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Opacity and Disclosure in Short-Term Wholesale Funding Markets

Michał Kowalik

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Federal Reserve Bank of Boston

Introduction

Short-term wholesale funding serves as a liquidity management tool for banks and a money-like instrument for investors. However, as the 2007-09 financial crisis showed, an important source of vulnerability for the whole financial system is the roll-over risk induced by the short-term nature of wholesale funding. This roll-over risk materializes in creditors' runs on banks. If enough banks are affected by these runs, the whole financial system could collapse.

As argued by the Financial Stability Board (2013), during the recent crisis this roll-over risk in short-term wholesale funding markets was exacerbated by their opacity.[2] Opacity can exacerbate this roll-over risk in two ways. First, short-term creditors in opaque funding markets are more prone to run. Second, the bank supervisors cannot detect the early buildup in liquidity risk and cannot make informed decisions about arresting system-wide disruptions once a crisis affects wholesale funding markets.

So far the policy response addressing opacity has focused on providing bank supervisors with more information on the wholesale funding structures of the individual banks.[3] In contrast, thus far the bank supervisors have not issued any proposals addressing disclosure of this newly

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[1] The views expressed herein are those of the author and do not necessarily represent those of the Federal Reserve Bank of Boston or the Federal Reserve System. I would like to thank Patrick deFontnouvelle, Jose Fillat and Noam Tanner for useful comments.

[2] This opacity emanates from uncertainty about individual banks' asset quality and exposures, liability structure, and counterparty exposure.

[3] This started with initiatives by the FSB (2013). In the U.S., bank supervisors started to gather such information directly from the largest financial institutions.

gathered information to the bank investors.[4] In this paper we review theoretical arguments for and against using disclosure to reduce opacity in wholesale funding markets and derive policy implications for bank supervisors' disclosure strategies.

Our main conclusion is that for disclosure to effectively address disruptions in wholesale funding markets strong conditions need to be met. First, disclosure tends to be beneficial only when these markets are frozen and the banking system faces a systemic run. Second, when disclosing, information provided by bank supervisors needs to be precise and bank supervisors need to know exactly what information banks and investors need to receive to reduce uncertainty. Finally, when deciding whether to disclose, the bank supervisors must take into account the consequences of their actions. On one hand, delaying disclosure might result in systemic runs later. On the other hand, disclosure might lead to immediate and disruptive runs, which can only be eliminated by outright guarantees for creditors of insolvent institutions.

The paper is constructed as follows. We first review standard arguments for and against disclosure in the context of wholesale funding markets. Next, we provide more nuanced arguments and outline conditions under which disclosure is either good or bad for functioning of wholesale funding markets. Finally, we conclude with suggestions for policy response.

Usual arguments for disclosure

In this section we review three standard arguments for reducing opacity in wholesale funding markets through disclosure of more information to investors: enhanced market discipline, elimination of inefficient runs, and reducing the impact of contagion.

Enhancing market discipline

The most prominent argument for providing market participants with more information about banks' wholesale funding is the enhancement of market discipline. Market discipline means that bank managers have less incentive to engage in actions hurting their banks' solvency, if they anticipate that their bank's creditors will punish them for such actions. In the context of wholesale funding, this punishment can take two forms. First, the creditors punish the bank for risky behavior

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[4] This paper does not address the question of why the financial institutions themselves should reveal more.

by increasing the bank's cost of funding (Flannery (1994)). Second, the creditors punish the insolvent bank by refusing to roll-over their funding (Calomiris and Kahn (1991)).

Flannery (1994) argues that the short-term wholesale funding is useful for the bank supervisors and investors, because its cost can quickly reflect information about the bank managers' actions. When investors learn that a bank manager has engaged in actions lowering the bank's solvency, they require the bank to pay more for the short-term funding. Hence, to keep the funding costs low, the bank managers have an incentive to engage in actions enhancing their banks' solvency.

