Incentives through the cycle: microfounded macroprudential regulation

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Abstract

Following a decline in the fundamental risk of assets, the ability of banks to expand the balance sheet under a Value-at-Risk constraint increases (as in Adrian and Shin (2010)), boosting the bank's incentives to provide costly monitoring effort that prevents asset deterioration. On the other hand, high asset demand and prices, eventually, raise the bank's payoff in the event of liquidation associated to asset deterioration, jeopardizing incentives. This paper shows that a microprudential regulatory regime that disregards the equilibrium effect of macro variables (asset prices) on micro behavior (effort), performs poorly as low fundamental (exogenous) risk reduces bank's effort and induces high (endogenous) deterioration risk. This analysis calls for a macroprudential regulatory regime in which the equilibrium feedback effect is fully taken into account by the authority in designing incentive compatible capital requirements, providing a theoretical foundation to the countercyclical buffer of Basel III.

Keywords: Macroprudential regulation, incentives, financial stability, externality.

JEL Classification: E44; D86; G18

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1 Introduction

The fact that under certain conditions the financial system contributes with additional volatility to macroeconomic dynamics is nowadays a shared and well analyzed view (Kiyotaki and Moore (1997), Bernanke et al. (1999), for a recent survey Panetta et al. (2009)). And indeed, in the aftermath of the crisis, many analysts, commentators and policymakers blamed the financial industry for their devastating contribution to the run-up of the crisis.

Financial regulation did also have some responsibilities. Flaws in micro-prudential rules have in fact provided bankers with head-we-win-tail-they-loose incentive structures, fostering excessive risk-taking, deterioration of lending standards and perverse behaviors (Borio (2008); Buiter (2007); Kashyap et al. (2007); for a discussion, see Cannata and Quagliariello (2009)). In the benevolent version, bankers and individual institutions were not perfectly in the position to foresee the ongoing overheated dynamics and the imminent burst as they miss a bird's eye view of the economic system. In this respect, it was up to policy makers and regulatory authorities to address the problem of externalities that arise from the inefficient aggregate outcome of individually optimal decision-making. And they have failed to do so. While macroprudential issues were increasingly debated before the eruption of the crisis (Crockett (2000), Borio (2003)), they were mainly confined to macroprudential analysis, with almost no room for macroprudential policies, not to mention concrete tools (Clement (2010)).

The debate on macroprudential issues is still lively and answers to relevant questions are still not completely conclusive.

- First, some policymakers and academics (Borio et al. (2001)) argue that the cycle is endogenous to the behavior of financial institutions.[1] In this sense, the rationale of macroprudential regulation should go beyond the accumulation of capital in good times to be released when the bad times arrive. We provide insights that support this view highlighting the mutual interplay between macro variables, individual incentives of banks in implementing sound risk management and prudential rules.

[1]According to Borio et al. (2001), those decisions are frequently based on misperceptions of the evolution of risk over time. The stylized facts are simple. During expansions, intermediaries tend to underestimate risk exposures to risks, relaxing borrowers selection criteria and monitoring processes. Accordingly, they also reduce the amount of provisions for future losses. After the peak of the cyclical upturn, customers' profitability worsens, borrowers creditworthiness deteriorates and losses are revealed. This pattern is often coupled with the fall of asset prices that, in turn, further affects customers' financial wealth and depresses the value of collateral. Banks' exposures to credit risk increase, thus requiring larger provisions and higher levels of capital, at the very moment when capital is more expensive or simply not available. Intermediaries may react by reducing lending, thus exacerbating the effects of economic downturn.

- Second, the role of macro variables as asset prices in the allocation and in the build up of risk. In the model banks' utility and incentives crucially depend on asset prices. We argue that high asset prices jeopardize incentives.

- Finally, why and how should capital requirements evolve along the business cycle. The model highlights the drawbacks of microprudential risk-weighted capital requirement in line with the Basel II Accord and provides theoretical foundations to macroprudential buffers as in the Basel III proposal.

