Journal of Banking & Finance 37 (2013) 2173–2182

Contents lists available at SciVerse ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

Funding liquidity risk: Definition and measurement

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ARTICLE INFO

Article history:
Available online 8 January 2012

JEL classification:
E58
G21

Keywords:
Funding liquidity
Liquidity risk
Bidding behaviour
Central bank auctions

ABSTRACT

Funding liquidity risk has played a key role in all historical banking crises. Nevertheless, a measure for funding liquidity risk based on publicly available data remains so far elusive. We address this gap by showing that aggressive bidding at central bank auctions reveals funding liquidity risk. We can extract an insurance premium from banks' bids which we propose as a measure of funding liquidity risk. Using a unique data set consisting of all bids in all auctions for the main refinancing operation conducted at the ECB between June 2005 and October 2008 we find that funding liquidity risk is typically stable and low, with occasional spikes especially around key events during the recent crisis. We also document downward spirals between funding liquidity risk and market liquidity. As measurement without clear definitions is impossible, we initially provide definitions of funding liquidity and funding liquidity risk.

1. Introduction

Funding liquidity risk has played a key role in all historical banking crises. Recent events are not different. The global credit crisis bore all the hallmarks of a funding liquidity crisis as interbank markets collapsed and central banks around the globe had to intervene in money markets at unprecedented levels. Nonetheless, a concrete measure of funding liquidity risk based on readily available data remains so far elusive. This paper addresses this gap by showing that banks' bids during open market operations reveal funding liquidity risk.

Measurement without definition is, however, difficult if not impossible. In this paper we define *funding liquidity* as *the ability to settle obligations with immediacy*. It follows that, a bank is illiquid if it is unable to settle obligations in time. Consequently, we define *funding liquidity risk as the possibility that over a specific horizon the bank will become unable to settle obligations with immediacy*. In contrast to other definitions used by academics and practitioners, our definitions have important properties, shared by definitions of other types of risk. First, like solvency, funding liquidity is a point-in-time and a binary concept as a bank is either able to settle obligations or not. Funding liquidity risk, on the other hand, can take infinitely many values depending on the underlying funding position of the bank. As any other risk, it is forward looking and measured over a specific horizon.

Ideally and in line with other risks, we would want to measure funding liquidity risk by the distribution summarising the stochastic nature of the underlying risk factors. This is impossible as these distributions cannot be estimated because of a lack of data, even for banks with access to more (confidential) information. Against this drawback, we propose a new approach for measuring funding liquidity risk. We extract funding liquidity risk from observing the costs that banks are willing to pay in order to secure liquidity from the central bank. The underlying trade-off at the central bank auction is whether to obtain liquidity from the central bank directly or rely on other markets for liquidity. By submitting aggressive bids above the expected marginal rate (i.e. the rate which equates the aggregate demand for central bank money with its supply), the bank is very likely to obtain funds from the central bank. Thereby it can insure against becoming illiquid. This is intuitive. But it can also be shown theoretically that banks bid more at higher prices, the greater their funding liquidity risk (Nyborg and Strebulaev, 2004; Valimaki, 2006).

Putting it differently, a bank's bid reveals its funding liquidity risk. This is highly useful information, as it is a real time measure of bank specific funding liquidity risk, which is otherwise hardly available. For confidentiality reasons, we cannot show bank specific bids. But using this insight, we demonstrate that aggregate funding liquidity risk can be measured by the sum of the premia banks are willing to pay above the expected marginal rate (i.e. the expected interest rate which will clear the auction) times the volume they bid, normalised by the expected amount of money supplied by the central bank. This measure can be interpreted as the weighted average insurance premium against funding liquidity risk.

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doi:10.1016/j.jbankfin.2012.01.002

We construct our measure with the help of a unique data set of 171 main refinancing operation (MRO) auctions, conducted between June 2005 and October 2008 in the euro area, involving more than 1000 different banks. Expected marginal rates are taken from a new survey dataset from Reuters. To the best of our knowledge, this is the first time that this kind of data set has been used.

We find that our proposed measure has intuitive properties. Prior to the crisis, the average insurance premium was less than one basis point. Funding liquidity risk increased rapidly after August 2007 and spiked after the rescue of Northern Rock. Following the failure of Bear Sterns liquidity risk rose sharply again, even though to less elevated levels. Unsurprisingly, our measure identifies record pressures in October 2008 after Lehman failed, when the average insurance premium rose to over 40 basis points. More generally, our measure shares characteristics such as a high degree of persistence with occasional spikes, which have been documented by market participants using banks' own models (e.g., Matz and Neu, 2007; Banks, 2005). Moreover, these properties are also shared by measures for market liquidity (e.g., Amihud, 2002; Chordia et al., 2005).

Our measure also allows us to assess the interactions of market liquidity and funding liquidity risk. Whilst this has been shown theoretically (e.g., Brunnermeier and Pedersen, 2009) and anecdotal evidence points to these effects in the recent crisis, the interaction between both liquidity measures has not been shown empirically due to a lack of measures for funding liquidity risk. Using our measure, we are able to show that there are strong negative interrelationships between funding liquidity risk and a measure for market liquidity. In this sense, higher funding liquidity risk implies lower market liquidity.