Calomiris and Kahn (1991) provide an argument that the roll-over option embedded in short-term wholesale funding allows the investors to "express their confidence in the bank with their feet".[5] When creditors learn that a bank is solvent, they roll-over their funding and the bank manager can realize the profits from running the bank in the future. However, when creditors learn that a bank is insolvent, they withdraw their funding to avoid future losses. A threat of funding withdrawal and following bankruptcy provides the bank managers with an incentive to increase their banks' solvency.

The effectiveness of market discipline in Flannery (1994) and Calomiris and Kahn (1991) relies on the quality of information the investors receive about the banks they fund. Lack of accurate and timely information about banks means the investors cannot distinguish between sound and unsound banks. In Flannery (1994) this means that the banks' costs of wholesale funding become uninformative about the bank managers' actions. In Calomiris and Kahn (1991) the creditors do not know from which banks they should withdraw their funding. Because in both cases the investors lose the ability to discipline unsound and reward sound banks, bank managers do not have any incentive to increase their banks' soundness in the first place.

The policy implication from these models is that provision of high quality information about banks to their creditors would enhance market discipline and would be therefore beneficial for the health of the banking system. Equipped with high-quality information about banks, creditors could punish the unsound banks with higher cost and funding withdrawal, providing bank managers with the incentive to behave prudently.

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[5] See also Qi (1998) and Diamond and Rajan (2001).

Elimination of inefficient runs

Another argument for more disclosure is elimination of inefficient runs. An inefficient run occurs when the creditors refuse to roll-over their funding to a solvent bank. The concept of inefficient runs comes from the literature on information-based runs, which are runs that occur after the creditors receive unfavorable information about their bank's solvency.[6]

The crucial issue in the literature on information-based runs is that efficiency of these runs depends on the precision of signal about banks' solvency creditors receive. If the signal is very precise, there is a low probability of an inefficient run: the creditors mostly run on insolvent banks and roll-over their funding to solvent banks. Such outcomes are efficient, because the solvent banks continue to finance their productive investments and the insolvent banks are shut down.

If the signal about banks' solvency is not precise enough, two additional outcomes are possible. If the signal leads the creditors to believe that the banks are solvent, they continue to fund insolvent banks. If the signal is such that creditors believe the banks are insolvent, they run on solvent banks. Both outcomes are inefficient, because the insolvent banks continue to exist and the solvent banks are liquidated prematurely.

The early models of information-based runs differ in the source of noise in the signal of banks' solvency. In Gorton (1985) bank creditors receive a perfect signal about the systematic shock and a noisy signal about the idiosyncratic shock to banks' solvency. Because these two shocks are not perfectly correlated, depositors sometimes incorrectly infer the solvency state of their banks and might run on solvent banks. In Chari and Jagannathan (1987) creditors observe an initial amount of withdrawals from their bank, in addition to a signal about the quality of the bank's assets. If the signal about the asset quality is not precise enough, investors interpret a high amount of initial withdrawals as a sign of the other investors' lack of confidence in the bank's solvency rather than a sign of high investors' liquidity needs. In turn, the investors decide to withdraw, resulting in a run on an otherwise solvent bank.

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[6] Such information-based runs were introduced to the banking literature as a response to the Diamond-Dybvig (1983)'s sunspot view of runs. In the Diamond-Dybvig setup, lack of coordination among bank depositors leading to an inefficient run arises with no particular reason. In contrast, subsequent literature on the information-based runs was built on the observation that historically bank runs occurred after a string of bad news, which changed creditors' beliefs about the banks' health.

Although the precise reason for noise in the signal is different in each of the models, their implication is the same. Creditors should receive more accurate and timely information about individual banks' solvency in order to reduce the incidence of inefficient runs and increase the stability of the banking system.

In a recent contribution, He and Manela (2016) draw the same conclusion in a much more realistic and nuanced model of an information-based run. They model a bank run as a dynamic event, during which the creditors acquire information about the bank and constantly update their belief about the bank's ability to service withdrawals.

