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Measuring systemic risk-adjusted liquidity (SRL)—A model approach ☆

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ABSTRACT

Little progress has been made so far in addressing—in a comprehensive way—the negative externalities caused by excessive maturity transformation and the implications for effective liquidity regulation of banks. The SRL model combines option pricing theory with market information and balance sheet data to generate probabilistic measure of systemic liquidity risk. It enhances price-based liquidity regulation by linking a bank's maturity mismatch impacting the stability of its funding with those characteristics of other banks, subject to individual changes in risk profiles and common changes in market conditions impacting funding and market liquidity risk. This approach can then be used (i) to quantify an individual institution's time-varying contribution to expected losses from system-wide liquidity shortfalls and (ii) to price insurance premia that provide incentives for banks to internalize the social cost of their individual funding decisions.

1. Introduction

A defining characteristic of the recent financial crisis was the simultaneous and widespread dislocation in funding markets, which adversely affected financial stability in absence of suitable liquidity risk management and policy responses. In particular, banks' common asset exposures and their increased reliance on short-term funding in tandem with high leverage levels helped propagate rising counterparty risk due to greater interdependence within the financial system. Amid greater uncertainty about hard-to-value assets, lenders were more likely to increase haircuts on repo financing, limit eligibility of collateral, or stop rolling over short-term funding altogether in order to offset an asset shock by means of de-leveraging their balance sheets (Shin, 2009; Shleifer and Vishny, 2010). As such a behavior occurred collectively, coordination failure led to liquidation of assets under fire sale conditions (Coval and Stafford, 2007), which further depressed asset prices, and fueled a confidence-induced downward liquidity spiral, causing system liquidity to dry up, with negative consequences for solvency.

The negative market dynamics during the financial crisis serves as poignant reminder of how individual funding decisions of banks can have a direct impact on the vulnerability of other banks. The maturity transformation of financial intermediation creates refinancing risks when there are doubts about solvency conditions in stress situations, causing disruptive liquidity runs (Diamond and Dybvig, 1983) through fire sales of assets or negative externalities from higher counterparty risk affecting other intermediaries exposed to short-term funding (Brunnermeier, 2009; Allen et al.,

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Table 1
General systemic risk measurement approaches. *Sources:* Drehmann and Tarashev (2011), FSB (2011), Weistroffer (2011), and author.

	Contribution Approach ("Risk Agitation")	Participation-Contribution Approach ("Risk Amplification")	Participation Approach ("Risk Absorption")
Concept	Systemic resilience to individual failure	Individual suceptibility to amplify a common shock	Individual relience and capacity to absorb a common shock
Description	Contribution to systemic risk conditional on individual failure due to knock-on effect	Contribution to systemic risk due to insufficient resilience to shared exposure and risk concentration	Mitigation of expected loss from systemic event due to structural buffers to absorb shocks to shared exposure and risk concentration
Risk transmission	"Institution-to-institution"	"Aggregate-to-institution-to-aggregate"	"Aggregate-to-institution"
Risk scope	Probability of systemic risk	Scale of systemic risk	
	Economic significance of intra-financial asset holdings and liabilities ("size")	Claims on other financial sector participants	Obligations on other financial sector participants
	Intra- and inter-system liabilities ("connectedness")	Market risk exposure (interest rates, credit spreads, currencies)	
Risk indicators	Degree of transparency and resolvability ("complexity")	Risk-bearing capacity (solvency and liquidity buffers, leverage, time horizon)	
	Participation in system-critical function/ service, e.g., payment and settlement system ("substitutability")	Economic significance of asset holdings, term structure transformation/maturity mismatches ("asset liquidation")	
Policy objectives	Avoid/mitigate contagion effect (by containing systemic impact upon failure)	Maintain overall functioning of system and maximize survivorship of sound institutions (with endogenous shock absorbers)	
	Avoid moral hazard	Preserve mechanisms of collective burden sharing	Encourage diversity of business models and risk management

Note: The policy objectives and different indicators to measure systemic risk under both contribution and participation approaches are not exclusive to each concept. Moreover, the availability of certain types of balance sheet information and/or market data underpinning the various risk indicators varies between different groups of financial institutions, which requires a certain degree of customization of the measurement approach to the distinct characteristics of a particular group of financial institutions, such as insurance companies.

