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EUROSISTEMA

Questioni di Economia e Finanza

(Occasional Papers)

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CONTINGENT LIQUIDITY

by Sergio Nicoletti-Altimari* and Carmelo Salleo*

Abstract

After the crisis, bank regulators are considering mitigating liquidity risk by introducing quantity limits on liquidity and maturity mismatch. We argue that aggregate liquidity risk can be reduced with little deadweight loss by encouraging banks, through adequate regulatory relief, to satisfy part of their financing needs with a new class of securities. These would include a Roll-Over Option Facility (ROOF) that allows the issuer, for a price, to keep the funds if at maturity a readily observable variable correlated with systemic liquidity risk (e.g. the LIBOR-OIS spread) is above a trigger threshold. At roll-over the yield would reflect the current price of liquidity and credit risk, making ROOFs attractive to investors. The instrument could attenuate a liquidity crisis by reducing banks' need to roll debt over or sell off assets, and diminish the probability of runs, if markets are convinced that banks can secure sufficient liquidity when needed thanks to the widespread use of this contingent claim.

JEL classification: G18, G21, G28.
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1. Introduction[1]

The financial crisis that broke out in 2007 highlighted the role played by liquidity in triggering price spirals, contagion and eventually massive insolvencies. It also exposed severe weaknesses in the regulatory framework, namely a failure to gauge the importance of liquidity risk and its systemic dimension.

Several proposals have been formulated to avert another liquidity crisis: quantity limits, taxes and capital charges designed to reduce maturity mismatch. These measures share a number of unattractive features. They could cause significant deadweight losses by inefficiently restricting the banks' liquidity and maturity transformation function. Maturity transformation may have been excessive at some point, but it remains one of the financial system's vital functions and is unlikely to become less important in the future given investors' structural demand for safe and short-term assets and firms' and households' need for longer-term funds (Caballero, 2009 and Hellwig, 2008). Moreover, all the proposals are geared to averting a crisis, but in the event of another adverse shock to financial institutions, they would not generally serve to attenuate costs or prevent contagion. Finally, most of the measures are still micro-prudential in spirit, overlooking the systemic component of liquidity risk.

To address these shortcomings, we propose a contract that would help reduce the probability of a liquidity crisis and reduce its costs, while taking the systemic dimension into account. We suggest that banks issue securities that include a roll-over option, to be triggered by a measure of strain in the market for liquidity; their yield at roll-over would reflect the price of liquidity and credit risk at that time and would therefore protect the capital invested. The use of such an instrument would be encouraged by regulatory relief, for example within the framework of quantity limits to liquidity and maturity transformation proposed by the Basel Committee (BCBS, 2009), intended to shift at least part of the liquidity risk out of the banking sector. It would probably increase the cost of funding only marginally in normal times and therefore largely preserve the liquidity and maturity transformation function. At the same time, it would make a liquidity crisis less likely, in proportion to the extent of the instrument's use, because markets would anticipate that in case of a liquidity shock issuers could retain their funds until the crisis was past. The instrument would also help ward off contagion and mitigate price spirals, since freezing liabilities (held by investors with a higher tolerance for liquidity shocks than banks, such as institutional investors) would reduce forced asset sales. Finally, the option would be activated by systemic events rather than idiosyncratic shocks, performing a macro-prudential function now lacking and avoiding moral hazard and adverse selection.

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The rest of the paper is organized as follows: section 2 summarizes the main lessons of the crisis; section 3 critically reviews the policy options on the table; in section 4 we present our own proposal and discuss its pros and cons; section 5 concludes.

2. Liquidity Risk: Externality and the Systemic Dimension

In the years before the recent global financial crisis, a number of structural changes in the banking industry increased liquidity in financial markets. Banks very sharply raised the share of wholesale market funding relative to traditional retail deposits, fostering 'funding liquidity' (the ability to fund the maturity transformation) with the creation of large and deep money markets. This allowed banks to tap cheap and flexible funds in lieu of more expensive longer term securities or equity, and more rigid deposits. On the asset side, 'market liquidity' (the ability to sell assets for cash) also increased with the boom in securitization that had made banks' investment portfolios more liquid (only apparently, as the crisis has shown), by creating new markets for previously illiquid loans. The transfer of securitized assets and their short-term financing to off-balance-sheet vehicles (SIVs and conduits) made it possible to expand activities further by diversifying credit and liquidity risks (again, only apparently) and circumventing regulatory limits.

At the same time, liquidity risk increased. Within wholesale market funding, the very short-term component (in particular overnight repos) became relatively larger, increasing the banking system's reliance on shorter-term and more unstable sources of financing (compared with deposits, which are insured) and the maturity mismatch between assets and liabilities. Moreover, banks continued to be linked to off-balance-sheet vehicles by explicit or implicit back-up liquidity commitments and credit lines, so that the diversification of liquidity and credit risk away from the banking system was to a large extent illusory.

The crisis has unveiled the fragility of the liquidity market. Lack of liquidity was crucial in transmitting and amplifying the original shocks in credit markets. Following the first subprime mortgage defaults in early 2007, market liquidity was drastically curtailed as asset-backed securities lost value and became illiquid. SIVs and conduits were unable to roll their debt over and banks had to take impaired structured products back onto their balance sheets. At this point two different types of liquidity spirals set in (Brunnermeier, 2009): a loss spiral, as capital losses forced leveraged investors to dispose of assets (in order to maintain their leverage ratio) while the amount that they could borrow plummeted, and a margin spiral, as haircuts and margins rose and investors reduced leverage and sold assets, fueling the loss spiral still further.[2] As many investors were forced to dispose of assets, prices declined further, igniting panic and reinforcing the negative spirals. This "fire sale" externality – already recognized by Fisher in 1933 – was a key factor exacerbating past

