Discussion of "Liquidity, Moral Hazard, and Interbank Market Collapse"

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Financial intermediaries, such as banks, perform many roles: they screen risks, evaluate and fund worthy entrepreneurs, pool risks, monitor borrowers, refinance projects, and—when confronted with the default in their loans—they perform a valuable role in loss discovery and assessing whether the bankrupt concern is economically viable or not. All these activities, which constitute the actions of a bank in what concerns the asset side of its balance sheet, need to be funded, and much depends on how the bank structures its liabilities to obtain these funds, whether with time deposits, short- or long-term debt, equity, or other more novel forms of short-term financing such as commercial paper or repo transactions. Independently of the particular liability structure adopted by financial intermediaries, it typically involves some form of maturity transformation. For instance, bank deposits, which are available on demand, are transformed into longer-maturity loans to finance projects. Maturity mismatch is almost inherent in the intermediation business.

A liquidity shock for banks occurs whenever at some interim stage additional funds are needed to bridge the maturity mismatch between assets and liabilities. Given the nature of the bank's balance sheet, there are two potential sources of liquidity problems. First, it may be that projects that were funded at some past date need to be refinanced in some contingency and that failure to provide additional funds may result in some loss or even the wasteful liquidation of those projects. Alternatively, it may be that liabilities are coming due before the proceeds of the investments are realized and that funds need to be produced to meet those liabilities; a bank run is the classic example of the latter. Of course, both things can happen simultaneously: projects on the asset side of the bank's balance sheet

may need additional financing while liabilities are coming due, and in fact there are obvious theoretical reasons to expect this simultaneous occurrence. In summary, the liquidity shock can happen on the asset side of the bank's balance sheet, on the liability side, or on both.

Roughly, liquidity is of concern to banks (and financial economists) because the inability of financial institutions to contract ex ante on their potential funding needs may induce inefficiencies, either ex ante or ex post. For example, in order to meet a liquidity shock, a bank may be forced to liquidate some projects when it would be ex post efficient to carry them to maturity. That is, liquidity arises as a problem because it can only be addressed in a spot market transaction at the aforementioned interim stage and it may be that there are limits to what banks can achieve via these spot transactions.

These questions have been at the center of the literature on financial intermediation for a long time but more specifically since the seminal paper of Diamond and Dybvig (1983). The paper by Enisse Kharroubi and Edouard Vidon fits nicely in this tradition. It offers, though, some novel insights and implications that should be of interest to specialists in the field as well as to policymakers struggling with the largest financial crisis since the Great Depression.

Given all this, one can immediately ask, how can banks address potential liquidity shortfalls? Here there are essentially two possibilities. First, banks can meet their own liquidity needs via the reserves they carry, which is a form of self-insurance, and/or second, they can appeal to the reserves carried by *other* banks, which—not being subject to the liquidity shock—are willing to supply these reserves to banks in distress. A natural question is then, what determines the reliance on one form of liquidity provision versus the other?

Consider first the benefits of self-insurance via internal reserves. A bank can always protect itself against a shock on the liability side of its balance sheet by simply carrying every dollar raised via deposits as cash or a close substitute such as Treasuries. This is an extreme version of a narrow bank. If a liquidity shock occurs, the bank is well protected by its own large reserves and it does not need to appeal to potentially expensive outside sources of funding. An additional benefit of carrying reserves is that if the bank does not suffer a liquidity shock, it can deploy these reserves opportunistically

and provide funding to other banks in distress at attractive Sharpe ratios. In doing so, of course, it compromises the narrow-bank business model. The cost of carrying large reserves is that every dollar invested in cash or a close substitute is a dollar not invested in an attractive, but potentially risky, project: the return on carrying cash is typically very low, and depositors may prefer alternative institutions to keep their funds.