In their model, a bank run starts with a "rumor" that the bank might be illiquid, i.e., the bank is solvent but does not have enough cash to service withdrawals from all depositors. Rather than reaching all depositors at the same time, the rumor spreads through the bank's depositors' base over time. As soon as a depositor hears the rumor, she acquires additional but noisy information about the bank's liquidity. Some depositors learn that the bank is indeed illiquid and withdraw their deposits immediately. Other depositors receive a mixed signal about the bank's liquidity and prefer to wait rather than to withdraw immediately. As time passes, these depositors face the following trade-off between waiting and withdrawing. On one hand, by waiting they risk that the bank's liquidity position will deteriorate because more and more depositors will receive the perfect signal and withdraw. On the other hand, depositors also realize that lack of bank's failure as time passes means that the bank's liquidity position might be better than they assumed earlier. If the bank's fundamentals are not sufficiently strong, the depositors who received a mixed signal, might decide that waiting is too risky and withdraw. If a sufficient number of such depositors withdraw, the bank becomes illiquid, which results in its insolvency. Such a run is inefficient, because the bank is fundamentally solvent before the runs starts.

He and Manela (2016) show how information acquisition by depositors makes such an inefficient run more likely. Depositors, who receive mixed signals about the bank's liquidity, are at a disadvantage because they risk being outrun by depositors with a perfect signal. In turn, each depositor upon hearing a rumor has a stronger incentive to acquire information about the bank's liquidity. As more depositors learn that the bank is indeed illiquid, more of them withdraw immediately, which depletes the bank's liquidity more rapidly and makes the inefficient run more likely.

The policy implication is to provide all creditors with the same information about the bank's solvency because it eliminates the creditors' incentive to acquire information about the bank's liquidity and therefore eliminates the possibility of inefficient runs. This conclusion relies on He and Manela (2016)'s argument that runs occur usually when the depositors are unsure about their bank's solvency. As the depositors acquire information about the bank's solvency, they learn also about bank's liquidity. If the depositors learn that the bank is insolvent, then a run is efficient. However, if they learn that a bank is solvent but might be illiquid, this might result in an inefficient run. Hence, the bank supervisors should provide the depositors with information about bank's solvency to prevent the depositors from learning on their own, which might lead to an inefficient run.

Reducing contagion

The last argument in this section is that disclosure could reduce likelihood of contagion, i.e., the impact that a distress in one bank has on other institutions. Contagion can occur through three channels. First, a failure of a bank in a wholesale funding network might adversely affect liquidity and solvency of other banks. Second, asset sales by a bank, which loses access to wholesale funding, depress asset prices, and, in turn, values of assets at other banks, raising the possibility of disruptive fire sales. Third, news about distress of one bank may provide a negative signal about the health of other banks and lead to runs.

Caballero and Simsek (2013) address the first two channels of contagion in a model of a feedback between counterparty risk and fire sales. Banks are interconnected through network of wholesale funding exposures, but they know only their own exposures and are uncertain about exposures of their counterparties. The contagion in the network starts when banks hit by a liquidity shock start selling their assets. In turn, other banks, who are uncertain about their counterparties' exposure to the banks hit with the liquidity shock, start hoarding liquidity as a protection against possible insolvency of their counterparties. As healthy banks hoard liquidity instead of buying assets from selling banks, asset prices fall and undermine liquidity positions of these healthy banks, forcing them to sell too. As more banks sell, fire sale of banks' assets ensues and exacerbates the contagion in the network.

Caballero and Simsek (2013) argue that opacity of financial networks can turn a relatively small shock into a widespread contagion. The policy implication is to increase transparency of bank networks through provision of more information about the banks' cross-exposures. Increased

transparency of banks' networks would break the feedback loop between the counterparty risk and fire sales, because it would reduce uncertainty about counterparty exposures and, in turn, the precautionary motive to hoard liquidity, which is responsible for the contagion.