2010). The sudden disposal of large asset positions of an institution in distress can significantly disrupt trading and/or cause significant losses for other financial institutions with similar holdings due to increases in asset and funding liquidity risk.[1] Thus, banks are prone to contribute to systemic risk via intra-and inter-sectoral linkages to other institutions and markets ("contribution approach", see Table 1), including through either their reliance on the same providers of funding and large common exposures.

The devastating impact of systemic liquidity events also illustrated the shortcomings in existing liquidity regulations. Under normal circumstances, banking regulation ensures, as far as possible, that maturity and liquidity transformation in conducted safely with the necessary access to central bank lending facilities and depositor protection preventing sudden run-offs of liabilities that could deplete the availability of sufficient funding under stress. However, private sector liquidity (as opposed to monetary liquidity), which is created largely through banks and other financial institutions, is invariably influenced by market pricing, which can amplify cyclical movements in system-wide financial conditions with the potential of creating negative externalities resulting from individual actions (CGFS, 2011). The ability of banks to sell off assets to meet their critical funding needs is sometimes severely constrained by thin markets, significant valuation haircuts, and liquidation lags that limits the amount of securities that can be sold without amplifying negative price movements. Higher perceived counterparty risk can result in higher funding costs and can depress asset prices to a point where they eventually overwhelm bank's liquidity buffers despite these mitigating factors.

The opportunity cost of holding liquidity is invariably cyclical, resulting in the tendency of banks to underprice liquidity risk by disregarding their vulnerability to funding constraints in times of system-wide stress. Even if a bank takes into account its exposure to refinancing risk arising from the chosen funding structure it will not internalize the system-wide effect as the net private value of short-term funding dominates the socially optimal allocation of funding within a system (Perotti and Suarez, 2009). Thus, banks have an incentive to minimize liquidity (and mitigate the opportunity cost of holding excess liquidity in lieu of return-generating assets) in anticipation that central banks will almost certainly intervene in times of stress as lenders-of-last-resort. Although central banks can halt a deterioration of funding conditions in order to maintain the efficient operation of funding markets, and, thus, limit the impact of liquidity shortfalls on the real economy, their implicit subsidization of bank funding accentuates the magnitude of liquidity risks under stress.[2]

While *systemic solvency risk* has already entered the prudential debate in the form of additional capital rules that apply to systemically important financial institutions (SIFIs), proposals aimed at measuring and regulating *systemic liquidity risk* have been few and far between. Systemic liquidity risk is associated with the possibility that maturity transformation in systemically important institutions and markets is disrupted by common shocks that overwhelm the capacity to fulfill all planned payment obligations as and when they come due. For instance, multiple institutions may face simultaneous difficulties in rolling over their short-term debts or in obtaining new short-term funding (much less long-term funding). However, progress in developing a systemic liquidity risk framework have been hampered by the rarity of system-wide liquidity risk events, the multiplicity of interactions between institutions and funding markets, and the conceptual challenges in modeling liquidity conditions affecting institutions and transactions separately or jointly.

The policy objective of such efforts would be to minimize the social cost of systemic risk from liquidity disruptions in a competitive equilibrium of banks with different funding choices. While a

[1] See Manconi et al. (2012) as well as Merrill et al. (2012) for empirical evidence on the contagion effect of fire sales by capital-constrained banks. Ellul et al. (2013) show how regulatory requirements can contribute to contagion effects (based on empirical evidence from the insurance market).

[2] Central bank measures during the financial crisis have further reinforced this perception of contingent liquidity support, giving financial institutions an incentive to hold less liquidity than needed (IMF, 2010a).