[2] According to Brunnermeier and Pedersen (2009) there are two reasons why margins rise during a liquidity crisis: first, unexpected price falls may increase expected volatility; and second, asymmetric information may increase and investors may become increasingly cautious in accepting collateral for fear of bad selection of assets.

financial crises as well. In addition, given mounting uncertainty over their own future liquidity needs, banks were increasingly reluctant to lend one another and engaged in massive liquidity hoarding (Acharya and Merrouche, 2009), to the detriment of the interbank market. As a result, funding liquidity evaporated as well. Interbank rates soared for both secured and unsecured lending, while the spread between them widened to unprecedented levels. Apart from the escalation of counterparty (credit) risk, a significant part of the widening was due to the increase in the liquidity risk component (Eisenschmidt and Tapking, 2009). Access to markets became problematic: the weaker banks were basically shut out of funding markets, and even those with an investment grade rating would have had to pay exorbitant rates (fig. 1); to reassure markets, they had to de-leverage fast, augmenting the downward pressure on asset prices. Rising interbank rates and the deleveraging of financial institutions had strong spillover effects on lending rates and credit supply to the rest of the economy.

Eventually, central banks were forced to kick in with unprecedented and progressively larger liquidity provision operations, taking onto their balance sheet a large part of the outstanding stock of interbank intermediation (Papadia and Välimaki, 2009). Governments also had to intervene massively with recapitalizations, liability guarantee schemes and asset relief programs.

These events highlight the significant challenge that confronts policy makers and regulators.

The mechanisms described above unveil the sort of externality that attaches to liquidity risk. From the individual investor's perspective, it may be rational to accept exposure to the risk of a liquidity spiral with a large mismatch in asset-liability maturities, even if this can be very costly socially. Individual speculators do not consider that unloading assets will have adverse effects on others and force them to liquidate their positions as well, provoking a loss spiral. So this systemic component of liquidity risk is not internalized by individual institutions, nor is it priced in markets. In addition, the crisis has shown that the need for capacity to bear liquidity risk can be severely underestimated at the individual level as well: institutions overestimated the liquidity of their assets and their ability to resort to well-functioning money markets in case of need. Such problems threaten to becom even more acute in the future, because the large scale and unprecedented intervention by public authorities is likely to amplify moral hazard, reducing banks' incentives to hedge against liquidity risks. Because ex-post public measures carry a very high cost (in terms of both public resources and distorted incentives), preventive action to address the externality and the underestimation of liquidity risk is definitely warranted.

On the other hand, the markets for liquid assets, such as money markets, are ordinarily smooth, deep and resilient (fig. 2: the LIBOR-OIS spread is small and flat most of the time), performing a fundamental role in the economy. Short-term financing accommodates investors' preference for safe assets with short maturity (Caballero, 2009 and Brunnermeier, 2009) and serves as a commitment device to discipline banks with the threat of withdrawals (Diamond and Rajan, 2001). It also enables investors to adjust their maturity structure more quickly in response to changes in

asset values (Brunnermeier and Yogo, 2009). Maturity mismatch as such is not undesirable but it is the result of normal banking business, transforming the short-term assets that investors prefer into the financing of long-term investment projects.

Any public intervention to limit liquidity risk must therefore be balanced against the need to maintain efficient markets for short-term funding and to avoid impairing banks' fundamental role of maturity transformation. For this reason we should favor options that impact as little as possible on the functioning of markets but act to prevent extreme events and mitigate their cost.

3. Policy Options

Some policy proposals have been made to limit liquidity risk, mainly involving either quantitative limits or taxes. Before describing our own proposal, we briefly discuss the pros and cons of these options.

Quantity Limits

Since the current regulatory framework manifestly failed to prevent the liquidity crisis, regulators are discussing a new approach that relies on quantitative limits (BCBS, 2009).

First, to promote the short-term resiliency of financial institutions and ensure that they have sufficient liquidity to survive a high-stress scenario, a Liquidity Coverage Ratio (LCR) is being developed. The LCR is the ratio of unencumbered high-quality liquid assets to net cash outflows over 30 days, calculated positing a high-stress scenario (including downgrades, deposit runs, unexpected drawing on credit lines, etc.). The ratio should be maintained above 100 per cent for a bank to be deemed sufficiently protected against liquidity shocks.

Second, to foster resiliency in the long run and forge incentives for banks to fund themselves with stable sources on a structural basis, a Net Stable Funding Ratio (NSFR) has been suggested. The NSFR is the ratio of available stable funding (sources) to the required amount of stable funding for financial assets (uses), over a time period of one year, and should always be above 100 per cent. On the sources side, "stable funding" is defined as "those types and amounts of equity and liability financing expected to be reliable sources of funds over a one-year time horizon under conditions of extended stress". It includes: 1) capital; 2) preferred stock with maturity of over one year; 3) liabilities with effective maturities of more than one year; and 4) that portion of "stable" non-maturity deposits and/or term deposits with maturities of less than one year that can be expected to stay with the institution for an extended period in an idiosyncratic stress event. On the uses side: "the required amount of stable funding is calculated as the sum of the value of the assets held and funded by the institution, multiplied by a specific required stable funding (RSF) factor assigned to each particular asset type, added to the amount of off-balance-sheet activity (or potential liquidity exposure) multiplied by its associated RSF factor". The RSF factor is inversely related to the liquidity of each asset.

Third, in addition to these standards, supervisors should use a set of monitoring tools to assess the liquidity risk of a bank. These include analysis of the contractual maturity mismatch of all on- and off-balance sheet securities and cash flows, measures of the concentration of funding, estimate of the availability of unencumbered assets that can be used as collateral, and early warning indicators of liquidity risk drawn from high-frequency market data.

