

Revisiting the role of central banks as liquidity providers – old and new challenges

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This article offers a review of the role of central banks as providers of public liquidity. Against the backdrop of the global financial crisis of 2007-2009, we discuss various challenges for public liquidity provision and the effectiveness of central bank lending facilities. These challenges help us identify potential gaps in existing mechanisms and frameworks governing liquidity assistance. We discuss how the available liquidity policy tool kit can be used to deal with the challenges. Furthermore, we highlight modifications to existing central bank facilities during and after the global financial crisis. We point at trade-offs faced by policy makers and describe potential pitfalls for public liquidity providers. Lastly, we attempt to look ahead and outline some specific challenges posed by more recent structural, regulatory, and technological developments in the financial system.

1 Introduction

Central bank liquidity provision is related to all core tasks within the central bank mandate. It constitutes an important pillar for the transmission of monetary policy and the smooth functioning of the payments system, as well as for safeguarding financial stability. In relation to the latter task, central bank liquidity provision has played a key role in responding to liquidity crises since Bagehot (1873). This role became evident during the Global Financial Crisis in 2007-2009 (henceforth GFC),

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where the backstop provided by central banks acting as *lenders-of-last-resort* (LLRs) was instrumental in avoiding a melt-down of the financial system.

The objective of this article is to offer a review that could help enhance our understanding of liquidity provision and the role of central banks as providers of *public liquidity*. In this, challenges for the effectiveness of central bank lending facilities are given special attention. In light of the recent crisis experience, potential gaps in existing mechanisms and frameworks governing central bank liquidity provision are identified and discussed. Furthermore, we attempt to provide an analysis of the potential pitfalls, such as unintended implications for the behavior of financial institutions that may arise from the availability of certain lending facilities. The purpose of this article is not to generate specific policy recommendations, but rather to provide a descriptive and conceptual basis for further policy discussions.

We start off by describing what a private liquidity system would look like in an ideal world. Thereafter, we discuss relevant market failures that are associated with financial frictions. The resulting inefficiencies justify the provision of liquidity by central banks, which can improve the allocation of resources. We then describe the policy tool kit employed by central banks to achieve their objectives and consider the associated challenges. Furthermore, we examine how challenges can be dealt with. Our discussion is framed with the help of idiosyncratic and system-wide liquidity stress events that are motivated by the recent GFC.

During the last two decades, the financial system has undergone structural and regulatory changes that affect liquidity in financial markets and the conduct of public liquidity provision in both crisis times and normal times. At the same time, doctrines for central bank liquidity assistance (LA) have been questioned, not least during the recent GFC, when governments and central banks all over the world were forced to make massive interventions in the form of state guarantees and liquidity support to address system-wide liquidity stress. At the time, central banks reacted with ad-hoc modifications to their tools and practices, so as to address the emergence of new challenges to the effective provision of liquidity to financial institutions and markets. After the crisis, several central banks also made more permanent modifications to their LA frameworks. This included broadening the terms for existing facilities, creating new permanent and contingent facilities, and re-considering the degree of transparency of central bank communication.

Besides challenges related to systemic stress events such as the ones experienced in the GFC, this article also covers challenges related to idiosyncratic stress events and implications for liquidity provision in normal times. More generally, our focus is on specific aspects that are important when it comes to effective provision of liquidity to market participants in need, such as shortage

of eligible private collateral, solvency assessment, adjustment of LA to changing needs, and potential problems related to stigmatization of central bank lending facilities.

When evaluating the central bank policy tool kit, as well as potential gaps in lending facilities, it is essential to reflect on the effects of public liquidity provision on the behavior of financial intermediaries and markets. To this end, we offer a detailed account of the academic literature on public and private liquidity provision. We highlight challenges to central bank liquidity provision stemming from behavioral effects, such as implications for risk-taking and market discipline, impairment of private liquidity provision, and distortions in the allocation of credit. Moreover, we set liquidity provision in the context of monetary policy. Looking ahead, we identify future challenges related to the nexus between emergency LA and bank resolution, the high intensity of cross-border banking activities which is particularly relevant for Sweden and recent developments in financial markets.

The article is organized as follows. Section 2 presents the conceptual underpinnings of private and public liquidity provision, introducing the important role played by central bank liquidity provision, which is set in context with monetary policy. Section 3 discusses the tools and goals of a public liquidity provider. Thereafter, Section 4 describes the challenges and Section 5 how they can be dealt with. Section 6 discusses potential pitfalls and trade-offs from the viewpoint of central banks. Then Section 7 tries to look ahead at new challenges going forward and some concerns from the Swedish perspective. Finally, Section 8 concludes.

2 Central bank liquidity provision

Before discussing the conceptual underpinnings of private and public liquidity provision, we define some key terms (Table A.1 in the Appendix summarizes definitions). The term liquidity is related to the ease of transferring future income from long-dated assets into current income. Since liquidity is provided by both the private and the public sector, we can distinguish between *private liquidity provision* by financial institutions and *public liquidity provision* by the government or central bank. Furthermore, the literature distinguishes between *funding liquidity* and *market liquidity*. Funding liquidity refers to the ease with and cost at which financial institutions raise cash to make their immediate payments, either via collateralized debt or by selling assets. Market liquidity refers to the ability to execute large security transactions rapidly with a limited impact on market prices. Liquid financial markets are important for the allocation of resources in the

economy and to fund real investments. Thereby, liquid financial markets facilitate economic activity and growth. The two concepts of funding liquidity and market liquidity are closely related. While market liquidity is positively associated with funding liquidity, it is also the case that funding liquidity facilitates market liquidity through its positive effect on market-making.

In the domain of public liquidity provision, central banks play a prominent role by regulating *central bank liquidity*. We use this term to describe central bank money or securities that serve as collateral in money markets. Central bank money consists of financial institutions' deposits at the central bank (also known as reserves or settlement balances).¹ Especially in crisis times, central bank liquidity provision can be positively associated with funding and market liquidity. We'll come back to central bank money when discussing the liquidity policy tool kit in Section 3.