A new macroprudential orientation has been undoubtedly one of the key blocks of the reform roadmap. The Financial Stability Board (2009), clearly stated that a macroprudential orientation focuses policy on avoiding damage to the financial system as a whole with an eye to the impact on the real economy. Accordingly, Bernanke (2009) pointed out the need to combine a systemwide, or macroprudential, perspective with firm-specific risk analysis to better anticipate problems that may arise from the interactions of firms and markets. These principles have been transposed in prudential regulation by the Basel Committee (2010). While the system-wide perspective cannot be circumscribed to it, most of the policy measures focused on procyclicality. In particular, the Committee introduced countercyclical capital buffers above minimum capital requirements that banks are required to build-up in buoyant economic conditions. In practice, it is still controversial what macroprudential policies are supposed to achieve. On the one hand, the most pragmatic view advises not to attach excessive emphasis to the potential of such instruments. Macroprudential tools should just aim at ensuring that financial intermediaries accumulate sufficient resources in good times when they are cheap and risk is underestimated that can be run-down in bad times with no or little repercussions to financial stability. On the other, according to a more ambitious view, the macroprudential policy should go hand in hand with monetary policy and directly aim at managing economic cycles (for a survey, see Galati and Moessner (2010)).

We analyze macroprudential regulation using an incentives model in which banks perform two value-adding activities: monitoring of their asset holdings and screening of new assets. Monitoring prevents value-destroying asset deterioration. In the bad state of deterioration, the bank sells off assets at a discount liquidation price and exits the market. The bank's second activity consists in screening new risky assets to expand the balance sheet. The amount of assets the bank can purchase is affected by a Value-at-Risk constraint (as in Adrian and Shin (2010)). We refer to banks that participate to asset purchases as "active". The double activity (monitoring and screening) requires high effort and effort is costly for the bank. This create rooms for shirking behavior for active banks that may be tempted to trade-off a positive probability of deterioration with saving in effort costs. The opportunity cost of effort thus depends on (i) the liquidation price of assets and (ii) the amount of assets the bank can purchase when it avoids deterioration. Low fundamental risk and high fundamental value of assets relax the VaR constraint and ameliorates banks' incentives. In the model, a prudential authority is delegated to prevent non incentive compatible banks to be active. Incentive compatibility is endogenously derived as a condition on the minimum bank's equity (capital requirement). Under a microprudential regulatory regime, the authority disregards the equilibrium effects of positive shocks to fundamentals on asset prices (macro variable) and from asset prices to incentives. Indeed, high prices jeopardize banks' incentives both increasing the liquidation income in the bad state of deterioration and decreasing the amount of new asset the bank can purchase under the VaR constraint. This type of externality (see below) follows from a purely "macro" phenomenon *à la* Borio (2003) and should be taken into account by the regulatory authority in designing capital requirements. We show that the equilibrium (macroprudential) capital requirement is increasing in the fundamental value of assets and decreasing with the fundamental risk, thus providing theoretical underpinnings to macroprudential capital buffer of the Basel III proposal.

What is peculiar of our model is that it contemplates an externality, and the need for a policy intervention, as the consequence of improvements to fundamentals. Absent regulation, positive shocks exert two competing effects on incentives. Behaving banks with a positive asset demand sustain asset prices. This encourages shirking banks to free ride other banks effort, enjoying private benefits from low effort and high prices in liquidation. In the expanding phase of the cycle, low risk and/or high asset value increase the balance sheet capacity of banks. The positive price externality triggered by behaving banks sows the seeds of the following downturn as it decreases the marginal value of effort so inducing the build up of deterioration risk. The opposite happens if high deterioration risk materializes. Shirking banks would start to sell off their asset holdings. Eventually, low asset prices boosts incentives and increase the marginal value of effort.