A Tax on Liquidity

An alternative to quantitative limits to liquidity risk is some kind of price mechanism. The negative externality generated by banks with their strong reliance on short-term funding could be addressed by imposing a tax to force them to internalize the cost. Perotti and Suarez (2009) take this course and propose a Liquidity Risk Charge (LRC), essentially a Pigouvian tax to prevent excess short-term funding. The charge would be inversely proportional to the maturity of the bank's liabilities: capital and insured retail deposits would be exempt, the tax base would be scaled down by holdings in safe, liquid, unencumbered assets and augmented by contingent liquidity commitments (e.g. credit lines). Charges would be paid often and would be stable but adjustable according to the supervisory authorities' assessment of systemic risk. In essence, by making short-term funding more costly, LRCs would create an incentive for longer-term funding and therefore reduce propagation risk. The proceeds of the tax would be held in safe, liquid assets by some public authority to be used in the event of a crisis.

Capital Charges

Another, indirect, form of taxation of liquidity risk would be to levy specifically targeted capital charges, as suggested in the last Geneva Report (Brunnermeier, Crockett, Goodhart, Persaud and Shin, 2009). The proposal is to add, on top of the Basel II requirement, a capital charge proportional to the effective mismatch between asset and funding maturity, with a half-year as threshold (no additional charge for a mismatch of less than 6 months).

Systemic Charges

A fourth option is to base charges for liquidity risk on some measure of systemic risk. As part of the range of instruments to reduce systemic risk, Adrian and Brunnermeier (2009) suggest that macroprudential policy measures be set by looking at leverage, size and maturity mismatch, as these are the measures that correlate with the authors' measure of the marginal contribution of each financial institution to systemic risk (which they call $\Delta CoVaR$).

By benchmarking whatever policy instrument they select - be it capital charge, taxation, insurance schemes, contingent securities - against $\Delta CoVaR$, regulators would force financial institutions to internalize the cost they impose on the financial system, and risk would be reduced. Capital requirements would vary with the relative aggravation of systemic risk due to a bank's size and maturity mismatch. Similarly, Pigouvian tax rates could be proportional to the weights from forecasting regressions of leverage, size, maturity mismatch, etc. $\Delta CoVaR$-based measures would

be endogenous, i.e. the cost to each bank would depend on the cost to all the others, which would make the framework adaptable to changing circumstances. Finally, since Δ*CoVaR*-based measures are calculated by using expected values from forecasting regressions, they should be counter-cyclical.

While not designed specifically for liquidity risk, the proposal by Adrian and Brunnermeier (2009) could be used to address it. Δ*CoVaR*-based instruments undoubtedly depend on systemic risk, and at least in principle they can be made proportional to the contribution to total risk of each institution and each factor (including liquidity).

An Assessment of Policy Options

So far neither camp in the liquidity risk debate has explicitly compared its own proposal to the alternative.[3] The following section provides some indications on how to approach the issue, highlighting some problems common to all the proposals, and others specific to each option.

i) Quantity vs. Price

The question of whether to address an externality with a limit on quantity or a tax is a classic debate in public economics, first addressed analytically in a seminal paper by Weitzmann (1974).

The basic conclusion is that the answer depends on the slope and uncertainty of the marginal costs curve (if uncertainty is high the two solutions can yield very different results in terms of deadweight loss; if it is low they are broadly equivalent) and on the slope of the marginal benefits curve. If the latter is steeper than the former, the uncertainty over marginal costs generates large potential deadweight loss with a tax and small deadweight loss with a quantity limit; if the marginal benefits curve is almost flat the potential deadweight loss due to uncertainty over marginal costs is high for a quantity limit and low for a tax (for an illustration of this classic result in the framework of environmental economics, see Pizer, 1997).

When it comes to liquidity risk, therefore, in order to compare quantity limits and taxes one needs to look at marginal costs and benefits. If we reduce liquidity risk, by decreasing the maturity transformation performed by banks, the marginal cost is proportional to the credit spread between the return on the investment in long-term, potentially illiquid assets, and the cost of its short-term funding. The slope of the marginal cost curve depends on that of the yield curve, while the uncertainty over its shape and position depends on the volatility of short-term and long-term interest rates, which in turn relates to market conditions (the appetite for risk of the buyers of bank

[3] Weitzmann (1974) suggests why this may be: "That a person not versed in economics should think primarily in terms of direct controls is probably due to the fact that he does not comprehend the full subtlety and strength of the invisible hand argument. The economist's attitude is somewhat more puzzling. Understanding that prices can be used as a powerful and flexible instrument for rationally allocating resources and that in fact a market economy automatically regulates itself in this manner is very different from being under the impression that such indirect controls are generally preferable […]."

liabilities), the business cycle and technology (which determine when long-term investment opportunities start deteriorating). While volatility decreased over the past 20 years and until the onset of the crisis (see, e.g., BIS, 2006), thanks to what is commonly referred to as the Great Moderation, it was never close to zero; it increased substantially during the crisis and is now converging on higher levels than prior to the crisis. Therefore, whether to choose a quantity or a price mechanism is a most relevant issue.

The marginal benefit is related to the diminished probability of a crisis thanks to the reduction in liquidity risk. When the degree of maturity transformation is high, the marginal benefit is likely to be large and rapidly decreasing, i.e. the curve is steep close to the origin. Once maturity transformation is modest enough that the probability of a crisis becomes low, further decreases are unlikely to make much difference, i.e. the marginal benefit curve becomes relatively flat. Both the shape of the curve and the point where it starts flattening are likely to be uncertain, as they depend on general market conditions, the level of inter-connectedness of banks, and so on.

The relative advantage of quantity limits or taxes depends on whether the two schedules cross where the marginal benefit curve is relatively flatter (which would tend to favor a tax) or where it is relatively steeper (which would tend to favor a quantity limit) than the marginal cost curve. Considering the uncertainty about the relative slope of the curves for different degrees of maturity transformation, there is a large risk of choosing the wrong instrument, causing substantial deadweight loss.