We proceed by discussing in Section 2.1 what a private liquidity system would look like in an ideal world. Furthermore, we describe how market failures can justify the provision of public liquidity. Then we highlight in Section 2.2 the role of central banks as the natural providers of public liquidity from a conceptual viewpoint. Thereafter, Section 2.3 illustrates the historical relevance of central banks in safeguarding financial stability and Section 2.4 discusses the goals of central banks as liquidity providers. Finally, Section 2.5 discusses the close connection between monetary policy and liquidity policy.

2.1 Private liquidity provision – and its limitations

the classical business of financial intermediaries is to engage in *maturity transformation* by attracting short- and medium-term deposits that are used to fund long-term loans to corporates and households. This is an important role of financial intermediaries, because some financial investors prefer deposits that are short-term or demandable when they believe that potential liquidity needs (Bryant 1980; Diamond and Dybvig 1983) or investment opportunities (Holmström and Tirole 1996) may arise in the future. Instead, borrowers who want to fund investments prefer to match the maturity of their loans with the maturity of their investments, which are often longer-term. For corporate borrowers, such long-term investments may be in production plants or buildings, whereas for households investments may be in residential property or durable goods. By matching short-term funding with longer-term investments,

¹ These reserve balances are held by financial institutions to achieve final settlement of all financial transactions in the payments system (and, to the extent such requirements are applied, to meet central bank reserve requirements). Individual institutions can borrow and lend these funds in the interbank market, but the central bank is the only source of these funds for the system as a whole.

financial intermediaries build up a *maturity mismatch* on their balance sheet. While engaging in maturity transformation, intermediaries also engage in *risk transformation* by funding risky investments with riskless deposits (e.g., Diamond (1984)). Furthermore, intermediaries provide liquidity risk sharing opportunities to their customers in the form of demandable deposits, credit lines or market-making services. *Maturity transformation* and *liquidity insurance* expose intermediaries to a number of risks, including *liquidity risk*, which captures the financial risk stemming from the difficulty of selling a claim against a long-term investment quickly in order to make immediate payments to customers.

In the benchmark of an “ideal world” private liquidity system, financial intermediaries contribute to allocative efficiency by engaging in maturity transformation. Furthermore, financial intermediaries provide welfare-enhancing liquidity risk sharing opportunities to customers and efficiently share their own liquidity risk with other intermediaries via interbank markets by providing private liquidity to one another (Allen and Gale 2004). To manage their liquidity risk, intermediaries can limit the maturity mismatch by holding a sufficiently high proportion of reserves with the central bank and highly liquid securities such as government bonds. These liquidity holdings have a *precautionary* and a *speculative* component. On the one hand, liquid assets serve as a buffer against unexpectedly high outflows of funds. On the other hand, financial intermediaries can benefit from providing liquid assets to the market whenever their individual outflows of funds are small. In an “ideal world”, the precautionary and speculative motives are balanced to ensure an efficient level of private liquidity provision.

The real world, as opposed to this “ideal world” is however prone to various market failures causing inefficiencies that can justify the provision of liquidity by the central bank, as well as regulatory policies such as liquidity regulation, bank capital regulation, and prompt corrective action.² One source of market failure is the *incompleteness of financial markets and contracts* (Allen and Gale 2004). Notably, the occurrence of liquidity crises that are associated with failures of financial intermediaries in itself must not be inefficient (Allen and Gale 1998). However, incomplete markets and contracts can impair the incentives for private liquidity provision and lead to *asset fire sales* and an inefficiently high incidence of liquidity crises. Insufficient incentives for private investments in liquid assets have also been associated with distortions related to *asymmetric information* (Greenwald and Stiglitz 1986; Geanakoplos and Polemarchakis 1986), *moral hazard* (Bhattacharya and Gale 1987) and *monopoly power* (Acharya, Gromb and Yorulmazer 2012).

² See De Nicolò (2016) or Allen (2014) for a review.

In private liquidity systems with asymmetric information and incomplete contracts, financial intermediaries can be prone to *panic-based runs* (Diamond and Dybvig 1983) or *information-based runs* (Chari and Jagannathan 1988, Jacklin and Bhattacharya 1988, Rochet and Vives 2004). Furthermore, the presence of *contractual incompleteness* or *asymmetric information* can reduce the abilities of intermediaries to pledge future cash flows (Hart and Moore 1988). The same is true for *moral hazard* stemming from *unobserved costly effort* by financial intermediaries (Holmström and Tirole 1997), which can be related to an insufficient effort in risk management or in the monitoring of loans. Moreover, *agency problems* can also be associated with a different type of *moral hazard* resulting from *risk-shifting* on the asset side (Jensen and Meckling 1976), potentially in combination with deposit insurance (Cooper and Ross 2002, Calomiris and Jaremski 2016a,b), or bailouts.³ Finally, an inefficiently high incidence or intensity of liquidity crises in private liquidity systems can also be associated with *network externalities* or *contagion risk* resulting from the interconnectedness of financial intermediaries.⁴

Due to the above mentioned market failures, the aggregate level of private liquidity creation may at times be either excessive or insufficient. Diamond and Rajan (2000,2001) show that higher leverage and, hence, greater financial fragility can be positively associated with liquidity creation. On the other hand, adverse shocks can lead to a reduction in liquidity creation, and even more so if the fragility of financial intermediaries is higher. Acharya and Naqvi (2011) link the access of abundant liquidity to the formation of *asset price bubbles* and greater risk-taking due to an agency problem, thereby sowing the seeds of the next crisis. In empirical work, Berger and Bouwman (2009,2011) study the evolution of liquidity creation by U.S. banks and find that high bank liquidity creation has some explanatory power in predicting the GFC of 2007-2009 (with an important role played by off-balance sheet liquidity creation). Whether there is an “optimal scale” of liquidity creation in the banking system is still an open question (Berger and Bouwman 2016).