Our approach is thus complementary to standard models, which rely mainly, if not uniquely, on negative exogenous shocks and amplification mechanisms (see Rochet et al. (1996), Allen and Gale (2004)) and is related to the endogenous risk literature (Morris and Shin (2003), Danielsson and Shin (2003)). Indeed, in the model, we can distinguish between two components of risk: a fundamental (perceived, exogenous) risk and an endogenous "deterioration" risk that depends on incentives. When fundamental risk is low – which typically happens in good times – banks become eager to expand the balance sheet. This ameliorates incentives and, under a microprudential regulatory regime, determines the minimum incentive compatible equity to decrease. However, the indirect effect that goes through higher demand and asset prices, jeopardize incentives and operates in the opposite direction. Banks may be tempted to leverage the booming times to save on costly effort (high prices guarantees high payoffs from asset liquidation). This behavior increases, eventually, the overall risk in the economy. We are in line with the view that macroprudential orientation of regulation can effectively correct perverse behaviors and implement efficiency reducing the amplitude of boom-bust financially driven cycles.

In section 2.1 we describe the building blocks of the model. Then we analyze the bank's incentive problem and the demand for assets according to the Value-at-Risk constraint (section 2.2 and 2.3). Capital requirements for banks, and their evolution in response to change in fundamentals, are derived from incentive compatibility (section 2.4). We characterize the microprudential regulatory regime (section 2.5), assuming the authority disregards the effects of shock to fundamentals on asset prices and from asset prices to individual bank incentives (section 2.5). We describe the macroprudential dimension of capital regulation (section 2.6) and discuss the dynamics of the incentives through the cycle (section 3). Section 4 concludes.

2 The model

2.1 Description

There are three dates: $t = 0, 1, 2$. All agents are risk neutral and do not discount future cash flows. There are three types of agents: borrowers, market investors and banks.

Borrowers Borrowers have profitable projects or ideas. Projects require a unitary initial investment and payoff at date 2 a positive random amount $\tilde{w}$. The probability structure of $\tilde{w}$ is: $E(\tilde{w}) = q$, $\min(\tilde{w}) = q - z$ and $\max(\tilde{w}) = q + z$. We refer to $z \in (q - 1, q)$ as the fundamental risk. The role of borrowers is really passive and we often treat them as securities that are purchased by banks. All the following considerations hold for the case of firms that are financed with loans or households that take out mortgages. Borrowers need to be monitored.[2] Lack of monitoring implies value-destroying asset quality deterioration: if at date t a borrower is not adequately monitored, with probability $1 - \pi$ the quality of its project deteriorates and the associated payoff declines to $\tilde{w} - c$ where $c \in (0, q - z)$ at date $t + 1$. In this case, if the bank that holds the deteriorated asset liquidates it, the latter would payoff a random amount $\tilde{w} - c$ at date $t + 2$ to the purchasing bank. Otherwise (no liquidation) it would payoff zero with certainty. Thus, following deterioration, banks always prefer to liquidate and we assume they exit the market after liquidation. For sake of expositional convenience, we distinguish between two kinds of securities: long term (LT) and short term (ST) securities. The only difference is the date at which they are purchased by banks:

- Each bank holds one long term security, purchased before date 0 at a unitary price (see Table 1).

[2] Only banks can provide adequate monitoring so that borrowers are not able to raise external financing directly from market investors.

- Short term securities are in a fixed supply S and are purchased (financed) by banks at date 1 at the equilibrium price $p \in [1, q)$.[3] To provide a scope for screening, one can imagine that, at the date 1 market for securities, besides ST securities, borrowers supply even junk assets that payoff zero at date 2 so that banks must screen to isolate junk assets. The latter are not purchased (financed) in equilibrium. Finally, note that LT securities in liquidation would be traded at the discount price $p - c$.

Investors A large number of perfectly competitive market investors (say households, pension funds, etc.) that hold and purchase banks' debt.

Banks The banking system is made up of a population of unit mass of banks that are uniformly distributed with respect to equity e. We treat e, together with the LT security, as an initial endowment for the bank. Table 1 shows the bank's initial balance sheet.

Table 1: Bank's initial balance sheet

Assets	Liabilities
1, long term security	$1-e$, debt e, equity

Finally, we assume banks cannot raise additional equity.