The third contagion channel was developed in Chen (1999) and Acharya and Yorulmazer (2008). In Chen (1999) uninformed investors draw inference about their bank's default probability from observed failures of other banks. If banks' returns are positively correlated, high amount of failing banks signals low return of remaining banks, prompting uninformed investors to run on their banks. Because the amount of failed banks is a noisy signal about the performance of individual banks, the information contagion leads to inefficient runs. In Acharya and Yorulmazer (2008) individual banks' loan portfolio returns contain systematic and idiosyncratic components. However, banks' creditors cannot observe the exact realizations of these components. As a result, a poor performance of one bank may prompt the creditors of other banks to believe that their banks are also doing poorly, causing an increase in the funding cost of these banks. In both models, increased transparency of banks would be beneficial, because it would reduce the scope for wrongful inferences, which lead to inefficient runs.

Usual argument against disclosure

In this section we review the most common arguments against disclosure: market freezes due to adverse selection induced by disclosure, creditors' over-reaction to disclosure of noisy public information, and hampering of market discipline.

It has to be noted first that the difference between the arguments for and against disclosure in this and the previous section boils down to differing assumptions about the effect of new information on banks' transparency. Models analyzed in the previous section implicitly assumed that disclosure of new information by bank supervisors increases banks' transparency. In this section, the arguments against disclosure rely on an assumption that disclosure of new information might not necessarily increase banks' transparency.

Adverse selection and market freezes

Disclosure of information about banks could lead to adverse selection and breakdown of wholesale funding. This argument rests on the assumption that bank creditors differ in their ability to interpret information. Once new information arrives to the market, it creates asymmetric

information between banks' creditors because some creditors have a better understanding of what this information means about banks' solvency than the others. This asymmetry results in adverse selection and breakdown of the wholesale funding market for these banks.

Dang, Gorton, and Holmstrom (2015) formalize the above argument in a model of optimal security design. They show that short-term wholesale funding in the form of debt such as repurchase transactions is an optimal security for investors, who care about selling it quickly without losses but cannot interpret information about this security as well as other investors.[7] Because a debt security pays the same return in most states of the world, its owners have no incentive to acquire information about this security. In turn, all investors have the same information about the value of the security and the security trades at its expected value. Hence, the owners of the security can sell it any time without incurring fire sales discounts.

However, the market for a debt security can break down upon arrival of imperfect information about this security. If the investors interpret this information differently, then some investors learn more about the security's value than the others. The investors that know more about the security try to exploit their knowledge by trading with those that know less. However, the latter investors anticipate that the former know more and might refuse to trade this security, meaning the market for this security can freeze all together.

The implication of Dang, Gorton, and Holmstrom (2015)'s model is that the bank supervisors should refrain from disclosing information that would undermine trading in banks' short-term debt securities. If the investors can interpret such information differently, such a disclosure might harm the banks by freezing the market for their wholesale funding instruments. In turn, the whole financial system might be affected as banks are unable to finance their assets on short-term markets.

Over-reaction to noisy public information

The second argument against disclosure is a possible over-reaction to noisy public information, proposed by Morris and Shin (2002).[8] Creditors, who receive noisy private and noisy public information about the bank's solvency decide whether to continue to fund the bank or

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[7] Pagano and Volpin (2012) show it in the context of securitization.
[8] We translate Morris and Shin's argument into a setting with wholesale funding. See also Goldstein and Pauzner (2005).

withdraw. As in any model of bank runs, each creditor's decision whether to withdraw depends on her expectation about other creditors' actions.

Morris and Shin (2002) show that the bank creditors, when deciding whether to withdraw from the bank, pay more attention to the public information than it is justified by this information's signal about the banks' solvency. The reason is that the public information conveys more information than just more details about the bank's solvency. Since each creditor receives the same public information, she can infer from it also other creditors' inclination for withdrawal. Since the public information provides also insight about other creditors' actions, the creditors rely more on it than it is justified by its additional information about banks' solvency.

The policy implication is that public disclosure of information about banks might have negative consequences if disclosed information is too noisy. Disclosure of information induces the following trade-off. On one hand, disclosure helps the creditors make more informed withdrawal decisions and incidence of inefficient runs is reduced. On the other hand, disclosure makes creditors' withdrawal decision depend more on the expectations' about other creditors' action, increasing the likelihood of inefficient runs due to lack of coordination between the creditors. If the disclosed information is too noisy, a bank run might ensue, because the disclosed information leads creditors to believe that other creditors would run despite the fact that information about banks' solvency on its own would rule out a decision to run. The implication is that disclosure of information to the creditors is beneficial only when the disclosed information is sufficiently precise.