The various market failures can justify government intervention and regulation. Specifically, one can distinguish between policies that mitigate the adverse effects of a crisis and policies that aim at preventing crises (De Nicolò 2016). The former policies are related to *ex-post* government interventions such

³ Besides the adverse effects of expected bailouts on risk management and risk-shifting (Perotti and Suarez 2002), there may also be adverse effects associated with the collective competitive behavior of banks (Bertsch et al. 2014).

⁴ Possible contagion channels include financial and balance sheet links (Rochet and Tirole 1996, Allen and Gale 2000), information contagion (Acharya and Yorulmazer 2008), a common investor base (Goldstein and Pauzner 2004), and wake-up calls (Ahnert and Bertsch 2015).

as guarantees or bailouts and to central bank LLR measures (liquidity support to financial institutions or markets). Instead, the latter policies have an *ex-ante* nature and are mostly related to financial regulation, prompt corrective action and deposit insurance. However, the availability of central bank lending facilities and the ex-ante transparency thereof can also play a role when it comes to preventing crises, as well as effects on the incentives for private liquidity provision (Acharya et al. 2011).

In this paper, we focus on the provision of liquidity by central banks and how these interventions can improve the allocation of resources. Therefore, we treat in most of our analysis financial regulation as given, but acknowledge the important role played by these policies when attempting to prevent crises. In fact, recent regulatory initiatives such as the *Liquidity Coverage Ratios (LCRs)* and *Net Stable Funding Ratios (NSFRs)* address market failures associated with insufficient incentives for financial institutions to invest in liquid assets.^{5,6} Similarly bank capital regulation is usually associated with efforts to deal with moral hazard and insufficient incentives for financial institutions to maintain loss buffers.

We next turn to the role of central banks as providers of public liquidity and discuss the relationship with private liquidity provision from a conceptual viewpoint.

2.2 Central banks as the natural providers of public liquidity

Central banks are the “natural” providers of *public liquidity* and play an important role in regulating liquidity in the financial system by lending (against collateral) to, or borrowing from, financial institutions. The ability of central banks to perform this role in a fiat currency system derives from their power to regulate central bank liquidity by providing virtually unlimited quantities of liquidity in their own money. Financial institutions rely on functioning interbank markets to withstand temporary liquidity shortages. In normal times, banks provide unsecured or secured lending to one another at terms that are closely related to the central bank’s refinancing rate. With the help of overnight refinancing facilities, central banks can smooth out the aggregate liquidity need of the banking system and thereby mitigate excessive volatility of asset prices (Allen et al. 2009). Central banks do this via a circle of counter-parties for their operations, which comprises a

5 Perotti and Suarez (2011) outline a Pigovian approach to liquidity regulation in a model with systemic externalities and contrast it with quantity regulation (e.g. NSFRs).

6 For the LCR see the Basel Committee on Banking Supervision (2013) and for the NSFR see the Basel Committee on Banking Supervision (2014), as well as earlier documents (Basel Committee on Banking Supervision 2010a; 2010b).

number of commercial banks that hold reserves and can act as intermediaries for the broader financial system.

By supporting the functioning of an interbank market for liquidity risk sharing and providing an insurance against aggregate fluctuations, central banks can facilitate financial intermediaries' engagement in maturity transformation, that is, to match short-term funding from the private sector with long-term investments. In fact, central banks may have a "comparative advantage in providing contingent liquidity" (Holmström and Tirole 2013, p. 125) relative to the private sector in instances of an adverse economic shock that leads to a scarcity of private sector collateral. During a financial crisis, central banks can expand their lending and widen the pool of eligible collateral and counterparties to mitigate disruptions of the financial system and adverse effects on the real economy, thereby assuming their role as a LLR.

In the light of the discussion of a private liquidity system and its proneness to various market failures, central banks can provide an effective backstop for banking panics (Rochet and Vives 2004) and reduce contagion risk. Besides the proneness of private liquidity systems to panic runs, adverse selection problems can also lead to hoarding behavior and liquidity dry-ups (Malherbe 2014). In this context, central banks can help to restore market functioning by overcoming adverse selection (Tirole 2012). Furthermore, central bank liquidity support can be justified if it helps to curtail the adverse effects of fire-sale externalities (Stein 2012), or the failure of too-interconnected-to-fail institutions of systemic importance (Tirole 2011).

While LLR policies deal more broadly with assistance to financial institutions or the financial market as a whole in adverse states of the economy, central banks can also provide LA selectively to individual institutions faced with severe liquidity problems and unable to borrow from other financial institutions through interbank markets. Such interventions targeted at individual institutions fall under the preface of *emergency liquidity assistance* (ELA), which is part of the domain of LLR policies. The central bank's role as provider of ELA is important since the failure of an individual financial intermediary can lead to a contraction in the liquidity pool of the financial system, giving rise to a detrimental interaction between solvency and liquidity problems (Diamond and Rajan 2005). In such a situation, the provision of contingent public liquidity may be essential in arresting financial panics. Typically, central bank mandates, or the interpretation thereof, limit ELA to illiquid but solvent financial institutions since the extension of central bank liquidity support to insolvent institutions bears social costs. The *solvency assessment*, i.e. the distinction between illiquidity and solvency, is a core challenge of LLR policy. It plays a crucial role in the design of LLR policies with

implications for the ex-ante behavior of financial institutions. Furthermore, the solvency assessment is substantially affected by institutional factors related to bank capital regulation and liquidity regulation.

From the viewpoint of market participants, the financial regulator and the central bank, the availability of *public liquidity* supplied by the central bank – in normal and in crisis times – is typically not a perfect substitute for *private liquidity* supplied by the financial system. Such an imperfect substitutability may arise for several reasons and create a social cost for public liquidity provision.

First, the supply of private liquidity plays an important role, for instance, in mitigating potential moral hazard concerns. This is because the provision of liquidity by financial institutions to one another may have a positive disciplining effect and reduce risk-shifting. Specifically, the reliance of individual financial institutions on short-term debt and the provision of private liquidity by its peers or by markets can be part of an incentive-compatible intermediation where private investors monitor the bank to prevent fraudulent behavior (Calomiris and Kahn 1991). More generally, peer monitoring can reduce moral hazard problems by exposing banks to elevated funding costs whenever misconduct is detected. Relative to public liquidity provision, the reliance on private liquidity provision can improve the monitoring if market participants have more information than the central bank or regulator. Furthermore, the exertion of *market discipline* – or punishment – after detection by market participants is a credible threat, thereby reducing the likelihood of misconduct.