2.2 The problem of the bank

Banks can be *active*, i.e. participate to the date 1 market for assets or *inactive*. When active, the bank can decide to *behave*, i.e. put high effort to simultaneously *(i)* monitor the LT security to prevent deterioration and *(ii)* screen new assets, or to *shirk*, i.e. put low effort, save on effort costs and accept a positive probability of deterioration. Saving on effort yields a private benefits $B > 0$ (as in Holmstrom and Tirole (1997)). When inactive the bank ends date 2 with its initial portfolio.[4] Behaving banks prevent asset deterioration and expand their balance sheet purchasing new assets at date 1. Shirking banks (if any, see below) that experience asset deterioration would liquidate their LT asset holding at the price $p - c$.

[3] Note that when $p = 1$ the bank appropriates the entire outcome of the borrower investment project. On the other hand, the price cannot exceed the expected value q.

[4] Between date 0 and 1, banks should monitor their LT security to prevent deterioration and screen potential borrowers to isolate junks. We assume that it is this dual activity implies disutility to the bank. Between date 1 and 2, banks need only to monitor their portfolios.

Expected utilities are:

- For a behaving bank:

$$U_H = (q - p)x + q \tag{1}$$

where $(q - p)x$ is the expected payoff from new securities x purchased at date 1 at the price p and q the expected payoff from the initial LT security.

- For a shirking bank:

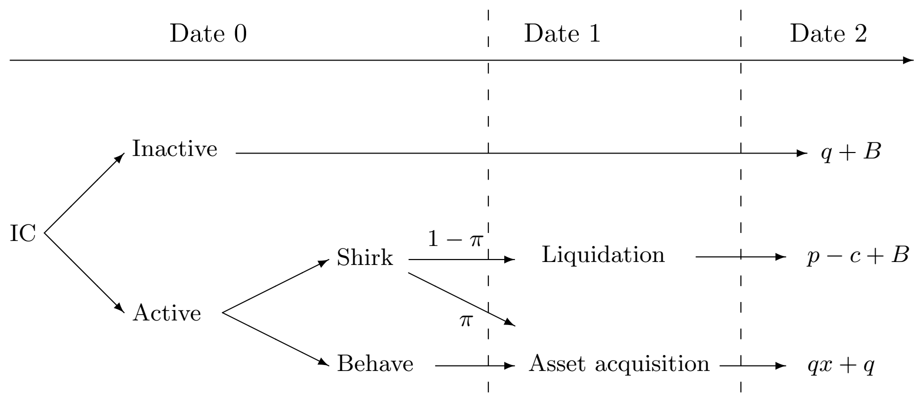
$$U_L = \pi[(q - p)x + q] + (1 - \pi)(p - c) + B \tag{2}$$

The shirking bank experiences asset deterioration with probability $1 - \pi$ and liquidate at the price $p - c$.

- The expected utility of an inactive bank is simply:

$$U_I = q + B \tag{3}$$

Figure 1: The timing of events in the model.



2.3 The demand for assets

At date 1, active banks that do not experience deterioration can afford the balance sheet expansion, issuing new debt and purchasing new assets. We follow Adrian and Shin (2010) assuming that the asset demand x is affected by a Value-at-Risk (VaR) constraint

$$\text{VaR} \leq e$$

The VaR constraint stipulates that the bank's equity is large enough so that the default probability is kept below some benchmark level. Default would occur when, at date 2, the value of the bank's assets is lower than the value of the bank's debt, that is $1 - e + px$. With no loss of generality, we assume that the benchmark default level is zero. Then, the VaR constraint is $(q - z)(x + 1) \geq 1 - e + px$ or, rearranging terms:

$$e - \{[p - (q - z)]x + [1 - (q - z)]\} \geq 0$$

where $[p - (q - z)]x + [1 - (q - z)] > 0$ is the worst case loss. As the utility of the bank is increasing in x, the VaR constraint is always binding. Solving for x, we get the asset demand of a bank with equity e:

$$x = \begin{cases} \frac{e-1+q-z}{p-q+z}, & \text{if } e > 1 - (q - z) \\ \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

The demand is non decreasing in the equity e, in the fundamental value of assets q and increasin in the price p and risk z.