High uncertainty on the relative shape of the cost and benefit curves and the possibility that the marginal benefit curve is kinked represent precisely the situation when a hybrid policy that combines quantity limits and a tax can be optimal (Pizer, 1997). If the quantity limit is set "sufficiently high" (depending on market conditions or the business cycle), the system works like a pure tax policy except when quantity triggers are reached. This sort of consideration is at the basis of the proposal we develop below.

ii) Micro vs. Macro Prudential Regulation

These proposals for quantity limits, taxation and capital charges share the micro-prudential approach to liquidity risk: they aim to reduce maturity mismatches at individual banks but they miss the systemic dimension, which for liquidity risk is crucial. To see why, one can go back to the classical example on the fallacy of composition about maturity mismatch, as in the latest Geneva Report (Brunnermeier et al, 2009). If in a banking system with n banks each having a one-week maturity mismatch but at different horizons (the first with one-week liabilities and two-week assets, the second with two-week liabilities and three-week assets, and so on), then at the individual level there is only a one-week mismatch but in the aggregate the mismatch is n weeks. The rules discussed above would do little, since each bank, per se, would apparently be safe from liquidity risk but the financial system as a whole would be severely exposed to liquidity shocks. This is precisely the unaddressed externality that generates systemic risk. Since liquidity crises have a large

systemic component relative to idiosyncratic shocks, measures that reduce the latter but not the former could induce a sense of false security.

In principle, the problem could be addressed by systemic charges, i.e. charges explicitly linked to systemic risk. However appealing intellectually, a system of $\Delta CoVaR$-based measures would be extremely complicated to apply. It would require a large amount of good quality data, models that evolve with changes in market structure, financial innovation and general regulation, and a broad agreement on the "right" model. Moreover, the complications are heightened if multiple instruments (capital charges, taxes on maturity mismatch, etc.) are used to address different risk factors, with differential effects on systemic risk. Given the uncertainty on how to measure risk and the political economy of regulation, this theoretically sophisticated model will probably be more useful as a benchmark to evaluate other, simpler proposals than as a formal regulatory tool.

iii) Regulatory Arbitrage

A general problem embracing both taxes and quantity limits is circumvention: they spur financial innovation to devise instruments that formally satisfy all requirements but that hide some different form of risk or are ineffective when needed. This was the case, for example, of asset-backed securities on the asset side (they were much riskier than thought) and hybrid securities on the liability side (when needed, they were never actually treated as equity). Naturally, this goes for regulation in all fields, but in this case it is especially relevant, given the nature of liquidity risk: systemic, sensitive to asymmetric information, in some cases self-fulfilling, very fast to materialize.

This problem is particularly acute for the proposed tax on maturity mismatch: in integrated capital markets, unless the tax is set at the same level for everybody, there is a strong incentive to arbitrage it. Experience shows that tax arbitrage leads to the lowest common denominator, especially in the case of a factor as mobile as financial capital. Therefore, unless there is a broad agreement among all the major financial centers on the level of the LCR adopted, this instrument will be ineffective. Ultimately it will be too low to have a significant impact.

Moreover, excessive or ill-designed regulation could induce non-regulated or less-regulated financial institutions to design securities to satisfy investors' demand for safe, short-term assets, just as they did to satisfy investors' demand for yield with subprime-based ABS. In this case, depending on the composition of the asset side, liquidity risk could be concentrated precisely in the sub-sectors of the financial industry that are least monitored.

iv) Crisis Prevention vs. Damage Control

All the policy options illustrated above are designed to avert a liquidity crisis. But should a crisis hit, they would be of little use; indeed, they could well need to be suspended so as not to make matters worse.

Quantity limits, for example, like all quantity regulation, may create a threshold effect that can increase pro-cyclicality. Since abiding by the regulatory ratios (LCR and NSFR) is costly, banks are

likely to keep their liquidity structure close to the minimum required, so a liquidity shock would push many below the threshold at the same time. If the stress scenario for calculating the ratios is well designed, they may survive the immediate impact; but the need to restore the ratios (in bad times) could nevertheless trigger forced sales of illiquid assets or a flight to "stable" sources of funds, thereby propagating the very panic that the regulation is intended to avoid.

What is needed is measures that reduce the risk of contagion or brutal deleveraging, which could reduce not only the probability but also the cost of a crisis.[4] This is especially important in the case of liquidity crises, which arise suddenly and unfold rapidly, leaving little margin for error in public intervention.

vi) Bank Profits

Both quantity limits and taxes lower banks' profitability. This is not bad per se, but in an environment in which banks are already required to hold more capital against unexpected losses they might find it harder to achieve satisfactory earnings, potentially heightening the incentives to take risk.

Summing up, while the policy options now on the table probably do reduce liquidity risk (at least for banks), especially at the individual level, they are likely to be unnecessarily costly in terms of social welfare generally and for financial institutions in particular and to generate undesired side-effects that might be difficult to control. Furthermore, the systemic dimension of liquidity risk is missing: the recommendations are set at the level of the individual institutions, so it is again an exclusively micro-prudential answer to a problem that has a strong macro-prudential component.

4. Our Proposal: Contingent Liquidity

Ideally, since a liquidity crisis is a rare systemic event, the countermeasures should correct externalities while minimizing deadweight losses. They need to be systemic in perspective, simple to implement and hard to circumvent, and effective in providing relief in the event of a crisis.

A New Instrument: a ROOF for Banks

Given the discussion on price and quantity measures, we tend to favor a hybrid policy, i.e. a price-based mechanism, but embedded within a quantity regulation. Since liquidity risk materializes rarely, we favor a mechanism that is light on banks in normal times but kicks in when needed, both decreasing the probability of a crisis and attenuating the effects should one occur.

Our proposal is a contingent contract that works as follows. The bank issues a security with a roll-over option, that is, at maturity the bank has the option to roll over the security if there is

[4] Perotti and Suarez (2009) suggest using the proceeds of their Liquidity Risk Charge to fund public intervention in the event of a crisis, thus mitigating the effects of the shock. Of course, the effectiveness of such a proposal depends on the size of the shock and the amount of funds collected.