Second, private liquidity provision plays an important role in assuring adequate pricing of risks in markets, which is reflected in the distribution of funding costs along different types of collateral used in repo markets. In this way, financial intermediaries face higher funding costs when shifting into riskier asset classes. The described mechanism may, however, be impaired if public liquidity provision crowds-out private liquidity provision to riskier asset classes.⁷

Third, the scope of public liquidity provision may be limited for practical and institutional reasons, which leaves an important role to be played by private liquidity provision. An example is the limited scope of central bank liquidity provision when it comes to the circle of eligible counterparties. Consequently, potential crowding-out effects on the private liquidity supply resulting from the existence of public liquidity provision may be undesirable if this puts non-eligible counterparties who do not have access to central bank liquidity provision at a substantial disadvantage. Taken together, private liquidity provision has a social value due to an imperfect substitutability of public and private liquidity provision.

⁷ Thereby, an abundant *public liquidity* supply may fuel risk-taking by banks, causing excessive lending and asset price bubbles. See also Section 2.1 and discussion in Acharya and Naqvi (2011).

The academic debate on the merits and different facets of private liquidity provision is still ongoing. We will come back to this as we go along. However, the importance of central bank liquidity provision to safeguard the financial system is unquestioned. We continue with a brief discussion of the historical role of central banks and the short-term funding of financial intermediaries.

2.3 Historical role of central bank liquidity provision and banks' reliance on short-term funding

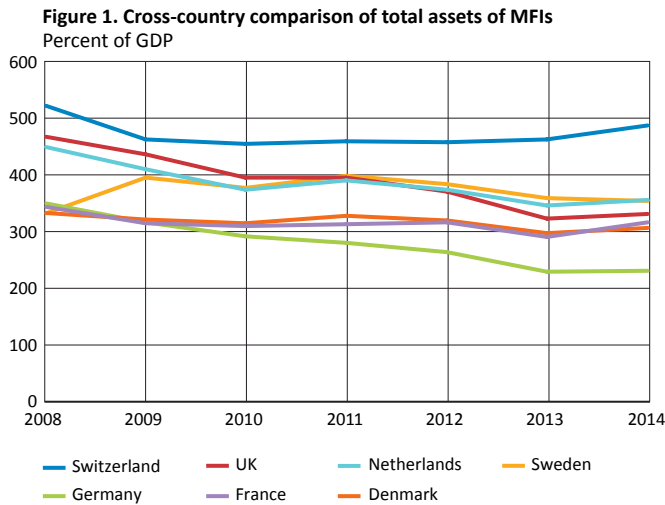
The 19th and 20th centuries have been rich in banking crises. For the U.S., Schwartz (1988) identified 14 years with banking panics between 1790 and 1930. Using a different methodology, Reinhardt and Rogoff (2008) identified 11 years with banking crises in the U.S. between 1800 and 2000. Also other high-, medium- and low-income countries across the world have been affected by frequent banking crises and panics.

Public liquidity provision has been regarded as a key instrument to avoid banking panics and to assist banks with liquidity problems (Thornton 1802; Bagehot 1873). Historically, the presence of an active LLR has been associated with a lower incidence of banking panics when considering cross-country comparisons. Bordo (1989) argues that the Bank of England's assumption of its role as LLR reduced the incidence of banking panics in the U.K. in the second half of the 19th century relative to the U.S.

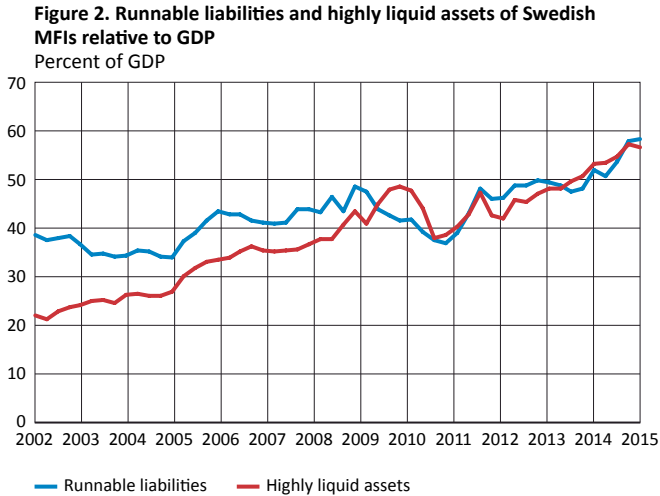
This role of central banks is as important today as it has been historically, given the increasing reliance of financial intermediaries on short-term funding. Since the late 1990s, U.S. bank holding companies have progressively shifted away from retail deposits and started to borrow *short-term wholesale funds* (Feldman and Schmidt 2001, Bradley and Shibut 2006). The U.S. non-core bank funding, mostly short-term wholesale funds, accounts for 20 percent of total bank funds (Beatty and Liao 2014). This phenomenon is strongest for larger banks and also holds for European banks. Empirical studies document that a higher reliance on short-term wholesale funds is associated with higher bank fragility (Demirgüç-Kunt and Huizinga 2010; Goldsmith-Pinkham and Yorulmazer 2010; Vazquez and Federico 2015). Markedly, this played an important role during the GFC of 2007-2009 (IMF Global Financial Stability Report, October 2013, Chapter 3). A recent study by Bao et al. (2015) gives a detailed assessment of uninsured short-term funds, or so-called *runnable liabilities*,⁸ of U.S. banks during the build-up to the GFC.

⁸ Runnable liabilities constitute short-term liabilities without insurance or backing from the federal government that are considered to be prone to withdrawal or roll-over risk.