Hampering of market discipline

The third argument is that the creditors' reliance on free but noisy information can hamper market discipline. This argument is a corollary from a model by Huang and Ratnovski (2011). They start with a simplified version of Calomiris and Kahn (1991) and replicate the result that, in absence of noisy and public information, the creditors acquire information about the bank's fundamentals and discipline banks with runs.

However, once the creditors have access to free but noisy information about the bank's fundamentals, Huang and Ratnovski (2011) show that market discipline can break down. If free public information about the bank's solvency is not too noisy, the creditors prefer to rely on this information rather than on acquiring costly, but more precise, information about the bank on their own. In turn, with less precise information about the bank's solvency the creditors might not be able

to distinguish between solvent and insolvent banks. Hence, market discipline is less effective because the bank managers have no incentive to improve their banks' solvency.

The policy implication is that the bank supervisors should not release information to the public if they are not sure whether this information is precise. As argued above, provision of such noisy information results in reduced market discipline and is detrimental for stability of the banking system.

More nuanced arguments about disclosure

Although the literature discussed above provides a rich set of arguments for and against public disclosure of bank information, disclosure itself is not the central theme of this literature. In this section, we review four models that focus directly on disclosure of bank information. These models capture explicitly a trade-off between the benefits and costs of disclosure to bank investors. As a result, the policy implications from these models are more nuanced than the implications from the literature discussed above.

Four models discussed in this section focus on wholesale funding markets and offer the following arguments. First, disclosure strategy might depend on the state of wholesale funding markets. Second, the act of disclosure has informational content itself that the bank supervisors need to take into account when deciding what and when to disclose. Third, disclosure strategy might depend on the fiscal capacity of the disclosing government. Finally, disclosure might hamper the banks' incentive to provide information truthfully to the bank supervisors.[9]

State-dependent disclosure

Goldstein and Leitner (2015) study optimal disclosure strategy in a model of an interbank market. They argue that disclosure of individual banks' solvency information should depend on the state of banks' funding markets.

As long as the interbank market functions without disruptions, the supervisors should not disclose any information about individual banks. This argument relies on the idea that more disclosure might destroy risk-sharing opportunities among banks (the Hirschleifer effect). Banks use interbank, and for that matter, wholesale funding, markets to insure against liquidity shocks.

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[9] These four models are just a snapshot of a growing literature on information provision in the banking context (broader than just the wholesale funding). For much fuller review we refer the reader to the survey by Goldstein and Sapra (2014).

However, once the market participants learn more about the solvency of individual banks through public disclosure, they might refuse to trade with banks that they perceive less healthy. In turn, the opportunities to insure against liquidity shocks would be reduced harming the entire banking system.

However, Goldstein and Leitner (2015) argue that public disclosure of bank-specific information is warranted when the interbank market freezes in a crisis. Without more precise information about solvency of individual banks, in a crisis all banks are perceived as weak and individual banks refuse to share their liquidity with other banks. The interbank market freezes, leaving individual banks uninsured against liquidity shocks. This outcome is inefficient because the freeze of the interbank market might lead to collapse of illiquid but solvent banks. In such a case, bank supervisors could unfreeze the interbank market by providing solvency information about individual banks. The supervisor should single out just enough bad and good banks to unfreeze the interbank market without harming the risk sharing opportunities through too much disclosure.

Signaling content of disclosure

Bouvard, Chaigneau, and deMotta (2015) provide a theory of disclosure when the bank supervisors cannot commit to disclosure and the disclosed information is noisy. The assumption about lack of commitment to disclosure is plausible because it is impossible to define all contingencies in which the bank supervisors should disclose. Moreover, it is possible that the information provided by the bank supervisors is noisy, because the bank supervisors might not possess all relevant information about the banks in a given moment.