"sufficient tension" (with a trigger to be specified) on liquidity markets. The security is rolled over with a yield that reflects both the creditworthiness of the bank and the current market price of liquidity (determined by one of the many sector-rating class-specific yield indices that are routinely published to index the security). If at the new expiration date (the original maturity replicated once or, when the security is long-term, a pre-set contractual date such as one month or three months ahead) the price of liquidity is below the trigger value, the security expires and is liquidated. If not, it is rolled over once again, and so on. This Roll-Over Option Facility (ROOF) allows banks to retain the liquidity they have during a crisis, so that they would have less need to return to panicked markets to get funding or "fire-sale" assets, triggering price spirals, etc. We propose that the security be indexed to current credit and liquidity spreads, since a liquidity crisis essentially involves rationing. That is, nobody wants to fund a bank even though returns would be very high, because of asymmetric information; banks would be willing to pay very high spreads but there are no funds.

The Trigger Variable

The variable that triggers the roll-over option should be a measure of the tightness of the liquidity market, such as the LIBOR-OIS spread. This spread captures both default risk and liquidity risk. In principle one could try to disentangle them - say by linking the option only to the component involving the liquidity risk. But as the recent crisis has shown, the two risks are strictly intertwined, and not easy to separate. The principle is that the trigger variable should be an easily observed indicator, one that cannot be manipulated and that signals a situation of general distress in financial markets that could result in a liquidity crisis, whatever the source of the initial shock. In this respect, the LIBOR-OIS spread appears to be a good choice.

What should the trigger level be? If it is set too high it would be useless, if too low it would be activated too often and unnecessarily from a systemic perspective. We propose that the supervisory authorities set a maximum value for the trigger in ROOF contracts. Otherwise, banks could set the value extremely high and use ROOFs merely to circumvent the liquidity requirements. Below this ceiling, the exact value of the trigger would be left to the contracting parties and could even vary with each contract. Authorities could announce the maximum value, based on their evaluation of expected liquidity trends and the probability of turmoil, and could review the value as needed.

Regulatory Relief

The incentive for banks to issue ROOFs would come from treating the funds raised as retail deposits (or even a completely stable source of funding) for the purposes of liquidity gauges, such as the Basel Committee's liquidity ratios, the LCR and the NSFR. By issuing a ROOF a bank would lower the denominator of the LCR and increase the numerator of the NSFR. In both cases, this would improve its regulatory liquidity position. On the other hand, purchasing a ROOF would increase the denominator of the bank's NSFR (the impact on the numerator is unclear, since a ROOF could still qualify as a high quality liquid asset if it is tradable and incurs limited capital

losses), thus worsening the bank's liquidity position. This would have the benefit of giving banks an incentive to sell ROOFs outside the banking industry, thus reducing interconnectedness and shifting at least part of the overall liquidity risk away from the banking system.

If regulators opt for a tax on the maturity mismatch instead of quantity limits, ROOFs could be exempted in the same way, being again treated as deposits. The same logic applies.

Pricing

What is the cost of the option embedded in a ROOF? Normally it should be very low, since liquidity crises are rare and the cost borne by the buyer, should the option be triggered, is the unavailability of the invested capital, but with a return that reflects current market prices for liquidity and credit risk. This should limit capital losses and, since liquidity crises usually do not last "too long", the inconvenience of not being able to dispose of funds should be relatively short-lived and the cost low.

More analytically, at roll-over the new yield should fully cover liquidity and credit risk (actually, it probably over-estimates them since in a panic prices fall below fundamentals), so there should be no capital losses. In this respect contingent liquidity is fundamentally different from contingent capital, an instrument advocated by many to address solvency risk (see e.g. Panetta et al., 2009, for a review of the main proposals), which basically converts debt into equity at the outset of a systemic crisis and is consequently subject to a high risk of heavy losses, at least in the short run. In the case of a ROOF the loss-given-default is arguably lower. The option's value is proportional to the opportunity cost to the holder, i.e. the transaction cost of selling in a panicked market if the holder wants to readjust her portfolio (a proxy for this cost could be the bid-ask spread during the crisis); or, if there is no market at all, to the cost of holding a suboptimal portfolio. Since both costs are a fraction of the value of the ROOF, the price of the option should be almost negligible when the probability of a crisis is low and just a few percentage points when it is higher.

In fact, if ROOFs are standardized in terms of maturity and other contractual characteristics they can be traded via centralized counterparties. This would lower the cost of holding the instrument in a liquidity crisis still further, since the holder could resell it to investors with a lower liquidity preference at close to par value, as the yield is automatically reset to reflect current credit and liquidity risk.

For a practical example of what would have happened had ROOFs been in place, take the liquidity crisis of 2007-09. Assuming a trigger value of the LIBOR-OIS of 100 basis points, there were three periods of time in which the roll-over option would have been exercised: the first two weeks of December 2007, from mid-September 2008 to mid-January 2009, and from mid-February to mid-March 2009. During these three periods, exercising the roll-over option would have cost a U.S. bank with a single A rating respectively between 210 and 250, 620 and 850 and 690 and 870 basis points (calculated as option-adjusted spread; see figs. 1 and 2). The spread may be very large,

then, but it is paid over a short time span (at most four months in our case), so in absolute value the cost to the bank is relatively low; on the other hand this protects the buyer. Banks would have retained much-needed funds thus easing tensions on markets, and investors would have been handsomely rewarded.