In Sweden, the financial system is essentially bank-based. The financial sector is large relative to the size of the economy and characterized by a strong whole-sale funding reliance. Figure 1 depicts the evolution of the size of the Swedish financial sector, measured as total assets of monetary and financial institutions (MFIs) relative to gross domestic product (GDP), and puts it in an international comparison. Figure 2 shows the evolution of highly liquid assets and runnable liabilities of Swedish MFIs.⁹



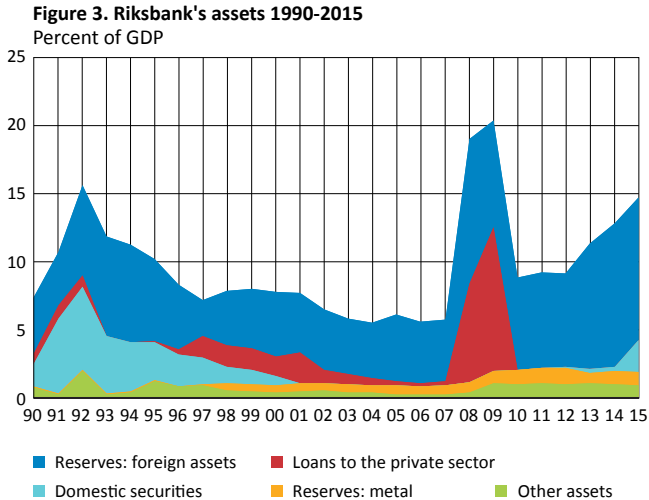
⁹ The vast majority of runnable liabilities consist of short-term money market funding, but it also includes deposits from the rest of the world (which tend to be large uninsured deposits). Given that uninsured deposits from domestic investors are not included in the runnable liabilities, it can be considered as a lower bound for the actual reliance of Swedish MFIs on short-term funding. The IMF Country Report from September 2011 indicates that the whole-sale funding reliance of the biggest Swedish banks exceeded that of its European peers during the build-up to the financial crisis. Furthermore, a significant proportion of the total funding was short-term (15 percent of the bonds had a maturity below 1 year and 20-25 percent a maturity below two years), which affected Swedish banks after the failure of Lehman Brothers in September 2008 when the U.S. dollar money market was severely disrupted causing difficulties in rolling-over debt.



Sources: Statistics Sweden. Runnable liabilities: deposits from the rest of the world; money market papers. Highly liquid assets: cash and credit balances at central banks; treasury bills etc. eligible for central bank financing; bonds and other interest-bearing securities

In Sweden, runnable liabilities as a share of GDP are increasing. At the same time, also highly liquid assets as a share of GDP are increasing. For recent years, this may partially reflect a tightening of the liquidity regulation and an increased attention of markets to liquidity buffers of individual institutions after the GFC.

Despite improved liquidity buffers, the evolution of runnable liabilities is a relevant concern for central banks given the inherent vulnerability of runnable liabilities to systemic runs. During the GFC, central banks all over the world had to assume their role as LLR by extending about the equivalent of four trillion U.S. dollars (USD) in extraordinary LA. The necessity of this magnitude of interventions results from the vast amount of runnable liabilities on banks' balance sheets. In Sweden, the Riksbank extended a large amount of loans to the Swedish financial sector by lending against a wide range of collateral, including ELA for individual institutions. Figure 3 illustrates how the Riksbank's balance sheet grew drastically in 2008/09 from around 5 percent to over 20 percent of Swedish GDP.



Source: The Riksbank

Taken together, the previous figures underpin the importance of central bank liquidity provision to provide a backstop against panics in the financial sector. Against the backdrop of the historical role, we discuss in the next section in more detail the goals of modern central banks as public liquidity providers.

2.4 Goals of a public liquidity provider

As indicated at the outset, central bank liquidity provision has several goals or purposes pertaining to the implementation of monetary policy, facilitating smooth functioning of the payments system, and acting as a *lender-of-last-resort* – primarily to the banking sector – in order to safe-guard financial stability.

“The provision of short-term liquidity is ... a longstanding function of central banks, and – as we know from Bagehot and earlier authors – a principal tool for arresting financial panics” (Bernanke 2009, p.2).

The formulation of the classical LLR doctrine is frequently attributed to Bagehot (1873), whose recommendation was to lend *early and largely* to *illiquid but solvent* banks, and to “lend freely at a high rate, on good collateral”. From the beginning, one of the main challenges for a LLR was to distinguish between *insolvent* banks and *illiquid but solvent* banks. This distinction is especially difficult

in a crisis situation and played an important role in the academic and policy debate for years to come.

If the distinction between illiquidity and insolvency is sharp, then well-developed and well-functioning financial markets will safeguard solvent banks from becoming illiquid (Goodfriend and King 1988). In that case, it suffices to lend to the market as opposed to individual institutions. LLR liquidity assistance to individual institutions is not needed. If, on the other hand, information about solvency is imperfect, a differentiated view of the optimal LLR policy arises. Rochet and Vives (2004) have argued that lending to individual banks that are potentially insolvent may be justified to avoid inefficient liquidations if the margin of error is not too high. Similarly, systemic risk considerations may motivate assistance even to institutions whose solvency is severely questioned (Goodhart and Huang 2005; Freixas et al. 2000b).¹⁰

The high lending rate advocated by Bagehot, also known as *penalty rate*, has been challenged in the academic debate (Freixas et al. 2000a).¹¹ Moreover, penalty rates were shown to be potentially related to a higher stigmatization of central bank lending facilities (Bank of England, Winters Report 2012).¹² Still, the potential *moral hazard* associated with lending at low or zero penalties (Solow 1982; Goodfriend and Lacker 1999) remains a relevant concern.¹³

Tailored towards financial stability and crisis response, the classical LLR doctrine is still a benchmark for today's liquidity policy. Most importantly, the objective is to arrest panics by preventing idiosyncratic stress from developing into systemic stress. Furthermore, a rationale for LLR intervention is that either a payment default by an individual financial institutions or a broader shortage of market or funding liquidity can threaten the financial system's ability to fulfil a number of important functions in society. These include *the provision of payment services, the allocation of capital, and risk management*. On top of this, the functioning of the financial system is essential for the effectiveness of monetary policy. Therefore, an overarching goal of central banks acting as LLR has been to

10 In practice, central bank mandates typically exclude liquidity assistance to insolvent institutions.

11 While it served a clear role in a world with commodity money where liquidity is scarce (Martin 2009), the benefits of a penal rate are less clear in a world with fiat money.