The authors start their model with a similar view of optimal timing of disclosure as Goldstein and Leitner (2015) (albeit based on a different argument). Disclosure is harmful in good times, because it leads to disruptive runs on insolvent banks. However, disclosure is beneficial in bad times when banks in aggregate are perceived as insolvent. Disclosure then allows the bank investors to distinguish between solvent and insolvent banks, and therefore they run only on the weak rather than on all banks.

The authors then observe that, because disclosure is optimal in bad times, bank supervisors, who cannot commit to disclosure, might be tempted to *not* disclose in bad times. By not disclosing the bank supervisors could signal to the bank investors that the banking system is in better shape than the investors believe. Such a strategy is especially tempting when the investors are unsure about the true state of the banking system.

However, the authors show that the strategy of trying to improve the investors' beliefs about the banking system by not disclosing can backfire. It backfires when after lack of disclosure the investors learn that banks in aggregate are in a worse condition than the supervisor tried to signal with lack of disclosure. In such a case the investors run on all banks, because they cannot distinguish between solvent and insolvent banks. Hence, instead of disclosing and causing runs only on insolvent banks, the bank supervisor that decides not to disclose risks a systemic run on all banks.

The policy implication is a warning to bank supervisors. In times of high uncertainty about the banks' health the decision whether to disclose is complicated because the supervisory actions concerning disclosure convey a signal about the state of the banking system. Hence, the bank supervisors have to be aware that lack of disclosure might not be sufficient to calm down the investors and may in fact worsen the crisis.

Disclosure and fiscal capacity

Faria-e-Castro, Martinez, and Phillipon (2015) provide a theory of optimal government intervention during a financial crisis. They argue that the decision whether to disclose information about banks in a crisis depends on the fiscal capacity of the government.

The authors model the following trade-off that a government faces when deciding whether to disclose additional information banks during a financial crisis. On one hand, more disclosure might help to unfreeze the interbank markets (as in Goldstein and Leitner (2015)). On the other hand, disclosing too much might lead to a run on insolvent banks. These runs are assumed to be inefficient because they lead to liquidation of existing investments and to forgoing of new investment opportunities.[10]

The authors argue that governments with stronger fiscal capacity are more willing to disclose information about individual banks and unfreeze the interbank markets. Stronger fiscal capacity allows the government to insure creditors of insolvent banks and therefore eliminate inefficient runs on these banks. Because the downside of disclosure, i.e., inefficient runs, is eliminated, the government is more willing to disclose the information about banks to the bank investors in order to unfreeze the markets.

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[10] It has to be noted that the assumption that runs on insolvent banks are inefficient in a crisis is different from assumptions in papers reviewed so far.

Reduced incentives to reveal information to bank supervisors

Prescott (2008) makes an argument that disclosure of bank information by bank supervisors could hamper the supervisory effort to gather such information from the banks. In his model, banks provide their supervisor information about their assets' quality. If the supervisor does not disclose this information to banks' creditors the cost of banks' funding cannot reflect that information and is the same for all banks.[11]

When deciding whether to disclose the bank information, the supervisor faces the following trade off. On one hand, the cost of banks' funding becomes sensitive to the banks' asset quality (as in Flannery (1994)). On the other hand, banks become more inclined to report inflated quality of their assets to their supervisor, because they would like to keep their funding cost low.

The policy implication is that disclosure is beneficial only if the supervisor can ensure that banks report their assets' quality truthfully. If the supervisor could easily verify information provided by banks and penalties for misreporting were high enough to discourage it, banks would have little incentive to inflate their assets' quality and publicly disclosed information about banks' health would be accurate. However, if the supervisor cannot prevent misreporting by banks, investors could not rely on bank information disclosed by the supervisor. In turn, the supervisor would be better off by not disclosing the bank information publicly in the first place.

Policy Implications

Based on the literature review above, we derive practical policy implications for use of disclosure by the bank supervisors in the context of opaque wholesale funding markets.