2.4 Incentives and capital requirements

To make things interesting we assume that shirking destroys value in expectations (the expected payoff of the LT project of a shirking bank is lower than its cost):

$$\pi q + (1 - \pi)(q - c) < 1$$

and that private benefits are large enough

$$B > \frac{1 - \pi}{\pi}(q - p + c)$$

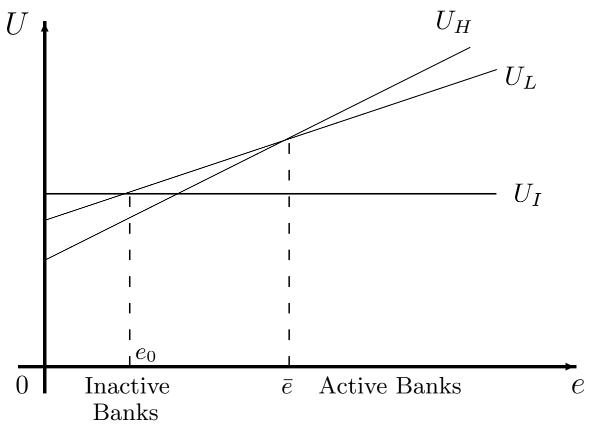
so that there exists a positive mass of banks that would prefer shirking both to inactivity and to behave (banks with $e \in (e_0, \bar{e})$ In Graph 1 below).

We follow the "representation hypothesis" of Dewatripont and Tirole (1994) and introduce a scope for prudential regulation assuming that a regulatory authority is delegated to restrict the possibility for non incentive compatible banks to be active so avoiding value destruction.

Banks incentive compatibility states that the expected utility from behaving is higher than the utility from shirking:

$$(q - p)x + q \geq \pi[(q - p)x + q] + (1 - \pi)(p - c) + B$$

Graph 1: Incentives and the capital requirement.



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$$(q-p)x + q \geq \pi[(q-p)x + q] + (1-\pi)(p-c) + B$$

Rearranging terms and using the equation (4) for x, the regulatory constraint can be reformulated as a condition on the minimum equity:

$$e \geq \bar{e} \equiv \frac{(p-c+b-q)(p-q+z)}{q-p} + 1 - q + z \tag{5}$$

where $b \equiv (1-\pi)B$ is again a measure of private benefits from saving on effort.

The regulatory intervention sets an incentive compatibility constraint that is a capital requirement: only if the bank meets that requirement is allowed to be active. Graph 1 depicts how the capital requirement would work in practice. The bank is endowed with a certain amount of capital e, which determines its ability (quantity $x(e)$) to subscribe new assets under the VaR constraint. The quantity of assets, in turn, is a driver of the bank's incentives. The supervisory authority does not allow the bank to carry on actions that lead to value destruction and pursues this objective setting a minimum capital requirement (the policy instrument). Banks with equity $e \geq \bar{e}$ can be active as they are expected to put high effort and prevent asset deterioration.

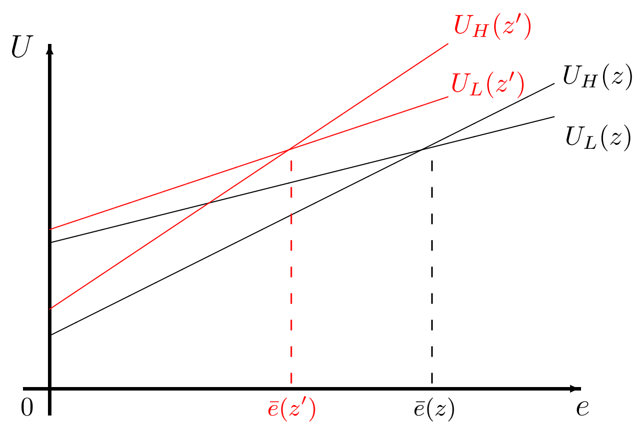
Turning back to the incentive compatibility constraint, the demand x and the expected return q are both disciplinary devices for the bank as they raise the relative payoff from behaving. On the other hand, the possibility to extract a positive income $p - c$ in liquidation jeopardizes bank's incentives.