Systemic Risk

ROOFs affect systemic risk in a variety of ways. First, as noted, banks would have an incentive to sell them to non-banks, thus shifting liquidity risk outside the banking industry; this reduces the inter-connectedness of banks and spreads liquidity risk among a larger variety of investors and to the extent that it does not result in high concentration among other systemic institutions, it should reduce systemic risk. Second, since liquidity risk has a self-fulfilling component triggered by runs, by making banks more stable ex ante in terms of funding requirements during crises the ROOF decreases the likelihood of a run and thus attenuates systemic risk. Third, since ROOFs are activated by a macro variable, they are sensitive to aggregate liquidity risk, not to its distribution at the individual level. Finally, this instrument would generate an additional form of market discipline, as buyers would need to monitor general liquidity conditions in the markets more carefully. In this respect, our proposal resembles the mechanism devised in the context of solvency risk, with a similar role for subordinated debt (see e.g. Calomiris, 1999).

Buyers

Who would buy a ROOF? The answer is: any investor willing to bear systemic liquidity risk, i.e. to face the possibility of not being able to cash a security in during a liquidity crisis, possibly without suffering capital losses by the end of the crisis. This is a case of diversifiable systemic risk, since there are many possible investors that routinely keep part of their portfolio in liquid assets but that are not necessarily interested in selling them during relatively brief liquidity crises: pension funds, mutual funds, households, sovereign funds, hedge funds, etc. ROOFs should be attractive to these investors, because the return would be better than on alternative assets with equivalent maturity, while the extra risk would normally be very low.

Should banks be allowed to buy ROOFs? Given that a liquidity crisis has a systemic dimension (the banking system as a whole demands more funds), if banks buy ROOFs there would merely be a reallocation of funds between banks, which is not going to help much. Within the new Basel regulatory framework, if ROOFs are granted relief for the issuers they worsen the ratios for purchasing banks. If this is not enough to stop banks from buying such securities, an outright ban might well be considered, to make sure that ROOFs are placed outside the banking system.

Even if it is non-banks that buy these securities, though, we must consider what would happen if there were a crisis and they wanted to sell their ROOFs. Wouldn't this just shift the liquidity crunch out of the banking industry without solving the problem? Clearly, that is a possibility, and we do not claim that ROOFs would eliminate liquidity crises. Our argument is that they provide a way of

shifting liquidity risk ex ante towards investors with smaller liquidity and maturity mismatches than banks. Even if liquidity preference increases for all market participants in a crisis, it will still be lower for some than for others. And as capital value is better protected than with many other types of securities, it would make more sense to hold ROOFs than securities that are uncertain in value. In fact, during a crisis the demand for ROOFs could well increase, along with that for government securities and other safe assets.[5]

Should individual investors be allowed to purchase ROOFs? As long as the buyers' liquidity needs are covered by insured deposits, ROOFs could be an attractive alternative to bank bonds. They carry the same credit risk and offer a modest extra yield for liquidity.

A last question is: who would buy a short-term ROOF in the wake of a crisis, knowing full well that there is every likelihood of being obliged to hold it beyond its expected maturity? There are two answers. First, there are investors who know ex ante that they can afford to hold it and want the extra yield. Second, liquidity crises break very suddenly and unless a crisis is practically at hand, there is unlikely to be a widespread belief that it will arise in the next quarter. Indirect evidence of this comes from the performance of the LIBOR-OIS spread (our suggested trigger variable) in 2007-08: it spiked very suddenly (within days) after having been almost flat (or at least with no trend) for long periods (Sengupta and Man Tam, 2008, and also fig. 2).

Potential Market

To get an idea of the amounts involved, let us look at the aggregate balance sheets of banks and other financial institutions. At the end of 2007, on the eve of the crisis, US commercial and investment banks had total liabilities of 13 trillion dollars, including 5 trillion in deposits and about 3 trillion in credit market instruments. Monetary financial institutions in the euro area had total liabilities of around 30 trillion euro, including 9 trillion in deposits and 6 trillion in debt securities.[6] Assuming an average maturity of 3 years for outstanding bonds and given the share of short-term securities, each year US banks have to roll over about 2 trillion dollars worth of debt, euro-area banks more than 2 trillion euro.

Central bank interventions during the crisis amounted to about 2 trillion dollars for the Federal Reserve and 750 billion euro for the European Central Bank (ECB, 2009). This means that if banks had put a ROOF on a third of their market-based funding, US banks would have still been very substantially exposed to the liquidity shock but not euro-area banks. The instrument, clearly, is not a panacea, but it would be very helpful especially where the liquidity shock is not "too big" (when lending of last resort is needed save the day).

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[5] If the risk of generating a liquidity crunch in other (non-bank) sectors is considered to be a serious problem, it could be tackled by designing the roll-over option in a slightly different manner, by allowing investors to withdraw part of the funds at the expiration date (or an increasing proportion over a pre-specified period of time).

[6] The data are drawn from the Flow of Funds (Federal Reserve statistical release, December 10, 2009) for the United States and from the Integrated Economic Accounts for the Euro Area (ECB, Q4 2007).

As for potential buyers, at the end of 2007 US money market and mutual funds alone held more than 5 trillion dollars of debt securities, while the equivalent financial institutions in the euro area held more than 2 trillion euro in such securities and insurance companies and pension funds another 2 trillion. Of course, these figures already include banks' liabilities. The balance sheets of institutional investors seem to be able to absorb an instrument that, in the event of a crisis, only postpones its maturity without prejudice to capital invested.

Cost for Banks and for Society

A ROOF comes at some cost –the value of the option that the bank is buying from investors, which hopefully will be mostly out-of-the-money. But since each bank can choose freely how much to use this facility, it would help to avoid the straightjacket of quantity limits or taxes and thus limit deadweight loss while still curbing excessive liquidity and maturity transformation.

Moral Hazard

Like all insurance mechanisms, ROOFs could produce moral hazard by making the issuing banks more prone to take on liquidity risk. In this case, unlike deposit insurance, there is no public subsidy, and if the instrument is priced fairly, risk should be internalized. In any case, as long as a bank cannot fund itself entirely with insured deposits and ROOFs, a run on deposits will always be a possibility. This too should limit moral hazard, the way deductibles in insurance do (i.e. up to some threshold losses are borne by the insured, to ensure it has "skin in the game").