12 The penal rate for lending at the Bank of England's discount window facility was drastically reduced following the recommendations of the Winters report (see also Box 4 in Section 5). Before 2008, the Bank of England's rate stood at 100 basis points, while the new terms foresee a volume dependent discount window rate for borrowing against level A collateral (e.g. highly liquid, high-quality sovereign debt) starting at 25 basis points. Furthermore, the average cost of borrowing against level C collateral (e.g. less liquid securitization and loan portfolios) at the discount window facility was reduced from 200 basis points to 75 basis points (Bank of England, October 2013).

13 After scrutinizing the moral hazard problem, the usefulness of penalty rates remains questionable (Freixas and Parigi 2008). The specific nature of the moral hazard problem plays an important role (Freixas et al. 2004) and a penalty rate may be ineffective or even strengthen the moral hazard problem (Repullo 2005; Castiglionesi and Wagner 2012).

avert such costly disruptions by providing an *effective backstop* for the banking and the wider financial system. This requires regular and extraordinary lending facilities to be designed in such a way that the LLR is able to reach the market participants in need of liquidity and to achieve an appropriate distribution of liquidity in the private sector. At the same time, such lending facilities should be designed in a way that limits any *distortion of credit allocation*, preserves the functioning of monetary policy transmission, and avoids an *impairment of private liquidity provision and market discipline*. Finally, an important goal is to protect the central bank balance sheet from unwarranted credit risk.

Relative to the classical LLR doctrine, perhaps the most significant change of paradigm over the last decade manifested itself in the change of focus from the provision of funding liquidity to individual banking institutions to markets (Mehrling 2012; Tucker 2015).¹⁴ For example, the interventions during the GFC featured central banks as de facto *market-makers-of-last-resort* (MMLR), who lent against or purchased a wide range of core assets.¹⁵ Contrasting with a rather traditional view on LLR policies, MMLRs acted as dealers-of-last-resort by conducting liquidity operations that target markets and certain security classes (Brunnermeier and Pedersen 2009). In addition, it shows to be of growing importance for central banks to closely monitor and understand the liquidity situation in different parts of the financial system.

2.5 Monetary policy and public liquidity provision

The domains of monetary policy and liquidity provision are closely interrelated. For example, central banks rely on a limited set of counterparties for their core monetary policy operations. Hence, the liquidity and solvency of these counterparties is crucial in achieving a distribution of liquidity to the financial system and to the real economy, as well as in assuring a well-functioning *monetary policy transmission mechanism*, which is the process through which monetary policy decisions are transmitted to the economy. This is because the monetary policy transmission relies on a positive link between the monetary policy rate and market interest rates for borrowing against securities classes that are less safe and less liquid. For this reason, the implications of liquidity policy for the supply of safe assets also play an important role as a result of the effect on credit spreads and monetary policy transmission.

14 In this context, the modern pendant to the classical penalty rate is a wide bid-ask spread around the price that would prevail in normal times.

15 In situations of severe market stress, when the market fails to match buyers and sellers at prices acceptable to both, central banks can step in as MMLR. The MMLR function can be fulfilled in two ways. First, outright purchases and sales of a wide range of private sector securities. Second, acceptance of a wide range of private sector securities as collateral in repos, and in collateralized loans and advances at the discount window.

The *easing of monetary policy* (e.g. lowering of the nominal interest rate) is commonly used to complement public liquidity provision in support of funding and market liquidity when curtailing a systemic banking crisis. Holmström and Tirole (1998) find that a loose monetary policy in adverse aggregate states of the economy may be part of a welfare-improving mechanism that redistributes resources from investors to the firms or banks in need of liquidity, thereby underpinning an effective crisis response. However, conflicts can arise, e.g. with the mandate for price stability and the stabilization of the exchange rate.¹⁶

There are also monetary policy implications for liquidity provision since monetary policy can affect private liquidity creation in normal and in crisis times. Berger and Bouwman (2011,2015) study U.S. banks and find that monetary policy has an effect on liquidity creation by small banks only in normal times but little effect on liquidity creation by larger banks. From a conceptual viewpoint, it is argued that expansionary monetary policy may be associated with the creation of asset price bubbles and risk-shifting (e.g., Acharya and Naqvi (2011)). In such a scenario, a central bank's liquidity policy may be able to limit such shifting into riskier asset classes by appropriately calibrating its collateral framework.

Evidently, there is a fine line between monetary policy and liquidity provision for financial stability purposes.¹⁷ As we go along, we will highlight specific interrelations and tensions within monetary policy and liquidity provision. From the viewpoint of the liquidity tool kit discussed in Section 3, it becomes clear that certain instruments can be clearly associated with LA. Instead, other instruments are primarily designed for monetary policy purposes, but can – at times – also be employed for LA.

3 The liquidity policy tool kit

The central bank tool kit for affecting the availability of liquidity in the financial system typically consists of a number of tools that can be used to ensure the smooth functioning of the payments system, implement monetary policy, or address various forms of liquidity stress. Table 1 represents one way (out of several) in which these tools could be categorized.

16 For developing countries and emerging markets, banking crises are often associated with a full-blown balance-of-payment crisis (Reinhart and Rogoff 2009). In such a situation, an easing of domestic monetary conditions is often difficult or impossible. On the contrary, domestic monetary conditions may need to be tightened so as to stem capital outflows.

17 This is also reflected in the ambiguity of central bank mandates on this issue. For example, the Sveriges Riksbank Act requires liquidity provision in the form of extraordinary market operations to be motivated by monetary policy concerns.