First, the timing of disclosure is important. As Goldstein and Leitner (2015) and Bouvard, Chaigneau, and deMotta (2015) argue, in good times opacity of wholesale funding markets is needed for these markets to function well. Disclosure during such times would either hamper profitable liquidity risk sharing opportunities or expose the banking system to disruptive runs on insolvent banks.[12] However, both theories suggest that disclosure is needed when wholesale funding markets freeze and there is a widespread run on all banks. Then the bank supervisors should provide information to the bank investors to allow them to distinguish between solvent and insolvent banks.

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[11] Kowalik (2015) makes a similar point in a broader context of designing optimal risk-based capital requirements.
[12] These arguments rely on the assumption that failures of bad banks to repay their debt in the future cause less harm than loss of risk sharing opportunities and runs.

The papers differ slightly in the exact design of disclosure, but in both cases the underlying logic is the same. Revealing insolvent banks to investors unfreezes wholesale funding markets and protects solvent banks from runs.

Second, once the bank supervisors decide to disclose, the disclosed information must be accurate. Several of the above discussed papers suggest that disclosure of imperfect/noisy information would be harmful for the functioning of wholesale funding markets, because it might results in a freeze of market for short-term debt (Dang, Gorton, and Holmstrom (2015)), trigger a run on solvent banks (Morris and Shin (2002)), and crowd out private information acquisition and hamper market discipline (Huang and Ratnovski (2011)).

Third, the bank supervisors should also know what information they need to disclose to address disruptions in wholesale funding markets. In other words, the bank supervisors should understand the reasons for these disruptions to be able to eliminate them using disclosure. In most of the discussed papers the freezes and runs in wholesale funding markets originate directly from the investors' uncertainty about the banks' solvency. This implies that the bank supervisors should disclose this information. However, under some circumstances information about banks' solvency might not be sufficient or even possible to disclose, because the banks' solvency might be endogenous to the wholesale funding arrangements. As Caballero and Simsek (2013) point out, in an opaque network of interconnected banks, individual banks' solvency depends also on their and their counterparties' exposures to other banks and also on the extent of uncertainty about these exposures. If the uncertainty about banks' exposures is severe enough, even a small liquidity shock in one of the network's nodes might lead to insolvency of banks that have little or no exposure to the affected node. Hence, to arrest the propagation of the shock in a funding network and insulate the otherwise solvent banks, the bank supervisors should provide information about the connections between banks rather than the information about their solvency.

Finally, the bank supervisors should be aware that each disclosure strategy has important consequences that need to be taken into account when making the decision whether to disclose. The bank supervisors that decide not to disclose in order to signal the banking system's good state and prevent runs on insolvent banks now risk a run on the whole banking system later (Bouvard, Chaigneau, and deMotta (2015)). Moreover, since disclosure aimed at unfreezing wholesale funding markets usually ends in a disruptive run on insolvent banks, the disclosing bank supervisors should

be prepared to arrest the runs through insuring insolvent banks' creditors (Faria-e-Castro, Martinez, and Phillipon (2015)).

Conclusions

The events of the recent crisis highlighted the importance of opacity in wholesale funding markets as a factor contributing to the severity of the crisis. Although the policy response was to provide the bank supervisors with more information about the arrangements in wholesale funding markets, there has been very little done about sharing this information with bank investors. In order to shed more light on this issue we reviewed several theoretical arguments for and against provision of such information to the bank investors. Moreover, we provided conditions under which a disclosure could be a useful tool to address disruptions in wholesale funding markets stemming from their opacity.

We argue that the conditions for disclosure to be effective in addressing the disruptions in wholesale funding markets are strong. First, disclosure seems to be beneficial only when these markets are already shut down and banks face systemic runs. Second, for disclosure to be effective bank supervisors need to provide investors with precise and accurate information, which might be hard to obtain in an acute crisis. Finally, the bank supervisors need to be aware of the consequences of their decisions on disclosure: delaying disclosure might result in systemic runs later, and disclosure aimed at unfreezing wholesale funding markets should be combined with guarantees for creditors of insolvent institutions.

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