Adverse Selection

A possible problem is the stigma that might be attached to issuers of ROOFs: investors might fear that the instrument will be used mostly by the riskier or more fragile banks, and issuance of ROOFs might thus actually heighten the danger of a run. If this were the case, banks would be reluctant to issue these securities. This phenomenon has been observed, for example, in recourse to central banks' discount windows/marginal lending facilities. There, however, the stigma derives from the markets' belief that banks use that facility because they lack alternative options with private investors, and this impression is reinforced by the existence of a penalty rate. The ROOF, by contrast, is a transaction between private institutions at market prices, so the adverse selection problem resembles that for insurance products. For insurance, the solution is the deductible. For ROOFs, it is the fact that a bank would still be exposed to liquidity shocks even if it issued them, unless it covered all of its liabilities. Furthermore, the regulatory relief should be a powerful enough incentive to induce many banks to issue ROOFs, and the large pool of issuers would decrease adverse selection.

Adverse selection could still emerge if, during a liquidity crisis, some banks chose not to exercise the option (i.e. to renounce rolling over the liability) in order to signal their strength to markets. This would make it more difficult for the banks that did exercise the option to access the

market for liquidity shortly thereafter. If this were deemed to be a substantial problem, a possible solution would be to make the exercise of the option automatic.

Focal Points

Would a common trigger become a focal point for liquidity crises, by making investors nervous as the LIBOR-OIS spread approaches the critical level? This is possible, of course, but banks would not have to cluster at the maximum trigger value set by supervisors; if they feared that refinancing would become difficult as the spread approaches its upper limit, they might actually want to set lower levels in their contracts, to keep funding before a liquidity crisis starts. This would create a range of trigger prices, depending on each bank's estimate of its own critical value.

Market Manipulation

Would it be possible for banks to influence the trigger variable when it is close to its threshold so as to push it over the threshold and activate ROOFs? If this were the case, the instrument might actually be counter-productive, generating collusion and market manipulation. The answer depends on how efficient the money market is. In normal times, of course, it is hard to imagine that any set of banks, however large, could manipulate it, but when a crisis impends it could happen. One response is that such banks would be going up against a player with very deep pockets and with regulatory powers - the central bank - just when they have every reason to avoid conflict with the lender of last resort. Nevertheless, one could think of a safeguard clause for ROOFs, such as requiring that the trigger variable be above its threshold for at least two or three consecutive trading days, so as to minimize the probability of flukes or frauds.

Information Dissemination

A side benefit of ROOF contracts is that their price can serve as an indicator of markets' expectations about a systemic banking crisis. As an option, its price conveys more information thanks to interbank rates expected volatility. This information can be used by the monetary authorities to fine-tune their interaction with markets and by macro-prudential supervisors as an early warning sign for liquidity problems.

International Cooperation

The adoption of ROOFs does not require special international cooperation, since it would be optional, and the regulatory relief could be decided at the level of the Basel Committee – and even if the relief is not granted, banks might still have an incentive to issue them. Insofar as liquidity crises are not necessarily global, each country could have its own trigger variable and threshold levels. In this scenario the possibility of selling ROOFs abroad would make it easier to find buyers not only with a lower preference for liquidity but also exposed to different liquidity shocks. This natural form of diversification would broaden potential demand and probably lower costs.

A Comparison with Similar Proposals

The general idea of allowing issuers to roll their debt over in certain conditions is not new. This is of course what is done in debt restructuring negotiations, corporate and sovereign. To make this an ex ante option rather than the result of difficult ex-post bargaining, Buiter and Siebert (1999) suggest that "all foreign currency liabilities must have a rollover option". The idea is that without a lender of last resort a foreign currency borrower that is solvent but not liquid might be forced into a crisis by sudden demands to reimburse its liabilities. With a rollover option, to be exercised only once, at a penalty rate and at the discretion of the issuer or with a trigger decided by the central bank or linked to some publicly available variable, the issuer buys time to "address disorderly market conditions" and avoid a liquidity crisis.

Buiter and Siebert's UDROP (Universal Debt Rollover Option with a Penalty) is similar in spirit to our ROOF, in that it seeks to solve liquidity runs by freezing debt. But it differs in important aspects. The UDROP is targeted mainly at foreign currency crises and therefore focuses on foreign currency instruments, whether short- or long-term. It is supposed to be mandatory in order to overcome possible adverse selection effects, it carries a penalty rate and the rollover option can be exercised only once. The ROOF is targeted at liquidity problems regardless of currency denomination, is not compulsory, it would be rolled over as long as the systemic trigger is above the threshold and it would not carry a penalty. Essentially, UDROPs are more dependent on individual borrower or country-specific conditions and are therefore more sensitive to moral hazard and adverse selection – hence the many restrictions and deterrents proposed, such as compulsory adoption, one shot activation and penalty rates. By contrast, the ROOF is designed to be activated only in case of systemic events and is accordingly much less restrictive.

5. Conclusions

The introduction of the Roll-Over Option Facility, possibly with the incentive of some form of regulatory relief, would provide a market-friendly tool to address liquidity risk and in particular its systemic dimension.

The ROOF would be less onerous for financial institutions than stringent caps or straight taxes on liquidity and maturity transformation, thus reducing deadweight loss. Our proposal embeds a price mechanism, within the quantity limits determined by regulators, or possibly other types of regulation, which may be particularly appropriate when the exact costs and benefits in terms of social welfare are uncertain. The adoption of ROOFs would lessen the likelihood of liquidity runs and attenuate the impact on the economy if one did occur. In addition, liquidity risk would be borne to a greater extent by institutions that may have a greater capacity for it than banks. Finally, the activation of the facility would depend on system-wide liquidity conditions. As such, it would be a macro-prudential complement to currently proposed micro-prudential regulation.