The benefit for the bank of lowering its own reserves and increasing its reliance on outside funding to confront liquidity shocks is now obvious: it frees funds to invest in attractive projects. If confronted with a liquidity shock, the bank can appeal to the liquidity carried by others in different ways. A first and obvious one is the sale of the assets carried by the bank in distress. There are several problems associated with this outright asset sale, though. For instance, it may be that there is a classic adverse-selection issue confronting the potential buyers of the assets in question: some assets are good and others less so, and buyers cannot readily distinguish one from the other. Sellers may be able to signal the quality of the assets sold, an issue to which I shall return, and this may imply some form of inefficiency that the seller of good assets must bear. If signaling is not feasible or pooling is the only equilibrium, the price incorporates an adverse-selection premium; effectively, the seller of the good asset gets a price below the one he would fetch if there was full information. Alternatively, it may be that there is some form of specific capital between the bank and the asset or project that is lost when the sale occurs; for example, the bank has some intangible information that—not being codifiable—cannot be conveyed to the acquiring party, which, being aware of this friction, pays less for the project than it would if it had a more complete picture of the asset.

Alternatively, the bank may raise equity at the interim stage to meet those liquidity needs, but here there are also problems. In particular, the amount of equity that can be raised is limited by the need to preserve incentives inside the bank. If the bank raises "too much," it can only come at the expense of lowering the stake of insiders, who remain in control of exercising the costly actions that guarantee the successful completion of the projects funded by the bank. Thus there is a third benefit of carrying reserves and it is that insiders can refinance projects with internal funds, which in

turn encourages the provision of external funds, as now outsiders can remain confident that incentives for high-effort provision are preserved. Another way of conveying this powerful insight, which is originally due to Holmström and Tirole (1998), is that internal funds relax the amount of outside funds that can be raised to reinvest in distressed projects, as when the former are reinvested, inside equity is preserved and with it the incentives to supply costly effort. To express this in a simple expression, if ℓ is the amount of inside reserves carried by the bank and d is the amount of external funds raised, then it is has to be that

$$d \leq A^* \ell, \tag{1}$$

where A^* is some constant to be determined in equilibrium and which determines the rate at which one dollar of inside liquidity can translate into outside liquidity.

Kharroubi and Vidon's model combines several of these ingredients to understand the workings of the interbank market. Specifically, they consider a model where banks choose the amount of internal funds they carry, trading off the opportunity costs of the foregone investment opportunities against the benefit of opportunistic liquidity provision in the absence of idiosyncratic liquidity shocks and the role that internal funds have in relaxing the constraint (1). Roughly, the model combines the analysis of the interbank market as in Bhattacharya and Gale (1987) with the frictions considered in Holmström and Tirole (1998) when it comes to the provision of outside liquidity, a strategy that has been followed by other researchers, such as Acharya, Shin, and Yorulmazer (2007), to address related, albeit different, questions.

The main result is that there are potentially two equilibria in the model. In the first one, which exists when the probability of a liquidity shock is relatively high, there are many banks in distress, and banks anticipating distress provision generously. The first effect dominates, and as a result the interest rate for ex post funding is also large, which further reinforces the incentives of banks to carry substantial internal funds, because if they are not subject to the liquidity shock they will be able to redeploy their funds at attractive rates; this they do in the knowledge that the internal funds of distressed banks which are reinvested preserve incentives for

effort provision. Moreover, when the probability of an idiosyncratic liquidity shock is high, this equilibrium implements the constrained efficient level of ex ante liquidity provision.

A second equilibrium occurs precisely when the probability of an idiosyncratic liquidity shock is low. In this case few banks are in distress and, in addition, banks don't carry internal funds. This limits the amount of funds that healthy banks are willing to supply to distressed banks, for given the limited amount of internal funds reinvested, the incentives for effort provision are also low, which further reduces the incentives to carry liquidity and so on. The resulting equilibrium features no ex ante provision of liquidity and thus the breakdown of the interbank market. In this case good times (periods where idiosyncratic liquidity shocks are less likely) lead to breakdowns in the interbank market. Both equilibria can coexist when the probability of an idiosyncratic shock is in some intermediate range.

The model offers some novel insight in investigating carefully how the strategic complementarity between inside and outside liquidity may result in an equilibrium that supports a constrained efficient level of provisioning, which is precisely when the probability of idiosyncratic liquidity shocks is high—that is, when crises are most likely. Several policy implications follow from the analysis in the model.

