012) who study how, in the presence of credit and liquidity risk, capital and liquidity requirements affect a bank's risk-taking incentives in a calibrated dynamic

¹This regulatory view was supported by macroeconomic models built in a Modigliani-Miller world where the absence of financial frictions made regulation and supervision unnecessary. Even when macro models such as Bernanke and Gertler (1996) and Kiyotaki and Moore (1997) highlighted the possibility that simple agency problems could lead to potentially dangerous credit cycles, the idea of using prudential instruments to smooth business cycle fluctuations was considered as *passé*. Given such a background, it is not surprising that prudential regulation was generally analyzed in micro-models (as the one surveyed in Freixas and Rochet, 2008) and its macro impact generally overseen.

²Usually in the form of collateral constraints that create externality problems that lead to episodes of overborrowing and subsequent Fisherian deflation.

³Macroprudential policies force agents to internalize the external cost of borrowing making the economy less vulnerable to financial crises. This is the argument for Pigouvian taxes in Jeanne and Korinek (2010), and Bianchi (2011).

⁴Bianchi (2011) formally proves the equivalence between these different instruments.

model. Calomiris et al. (2012) discuss the relative effectiveness of capital and cash requirements and, differently from our paper, they find that reserve requirements may be an effective tool to decrease default risk. However, the channel they emphasize is the decrease in leverage, which, in our model, can only be achieved through tougher capital requirements.

2 The Model

2.1 The Bank's Problem

We focus our analysis on a (representative) monopolistic competitive bank facing a downward sloped demand curve for loans L , $L = (A - \beta R)$, with R denoting the interest rate offered by the bank. Notice that A can be thought of as a measure of the strength/quality of the demand for credit, and β as an inverse measure of the bank's market power. In addition to the lending rate, the bank also chooses the riskiness of its portfolio. Here, we model the choice of risk as the choice of a level of monitoring effort q , $q \in [0, 1]$, exerted by the bank, which also represents the probability that the loan is repaid; we further assume that the cost of monitoring is $c(q) = \frac{cq^2}{2}$ per dollar lent.

Monitoring costs are borne by the bank before returns are realized. Monitoring can be literally thought of as a non pecuniary cost associated with screening efforts; however, we prefer to interpret our set-up more broadly, and think of it as a reduced form of a model in which the bank chooses among portfolios with different risk returns profiles.⁵

As per the source of funding, theoretically, banks can choose between demand deposits and capital. However, since we assume that (i) deposits are fully insured and are supplied inelastically at an interest rate r , and (ii) the cost of raising capital is $r + \kappa > r$, in the absence of capital requirements, the bank will rely exclusively on the (cheaper) demand deposits. The problem of the bank can thus be written as:

$$\underset{q \in [0,1], R \in [r, A/\beta]}{Max} \Pi = \left(q(R - r) - \frac{cq^2}{2} \right) (A - \beta R).$$

The necessary and sufficient first-order conditions for a maximum are:

$$\frac{\partial \Pi}{\partial q} = (A - \beta R)(R - r - cq) = 0, \quad (1)$$

$$\frac{\partial \Pi}{\partial R} = Aq - 2\beta qR + \beta \left(qr + \frac{cq^2}{2} \right) = 0, \quad (2)$$

so that⁶

$$q^* = \frac{2(A - r\beta)}{3c\beta}, \quad (3)$$

$$R^* = \frac{2A + r\beta}{3\beta}. \quad (4)$$

⁵ As in Blum (1999), or Cordella and Levy Yeyati (2003).

⁶ To avoid boring the reader with tedious assumptions, throughout the paper we implicitly assume that the parameters are such that the optimal monitoring effort and interest rate correspond to an interior solution to the bank's maximization problem— $q^* \in (0, 1)$ and $R \in (r, A/\beta)$.

Not surprisingly, monitoring effort depends positively on the strength of the demand (and on the bank's market power) and negatively on its costs (both monitoring and funding costs). Having worked out the simplest model in which a bank strategically chooses risk and interest rates, the next step is to introduce in the model some of the most popular macroprudential instruments discussed in the literature and see how they may affect the bank's behavior.

Notice that the analysis of this paper is purely positive. Our interest is that of highlighting some of the possible trade-offs that may arise between micro and macro prudential objectives without modelling the overborrowing externalities (that call for macroprudential policies in the first place) and thus without explicitly solving for the optimal policy. This is why we decided to focus on a representative monopolistic competitive bank. In other words, we assume that the macroprudential regulator might want to smooth the credit cycle because of the negative externalities associated with lending booms and busts (which we do not model) and we ask how the different instruments it uses affect the risk-taking incentives of a representative bank (which we do model). In addition, we also abstract from other (good) prudential reasons why reserve requirements (or other measures targeting the banks' liability structure, such as the net stable funding ratio introduced in Basel III) may be put in place.

2.2 Prudential Regulation

We now look at three macroprudential measures that have received particular attention in the recent literature: a tax t on deposits (which is equivalent to the presence of unremunerated or partially remunerated reserve requirements), a tax τ on loans levied on borrowers,⁷ and a minimum capital requirement set equal to a fraction $\phi \in [0, 1]$ of total lending.