If this concept were adopted by regulators and market participants, to make it fully operational some fine-tuning would be needed to develop the legal framework and address some implementation issues in greater detail, such as the choice of the trigger variable and the reference indices for yield when the roll-over option is activated.

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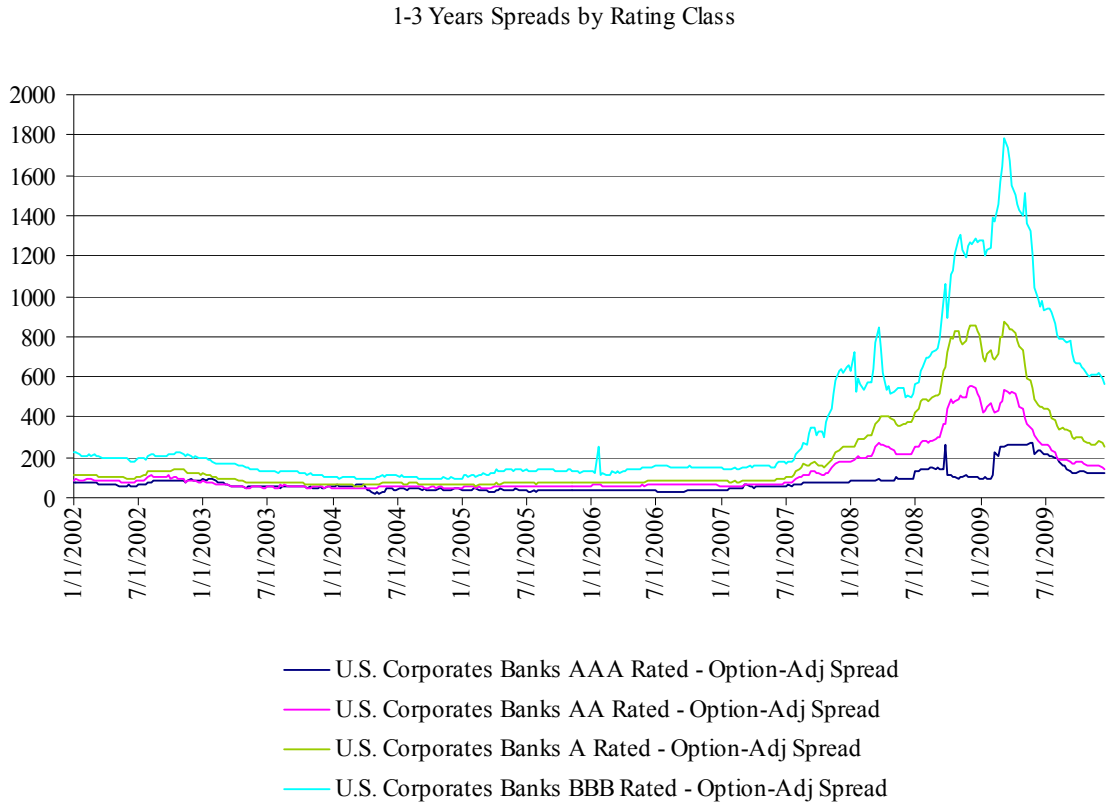
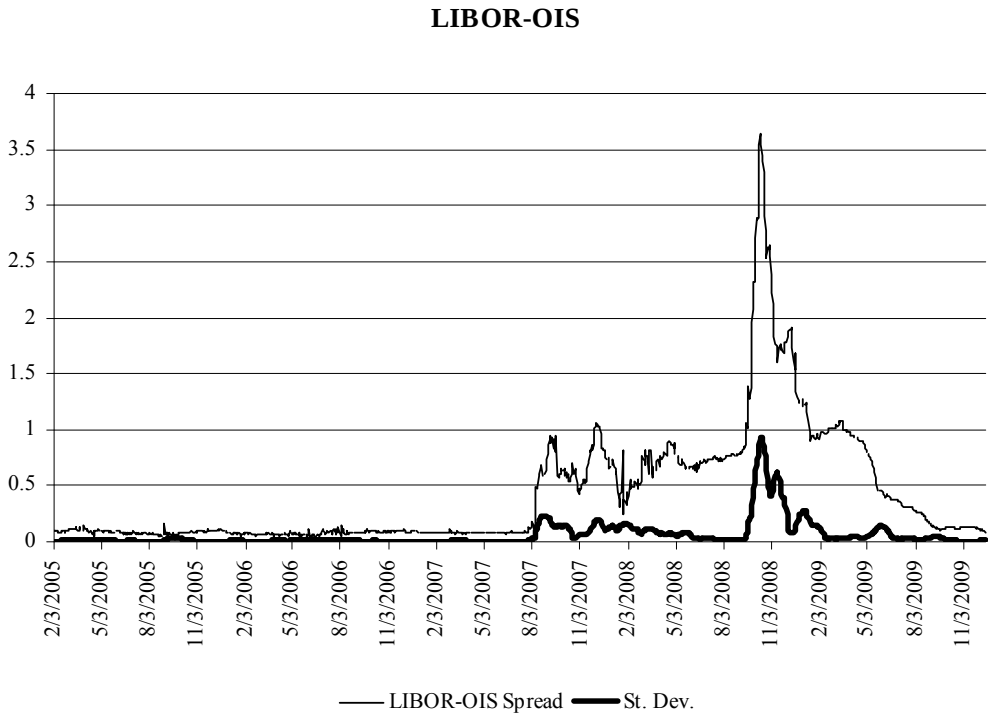
Fig. 1



Source: Merrill Lynch. Indices for 1-3 year bonds issued by US banks.

Fig. 2



Source: our calculations on data by Bloomberg. The spread is calculated as the difference between the three-month LIBOR rate and the OIS rate. The standard deviation is calculated on a monthly basis.