2.5 Microprudential regulation

We analyze the effects of a decline in risk z and those of an increase of the fundamental value q of assets under two different regulatory regimes. We refer to the first one as *microprudential regulation*: the regulatory authority simply sets the capital requirement according to condition (5), taking p as given and fixed.

Following a decline in risk $z' < z$, the minimum incentive compatible equity decreases. In the regulatory interpretation, in the expanding phase of the cycle when fundamental risk is low, the minimum capital requirement declines as low risk relaxes the VaR constraint and the authority expects banks incentives to be more easily aligned. Another way to visualize the same effect is the following: for any given amount of equity, the demand x is inversely related to risk. Therefore, low risk boosts incentives and the minimum equity decreases.

Graph 2: Decline in risk $z' < z$ and microprudential requirements.



Note that an improvement of the fundamental value of assets ($q' > q$) exerts the same effects of a decline in risk. Indeed, the VaR constraint becomes less binding, increasing the payoff from behaving. The minimum equity $\bar{e}$ declines accordingly.

It is interesting to point out that, while the capital requirement used in our model is extremely simplified and very far from actual prudential rules, it still shows some characteristics that make it consistent with the Basel II risk-sensitive regulation. In particular, the time-dynamics is similar, with the minimum capital requirement decreasing in good times – as risk declines – and increasing in bad times. In other words, our model is able to replicate Basel II cyclicality, even though via different drivers.

In this respect, we label Basel II regulation as *microprudential* in the sense that it disregards the feedback effect that macro variables (i.e. changes in asset prices) exert on banks' behavior. Indeed, as we will see below, the key point is that the decline in risk, besides the previously mentioned positive direct effect on incentives (and, under a microprudential regime, on capital requirement), increases the demand and the equilibrium asset price. This would feed back on incentives: from equations (1) and (2), incentives are jeopardized by p. High prices lower the bank's utility from high effort while increasing the income in liquidation.

2.6 Macroprudential regulation

In this section we analyze the equilibrium in the asset market at date 1. Adrian and Shin (2010), in a similar setting, discuss the mechanism through which leveraged financial institutions' demand for assets generates an amplified response of asset prices to shocks to fundamentals.

The overall response of p to z can be obtained from the equilibrium condition in the asset market. Equating demand and supply, we obtain:

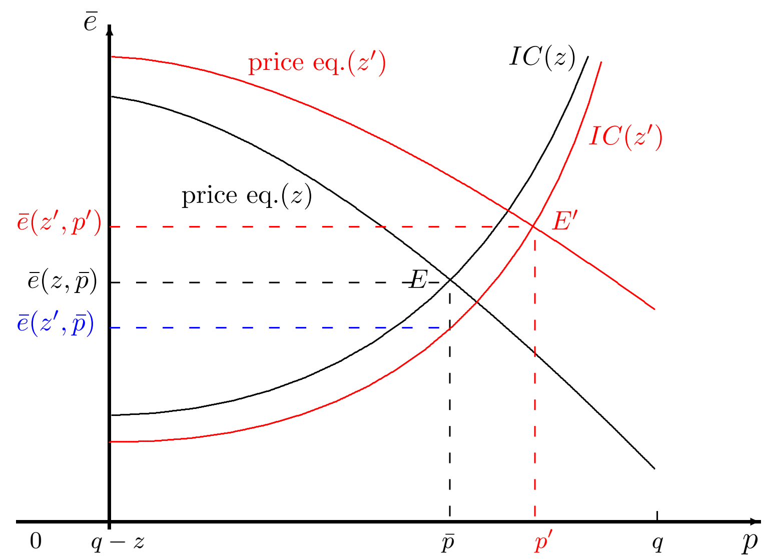
$$\int_{\bar{e}}^{1} x(e; p, z)\, \mathrm{d}G(e) = S \tag{6}$$

where $x(e; p, z)$ is the asset demand of equation (4). The L.H.S is the aggregate demand of securities from active banks, i.e. those with $e \geq \bar{e}$. Note that, in order for $\bar{e}$ to be an equilibrium, no active bank should shrink. $G(e)$ is the cumulative distribution function of banks with respect to equity. When G is a uniform $U[0, 1]$, with simple algebra, we obtain the price equation:

$$p = \frac{1}{S}\left[\frac{1-\bar{e}^2}{2} - (1-q+z)(1-\bar{e})\right] + q - z \tag{7}$$

The price equation (7) establishes an inverse relationship between the capital requirement and the market clearing price (in the relevant range $\bar{e} > 1-(q-z)$, i.e. where $x > 0$). A decline in risk z and/or an improvement of the fundamental value q both shift the price equation upward and make it flatter. Points E and E' in Graph 3 are, respectively, the equilibrium with z and z'.