First notice that in the paper the interbank market breakdown is simply a chronicle of a crisis foretold; it is precisely the low levels of internal funds which leads to a breakdown of the interbank market because healthy banks—were they to invest in distressed banks—could not elicit the high effort provision from them. It is thus obvious what the repair should be to restore efficiency to the interbank market: force the banks to carry a minimum level of reserves. This will guarantee that the banks in distress have enough to reinvest and thus preserve incentives for effort provision. But this obvious implication of the model is not robust to some sensible modifications of the framework. Consider the case where there are participants other than banks who can provide financing in case of liquidity shocks. Assume further that banks are good at finding and funding projects and thus, socially, it is wasteful to have banks carry "excessive" reserves. In this scenario (constrained) efficiency may call for banks to carry low internal funds and instead have them sell projects, even

at distressed prices, and fully rely on external funds to meet liquidity shocks. Imposing a minimum reserve requirement can only come at the expense of lowering the returns of carrying liquidity for financial intermediaries other than banks. In fact, it may be optimal in this case to impose maximum reserve requirements on banks in order to force them to sell projects when affected by the liquidity shocks, depress prices, and increase the returns of outside liquidity. This result has been shown recently in a paper by Bolton, Santos, and Scheinkman (2009), which offers an alternative view of the trade-offs involved between inside and outside liquidity.

Another comment concerns the particular friction that makes the supply of outside liquidity problematic in this setup, which is the moral hazard problem that follows the interim stage. It is important to note that—as Holmström and Tirole (2008) themselves emphasize—the insight is very general. Indeed, consider the case where the amount of a project's proceeds that can be pledged to outsiders $\underline{v}$ is less than what the project is worth to the party undertaking it, the insider, $\overline{v} > \underline{v}$; if the amount needed to implement the project i is somewhere between these two quantities, it trivially follows that the insider needs to have sufficient internal funds, $\ell \geq i - \underline{v}$. It follows that if the insider has insufficient internal funds, positive net-present-value projects will not be implemented. As mentioned before, there are several reasons why internal and external values may differ. Holmström and Tirole (2008) divide these reasons into two categories—exogenous and endogenous. An example of the first is when the project yields some private benefits to the party undertaking it—benefits that cannot be transferred to outsiders. An example of the second is the moral hazard problem emphasized by the authors and that was also the original modeling route chosen by Holmström and Tirole. One suspects that naturally the different frictions that open a wedge between internal and external values may lead in turn to different policy implications.

This is, in my opinion, of importance because if one thinks about the critical moral hazard in the financial crisis that started in the summer of 2007, it seems that, notwithstanding the potential moral hazard problems going forward in the banking sector, the critical one was related to the origination of bad risks that occurred in the real estate market. Roughly, it was the fact that intermediaries expected to distribute risks easily that led, ex ante, to the origination of assets

of dubious credit quality. It was not that the amount of liquidity was limited because of the need to preserve incentives going forward but rather that the considerable amounts of liquidity available to absorb risks led to a moral hazard problem ex ante. An interesting extension of the model would be to consider the incentives of financial intermediaries to originate risks of different credit qualities depending on their ability to refinance ex post.

In addition, it is worth emphasizing that there is a multiplicity of intermediaries, not just banks, willing to supply liquidity to banks in distress. Policy recommendations that focus exclusively on banks run the risk of ignoring the incentives that other parties may have to supply liquidity to banks in distress. To put it differently, financial markets have changed considerably over the last twenty-five years, and one of the more striking changes is precisely the fact that financing comes now from all quarters—insurance companies, investment banks, hedge funds, and even sovereign funds. It is important that banking models consider the fact that banks interact with other intermediaries and that the risks faced by banks are inextricably linked to the overall financial system, as the current crisis so painfully illustrates.

Finally, it would be useful to incorporate in our models some of the institutions that are in place in the interbank market to understand better the incentive problems faced by banks. Indeed, it is common to consider the policy implications of models without properly considering the effect that the expectation of the policy intervention may have on the incentives of the different parties to take particular actions—for example, portfolio decisions regarding the amount of reserves carried. Given that there has been much discussion on whether the actions of, for example, the Federal Reserve have led to excessive risk taking by large banks, it seems that adding to our banking models the possibility of a potential policy intervention and investigating the effects that such intervention may have on the private provision of liquidity would be a useful step in this interesting research agenda.

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