Table 1. Liquidity policy tool kit

| Tool | Description | Purpose |
|--|---|---|
| Intraday credit | <ul style="list-style-type: none"> • Option for banks to borrow from the central bank during the day | <ul style="list-style-type: none"> • Smooth functioning of the payments system |
| Standing facilities/ Discount window facility | <ul style="list-style-type: none"> • Option for banks to borrow or deposit money overnight in the central bank | <ul style="list-style-type: none"> • Monetary policy implementation • Smooth functioning of the payments system |
| Regular open market operations | For example: <ul style="list-style-type: none"> • Weekly monetary policy transactions (repos/ certificates) • Fine-tuning transactions | <ul style="list-style-type: none"> • Monetary policy implementation • Smooth functioning of the payments system |
| Extraordinary open market operations | <ul style="list-style-type: none"> • Lending or borrowing on different terms than normal, e.g. other maturities, other currencies • Outright purchase/sale of assets in open market | <ul style="list-style-type: none"> • Monetary policy implementation • Address market wide liquidity shortage • Avert systemic crisis |
| Emergency liquidity assistance | <ul style="list-style-type: none"> • Central bank ability to grant credit to individual institution on special terms | <ul style="list-style-type: none"> • Address acute liquidity shortage at individual institution • Avert spill-overs/contagion |

Some of the above tools, such as intraday credit and open market operations are primarily associated with a business-as-usual context, e.g. the practical implementation of monetary policy and the operation of large-value payments systems. Some of the tools could also be expanded, modified or activated to deal with different types of liquidity shortfalls. Other tools, such as ELA, are more exclusively reserved for emergency situations. To understand how the tool kit is devised, it may be of some use to take a look at the mechanics of the payments system and monetary policy steering mechanisms that some central banks have.

3.1 Intraday credit

Many central banks, like the Riksbank, operate a large-value payments system, in which participating banks can carry out payments to each other. Often, central banks provide intraday credit in order to facilitate smooth liquidity management during the day. Such intraday facilities are typically free of interest. Moreover, participating banks need to pledge full collateral to access intraday credit.

3.2 Standing facilities

At the end of the day some banks may find themselves with a surplus and other banks with a deficit vis-à-vis the central bank. To balance out such surpluses and deficits, central banks commonly offer Standing Facilities (SFs) or Discount Window Facilities (DWFs) allowing banks to either deposit or borrow money overnight in the central bank. SFs can be accessed on demand by the central bank's counterparties at a fixed discount rate and against full collateral. In principle, SFs can serve as a means to address temporary problems/malfunctions in the payments system. Furthermore, SFs can function as a form of liquidity insurance, if, for example, an individual institution finds itself with a shortage of central bank liquidity at the end of the day. However, such facilities are often priced at a premium to provide banks with incentives to lend and borrow among themselves rather than to actually use the facilities. This is because the primary function of SFs is not necessarily to provide LA. Instead, SFs are commonly part of the operational framework for implementing monetary policy. Specifically, the interest rate corridor given by the difference between a facility's borrowing rate and deposit rate sets the outer bounds for the overnight interbank rates.

3.3 Open market operations

Apart from standing facilities, central banks also engage in open market lending and borrowing of various kinds. In contrast to standing facilities, open market operations are initiated by the central bank rather than the banks. Typically, some form of a competitive auction mechanism is used for allocating liquidity. Furthermore, central banks can conduct outright purchase and sale of assets in the open market.

One could make a distinction between “regular” and “extraordinary” open market operations (OMOs). Regular OMOs are the transactions used to implement monetary policy, while “extraordinary” open market lending and borrowing can be used more generally to address liquidity shortages of various kinds. Extraordinary OMOs can be particularly useful when the financial market suffers wide-spread shortages of market and funding liquidity, as was the case in the GFC. Extraordinary OMOs can include, for example, temporary liquidity facilities for providing loans to market participants on terms that differ from what central banks offer in their regular facilities. This could be, for example, offering credit with longer maturities, against different collaterals or in other currencies than normal. Moreover, such facilities could also be offered to a broader set of market participants than the normal set of central bank's monetary policy

counterparties. In this sense, open market lending and borrowing is a flexible tool that can be adapted to the needs of the specific situation.

3.4 Emergency liquidity assistance

For circumstances where individual financial institutions are illiquid and lack sufficient eligible high-quality collateral, a central bank may decide to grant ELA to an individual bank by lending against any type of collateral.

An individual financial institution may face critical funding liquidity problems for different reasons. One reason could be general doubts about the solvency of the institution, which may affect the willingness of the institution's counterparties to provide funding. Such doubts need not necessarily be based on actual facts. Sheer rumors may suffice to start a run among depositors and providers short-term funding. In this way, even originally false expectations about an institution's problematic financial situation may become self-fulfilling.

To stop an escalating bank run and contagion to other parts of the financial system, central banks are able to extend ELA to a troubled institution. Provided the institution is eligible for ELA, central banks typically lend against a broad range of collateral. A key criterion in the ELA consideration is whether the institution in question is solvent or not. Furthermore, its systemic importance plays a role. As said earlier, the challenges associated with the solvency assessment and the ELA decision are complex and we will discuss them in Section 4.1.1.

3.5 Liquidity policy and monetary policy instruments

Besides ELA, intraday credit and some specific extraordinary OMOs, all elements of the liquidity policy tool kit presented in Table 1 have to be considered in the context of monetary policy.¹⁸ While regular OMOs are at the core of monetary policy implementation, the distinction between monetary policy and liquidity policy can be blurred when it comes to extraordinary OMOs. Most central banks do not have dedicated facilities for LA.¹⁹ Instead, central banks often extend the scope of their regular facilities for monetary policy implementation, e.g. to provide term liquidity (i.e. liquidity at longer maturities). Such measures may be justified in the context of monetary policy transmission or as element of a system-wide LA. Instead, other measures like foreign currency LA are more clearly distinguishable from monetary policy.

¹⁸ See Bindseil (2004) for a discussion of monetary policy instruments.

¹⁹ There are few exceptions like the Reserve Bank of Australia and the Bank of England, which we will discuss later on (see also Box 4).