Graph 3: Asset market equilibrium following a decline in risk $z' < z$.



Substituting equation (7) into equation (5), we obtain the equilibrium (macroprudential) capital requirement as a function of fundamentals (z and q). In the relevant set of values for parameters, the capital requirement is

- A decreasing function of the fundamental risk z.
- An increasing function of the fundamental value of assets q.

In other words, during the expanding phase of the cycle when fundamental risk is low and/or asset fundamental value is high the capital requirement that preserves incentive compatibility should increase.

More in details, when the authority disregards the effects of the shock on p (so taking $p = \bar{p}$ as given), the capital requirement declines from $\bar{e}(z, \bar{p})$ to $\bar{e}(z', \bar{p})$, following the downward shift of the IC curve (Graph 3). Trivially, this is not an equilibrium capital requirement as the clearing price would be much larger than $\bar{p}$. In that respect, the difference $\alpha \equiv \bar{e}(z', p') - \bar{e}(z', p)$ resembles the macroprudential buffer advocated in the Basel III Accord. From conditions (5) and (6), α is increasing in $z - z'$: the larger the decline in fundamental risk, the higher the buffer.

In sum, the policy response to a positive shock to fundamentals is simple. As in the Basel III proposal, the undesirable consequences of too low capital requirements in good times can be mitigated by macroprudential buffers. Incentive compatible regulation should thus ensure that incentives are reinforced in favorable conditions via higher capital requirements, which take the form of macroprudential add-ons (in the model, the quantity α).

3 Incentives through the cycle

It's worth to emphasize that in our model, risk is actually made up of two components. The "fundamental risk" z and the "deterioration risk" associated to shirking behavior of banks. The latter is endogenous in the sense that it depends on incentives. Incentives move in response to fundamentals, to regulatory actions and to a macro variable as asset prices. When (the perception of - fundamental) risk is low, which typically happens in good times, banks asset demand increases and this, in the first stage, is expected to improve their incentives. Ceteris paribus, this lowers the minimum incentive compatible equity that follows from condition (5). In the regulatory interpretation, in the expanding phase of the cycle, the microprudential minimum capital requirement declines as booming conditions boost effort and incentives are more easily aligned. What microprudential regulation neglects is the other, indirect, equilibrium effect of lower perceived risk on banks' behavior: banks that become eager to expand the balance sheet exert a positive pressure on asset prices. This triggers the feedback effect from macro variables to individual behavior: high asset prices reduces the incentives for banks to exercise adequate effort as the income from liquidation is expected to be high. As a result, absent proper regulation, banks would take on more and more "deterioration risk" at the very moment when fundamental risk is perceived to be low. In conclusion, microprudential regulation would miss the indirect effect that changes in asset prices exert on incentives. In this respect, the growth of the subprime market and securitization in the US in 2002-07 is a vivid and recent example; in particular, it can be truly crucial to appreciate the negative distortion of incentives induced by higher payoffs in liquidation induced by increasing asset prices; many argue that the deterioration of lending standard has been largely determined by the belief that increasing real estate prices would have continued to provide a floor to the value of assets.

The effects described above resemble Borio et al. (2001)'s idea that the credit cycle is endogenous with respect to the collective decisions of financial institutions.[5] And indeed our model shows - admittedly in a simplified setting - that the forces that lead to the upswing may carry the seeds of the subsequent downswing. In that respect, we are aligned with the spirit of Minsky's financial instability hypothesis, which does not rely upon negative exogenous shocks to

[5] According to Borio et al. (2001), those decisions are frequently based on misperceptions of the evolution of risk over time.

generate business cycles fluctuations (and financial instability), and with the more recent work of Bhattacharya (2010).