Under this regulatory framework, the bank's expected total cost of funding per unit of loans, $C(\cdot)$, can be written as

$$C(\phi, \kappa, t, r) = q(1 - \phi)(r + t) + \phi(r + \kappa),$$

where κ is the wedge between the cost of capital and the interest rate. For the sake of simplicity, in the remainder of the analysis, we assume that capital requirements are always binding, that is $t < \kappa$. This assumption is equivalent to imposing an upper bound on the tax on deposits, or on the level of unremunerated reserve requirements. The bank's problem can now be written as:

$$\max_{q \in [0, 1], R \in [r, A/\beta]} \Pi_i = \left(q(R - \theta) - \phi(r + \kappa) - \frac{cq^2}{2} \right) (A - (\beta + \tau)R), \quad (5)$$

with $\theta \equiv (1 - \phi)(r + t)$.

The equilibrium is now fully characterized by the first-order conditions:

$$\frac{\partial \Pi}{\partial q} = (A - \beta(R + \tau))((R - \theta) - cq) = 0, \quad (6)$$

$$\frac{\partial \Pi}{\partial R} = -\beta \left(q(R - \theta) - \phi(r + \kappa) - \frac{c}{2}q^2 \right) + q(A - \beta(R + \tau)) = 0, \quad (7)$$

⁷Notice that although the tax on loans is assumed to be paid by borrowers, the bank's problem will be affected through the demand for loans that now becomes $A - \beta(\tau + R)$.

which yield

$$q^* = \frac{1}{3c} \left(\frac{A}{\beta} - (\theta + \tau) + \sqrt{\left(\frac{A}{\beta} - (\theta + \tau) \right)^2 + 6c\phi(r + \kappa)} \right), \quad (8)$$

$$R^* = \frac{1}{3} \left(\frac{A}{\beta} + 2\theta - \tau + \sqrt{\left(\frac{A}{\beta} - (\theta + \tau) \right)^2 + 6c\phi(r + \kappa)} \right). \quad (9)$$

Expressions (8) and (9) provide the equilibrium levels of risk and interest rates (and thus lending volumes) as a function of the parameters of the model. Differentiating (8), and (9) with respect to ϕ , t , and τ , it is straightforward to verify that $\frac{\partial q^*}{\partial \phi} > 0$, $\frac{\partial q^*}{\partial t} < 0$, $\frac{\partial q^*}{\partial \tau} < 0$; and⁸ $\frac{\partial L^*}{\partial \phi} < 0$, $\frac{\partial R^*}{\partial t} < 0$, $\frac{\partial R^*}{\partial \tau} < 0$. We thus have that:

Result 1 *A tightening of macroprudential regulation (through an increase in either minimum capital requirements, reserve requirements, or taxes on credit) leads to a reduction in credit volumes. However, while an increase in capital requirements decreases the riskiness of the bank's loan portfolio, an increase in reserve requirements or taxes on credit increases it.*

The result suggests that, when incentives are taken into account, the equivalence between different macroprudential tools is broken. In particular, an increase in the bank's external cost of funds, triggered, for instance, by an increase in reserve requirements, increases individual banks' risk-taking incentives.⁹ The reason is that an increase in the cost of the bank's external liabilities, such as obligations to depositors, only matters if the bank does not fail. This tends to exacerbate moral hazard, and to induce the bank to behave in a less prudent way. Similarly, as long as the demand for loans is not completely inelastic, the introduction of a tax on credit reduces the bank's returns in the case of success and so its incentive to monitor. On the contrary, the introduction of capital requirements, by increasing the bank's skin in the game, makes it more liable and decreases risk-taking incentives.

Finally, comparing the effects of reserve requirements and taxes, it is easy to verify that, in the absence of minimum capital requirements, taxes on deposits and taxes on credit are equivalent. In the presence of capital requirements, instead, an increase in the tax on credit will affect credit (negatively) and risk taking (positively) more than a tax on deposits. This follows from the fact that the presence of capital requirements reduces the deposit tax base.

3 Conclusions

According to the current wisdom, prudential regulation should be thought of as an additional instrument in the hands of policymakers to avoid the build up of excessive risk along the business cycle. Such a view is supported by many recent contributions that incorporate financial amplification effects in open macro models, and study how 'macroprudential' taxes can help in coping with financial externalities.¹⁰

⁸Remembering that $\frac{\partial L^*}{\partial R^*} = -\beta$.

⁹According to Aldo Mendes, the Brazil Central Bank's a central bank director responsible for monetary policy. "Lowering reserve requirements helps financial stability," Bloomberg, September 20, 2012.

¹⁰See, among others, Bianchi et al. (2012), Korinek, (2011), and Benigno et. al. (2011)

In this paper, we show that while different prudential instruments may help reduce lending incentives, their effect on banks' risk-taking incentives are uneven. While capital requirements always promote safer behavior, the same is not true for liquidity requirements and, in general, for those kind of instruments that are equivalent to a tax on banks' liabilities. This means that if it is important to look at the macro effects of microprudential measures, one should also look at the micro effect of macroprudential policies. Policies that aim at reducing risk associated with financial externalities may under certain circumstances increase banks' risk appetite so that micro and macro prudential objectives may not always go hand in hand.

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