Finally, our measure significantly improves on other risk measures. For example, money market spreads have been a common reference point for practitioners, policy makers and academics to describe tensions prevailing during the current financial crisis. We show that the EURIBOR-OIS spread is much higher than our proposed measure. This is not unsurprising as the former is affected by a host of other risk factors and therefore is not a clean measure of funding liquidity risk (e.g., Gyntelberg and Wooldridge, 2008). Moreover, although no direct comparison is provided between our measure and banks' own measures of funding liquidity risk as data are unavailable, the latter are also not useful to measure funding liquidity risk on an aggregate basis. They rely entirely on confidential information and contain a lot of judgement (e.g., Matz and Neu, 2007), thereby preventing appropriate aggregation.

The remainder of the paper is structured as follows. In Section 2 we introduce our definition of funding and funding liquidity risk and discuss how this relates to other definitions in the literature. After providing a short overview of OMOs in the euro areas in Section 3, we show that higher funding liquidity risk will result in higher bids during OMOs in Section 4. Section 5 introduces our measure and Section 6 presents data used. In Section 7 we present the results. Further discussion is provided in Section 8. Finally, Section 9 concludes.

2. Definition of funding liquidity and funding liquidity risk

2.1. Funding liquidity and funding liquidity risk

Liquidity risk arises because revenues and outlays are not synchronised (Holmström and Tirole, 1998). This would not matter if agents could issue financial contracts to third parties, pledging their future income as collateral. Given frictions, this is not always possible in reality and agents may become illiquid. We define *funding liquidity* as *the ability to settle obligations with immediacy*. Consequently, a bank is illiquid if it is unable to settle obligations. Legally, a bank is then in default. Given this definition we define *funding liquidity risk as the possibility that over a specific horizon the bank will become unable to settle obligations with immediacy*.

It is worth to highlight important differences between funding liquidity and funding liquidity risk: Funding liquidity is essentially a binary concept, i.e. a bank can either settle obligations or not. Funding liquidity risk on the other hand can take infinitely many values as it is related to the distribution of future outcomes. Implicit in this distinction is also a different time horizon. Funding liquidity is associated with one particular point in time. Funding liquidity risk on the other hand is always forward looking and measured over a specific horizon. In this respect, concerns about the future ability to settle obligations, i.e. future funding liquidity, will impact on current funding liquidity risk. Therefore, the distinction between liquidity and liquidity risk is straightforward and analogous to other risks. For example, a similar distinction can be made between credit risk and default. Whilst default either occurs or does not, credit risk is associated with the likelihood that the borrower will default over a particular horizon.[1]

Surprisingly, a distinction in the definition of funding liquidity and funding liquidity risk has not been made by practitioners and academics so far. Borio (2000), Strahan (2008) or Brunnermeier and Pedersen (2009) for example, define funding liquidity as the ability to raise cash at short notice either via asset sales or new borrowing. Whilst it is the case that banks can settle all their obligations in a timely fashion if they can raise (sufficient) cash at short notice, the reverse is not true as a bank may well be able to settle its obligations as long as its current stock of cash is large enough to cover all outflows. As the ability to raise cash can vanish (Borio, 2000) this definition is implicitly forward looking and therefore associated to funding liquidity risk. The IMF defines funding liquidity as "the ability of a solvent institution to make agreed-upon payments in a timely fashion" (p. xi, IMF, 2008). This definition carries the notion that liquidity is related to the ability to settle obligations. However, it is crucial to distinguish liquidity and solvency as welfare losses associated with illiquidity arise precisely when solvent institutions become illiquid. The definition of the Basel Committee of Banking Supervision is close to our definition even though it mixes the concepts of funding liquidity and funding liquidity risk. In their view liquidity is "the ability to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses" (BCBS, 2008, p. 1). The first part of this definition is essentially equivalent to ours. However, it is unclear what 'unacceptable losses' really means.

Our definition raises the question how banks settle obligations. Most transactions, especially those involving private agents, are settled in commercial bank money. However, central bank money plays a crucial role for transactions between banks. In the Eurosystem, but also in most other economies, large value payment and settlement systems rely on central bank money as the ultimate settlement asset (CPSS, 2003).[2] While banks can create commercial bank money, the volume of central bank money is determined by central banks. Therefore, the ability to settle obligations, and hence funding liquidity risk, is determined by the ability to satisfy the demand for central bank money.[3]

2.2. Funding liquidity as a stock-flow concept

Based on our definition, it is easy to see that a bank is able to satisfy the demand for (central bank) money, and hence is liquid,

[1] A broader definition of credit risk also accounts for the stochastic nature of loss given default, changes in the underlying credit quality and changes in the exposure at default.

[2] Central bank money consists mainly of deposits held by commercial banks with the central bank. Central bank money has also been labelled high powered money in the monetary economics literature.

[3] The role of central bank money as a settlement asset is elaborated further in the working paper version (Drehmann and Nikolaou, 2010).