In the dynamic version of the story, abstract from regulation, we have two competing forces on incentives. Behaving banks exert a positive demand pressure on asset prices. This creates room for shirking banks to free ride other banks effort, enjoying both private benefits from low effort (B) and high income in liquidation ($p - c$). In the expanding phase of the cycle, low risk and/or high asset value increase the balance sheet capacity of banks. The positive price externality triggered by behaving banks sows the seeds of the following downturn as it decreases the marginal value of effort so inducing the build up of deterioration risk. The opposite happens when this high deterioration risk materializes. Shirking banks would start to sell off their asset holdings. Low asset prices boosts incentives and increase the marginal value of effort.

In the previous story it emerges a relationship between excessive price volatility and prudential regulation. Indeed, microprudential capital requirement in the style of Basel II (i.e. $\bar{e}(z', \bar{p})$) set according to equation (5) would amplify incentives and asset price volatility. On the other hand, macroprudential requirement would smooth fluctuations and avoid equilibrium shirking and the build up of deterioration risks.

4 Conclusions

In the aftermath of the financial crisis, a lively debate on the cyclicality of financial regulation and the possible options for mitigating it took place among policy makers, regulators and the industry. The outcome has been an unanimous call for a macroprudential approach to regulation. However, the discussion has been largely on the policy side, while the theoretical underpinnings of macroprudential devices have been generally neglected.

In this paper, we set up an incentive model in which banks face – beyond endogenous constraints to asset demand – a capital regulation that also affects their ability to subscribe new assets. The objective of capital regulation is to ensure that banks put effort in their monitoring activities, thus avoiding too risky investments and containing the probability of deterioration of the quality of the asset side of their balance sheet. Banks' effort is affected both by micro (fundamentals) and macro (market) variables. While our aim is not to setup a general framework for banking regulation as we concentrate only on one aspect of it, the model sheds some light on how microprudential rules (those that disregard the feedback effect of macro variables on incentives) may pose – particularly in benign economic conditions – wrong incentives to banks and suggests that a macro-perspective may be deemed necessary.

An illustrative example is a positive macro shock to fundamentals (say, a decline in the fundamental risk of assets). Favorable financial conditions affect bankers' incentives. In fact, the shock relaxes Value-at-Risk constraints and boosts the ability of banks to expand the balance sheet (Adrian and Shin (2010)) so increasing the optimal effort. Since banks are expected to voluntarily (endogenously) put high effort, (microprudential) capital requirements decrease. Lower capital requirements would add to other endogenous mechanisms and boost the demand for assets. Indeed, booming demand is the result of the procyclical behavior of leveraged financial institutions. Unfortunately, the soar in asset prices (and the associated high income in liquidation) feeds back on incentives and countervails the initial direct effect of the decline in fundamental risk: this implies that the effort in booming times may actually be lower than in normal times and that stricter capital requirements would be needed to avoid perverse behavior and value destruction. While the model is very simplified, the mechanisms it envisages are fully consistent with what happened before and during the big financial crisis.

There are two important policy implications of these results. First, banks plant in favorable conditions the seeds for future problems. In the dynamic version of the story, the initial improvement in fundamentals (that ameliorates incentives) is quickly coupled with the increase in the asset prices (that jeopardizes incentives). In this expanding phase, absent proper policy intervention on capital requirements, the incentive distortion is under way. Therefore, it is key that a macroprudential capital buffer is added to microprudential capital requirements to align incentives through the business cycle. Our evidence provides thus strong theoretical support for the Basel III countercyclical buffer.

Second, effective macroprudential policies should not only aim at the accumulation of reserves to be used when, somehow exogenously, "bad times arrive". Rather, they stand as effective policy tools to correct a class of distortions associated with the mutual reinforcing interaction between leveraged institutions balance sheet positions, increasing asset prices and incentives to provide sound risk management. On the other hand, the realignment of incentives may require severe buffer levels and their costs in terms of credit supply should not be neglected. We leave this as an open issue for future research.

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