One (potentially imperfect) way to draw a line between liquidity policy and monetary policy is to think of liquidity policy as being aimed at funding liquidity, whereas measures in the realm of monetary policy target asset markets and influence market prices. In other words, liquidity policy addresses liquidity shortfalls by filling a quantity gap and monetary policy aims to reduce spreads with the objective of improving monetary policy transmission.

The existence of contingent extraordinary OMOs via monetary policy instruments or via dedicated facilities for LA is unlikely to have a significant effect on the monetary policy stance in normal times even if the existence of such facilities is known *ex ante* by market participants. This is because the monetary policy stance primarily aims to steer the risk-free reference rate, which in normal times is not affected by the existence of contingent extraordinary OMOs for LA. On the other hand, the activation of contingent facilities for LA leads to a substantial increase in reserves against illiquid assets and affects the monetary policy stance in crisis times, especially when contingent facilities help to regain control over the risk-free reference rate and spreads in situations where the monetary policy transmission has been impaired. Finally, the existence of permanent dedicated facilities for LA may be associated with a small increase in the level of reserves when the permanent facility is tested in normal times.

The more relevant impact of liquidity facilities on monetary policy derives from the collateral framework used for liquidity policy and the implications for the supply of safe assets. First, the calibration of the collateral framework for the different facilities may impact on the supply of safe assets in the economy and thereby affect the implementation of monetary policy.²⁰ Second, the calibration of the collateral framework may affect the spread between *high-quality liquid assets (HQLA)* and risky securities such as covered bonds, which has implications for monetary policy transmission and credit allocation. We will highlight these implications as we go along.

4 Challenges for central bank liquidity provision

After laying the foundations in Sections 2 and 3, we are now ready for our discussion of the typical challenges for central banks as public liquidity providers and the trade-offs involved when dealing with these challenges. In this section, we cover challenges arising both during liquidity stress events (Section 4.1) and

²⁰ For instance, a liquidity policy that increases reserves against non-high quality liquid assets can facilitate monetary policy implementation in cases where a binding LCR pushes short-term interest rates to the floor of the rate corridor (Bech and Keister 2013).

in normal times (Section 4.2), which are discussed in the context of the central bank's goals and the liquidity policy tool kit.

4.1 Challenges during liquidity stress events

Different types of liquidity stress give rise to various challenges ranging from difficulties in providing an effective backstop for the financial system (Section 4.1.1), to intricacies of reaching the market participants most in need of liquidity (Section 4.1.2), and problems associated with stigma effects of central bank lending facilities (Section 4.1.3).

4.1.1 Providing a backstop: solvency assessment and communication

As described in Section 2, it is well known that uncertainty about the solvency of individual financial institutions constitutes a core challenge to LA. In an idiosyncratic stress event, i.e. where liquidity problems arise at a single institution, the difficulties associated with the solvency assessment are most pronounced in a setting where a central bank provides ELA to an institution that does not have sufficient collateral. Notably, the counterparty's creditworthiness may also depend on domestic and foreign authorities' supervisory or legal actions. During system-wide liquidity stress, assessing the solvency of an individual institution is exacerbated by the difficulty in evaluating the quality of illiquid assets that may be used as collateral for central bank liquidity. Such a difficulty arises if the availability of HQLA in the private sector falls short of the liquidity demanded by individual institutions. Furthermore, the need for a timely response may also conflict with the necessities of a careful solvency assessment. In such a situation, the outright purchase of assets in the market may have the advantage over bilateral LA that it does not require a solvency assessment for individual institutions.

In normal times, market valuations and ratings provide important guidance for the formulation of central bank collateral policies. However, during periods of massive systemic stress, such as at the onset of the GFC, this guidance is lost because private-sector collateral values are negatively affected by distress in financial markets, for instance due to harmful liquidity spirals (Brunnermeier and Pedersen 2009). As a result, the assessment of central banks who act as a MMLR during a systemic liquidity stress event may entail a stronger emphasis on the collateral values that would prevail in normal times (Mehrling 2012), as opposed to crisis-times market valuations. In this way, LA can contribute to stabilizing core collateral values that are affected by asset fire sales and contagion effects. Such a policy response, however, creates tensions due to the elevated risks for central bank balance sheets.

Besides the solvency assessment, central bank communication comprises important challenges. Only central banks are in the position to provide a backstop and to re-establish market confidence during a crisis by assuming their role as LLR. Important factors to this end are the central bank's institutional preparedness for dealing with stress scenarios and its ability to display and communicate a credible policy response and to perform rapid solvency assessments. Another challenge may be to adapt the degree of transparency about the available tools and lending terms without compromising the flexibility for policy going forward. Again, the GFC serves as an illustration, where central banks replaced constructive ambiguity with more explicit communication about available policy options and lending terms (Domanski et al. 2014) in order to fight against a crisis of confidence.

4.1.2 Reaching the market participants most in need of liquidity

Another key concern for central banks is reaching the market participants in need of liquidity. At the onset of the GFC, it became evident that existing frameworks for LA were not prepared for a global systemic stress event on such a massive scale, but were rather calibrated to deal with idiosyncratic stress events (see Section 2.4). As a result, central banks faced obstacles in extending the scope and reach of LA.

Reaching the market participants most in need poses challenges with respect to the location and type of liquidity demands. The location of a liquidity need in the financial system matters especially when banks are reluctant to provide liquidity to one another. Central banks conduct their regular lending operations only with a limited circle of counterparties. Hence, central banks may face obstacles in achieving the desired distribution of liquidity in the financial system in times of systemic stress when the banking system fails to intermediate the liquidity provided by the central bank to eligible counterparties. This issue proved to be an important obstacle to central bank LA during the GFC and we discuss in Section 5 how it can be dealt with.

The GFC also uncovered challenges related to the type of liquidity need. Existing frameworks for LA typically focused on liquidity support at short maturities, against highest-quality collateral and in domestic currency. This created discrepancies between the prevalent liquidity demand and the supply of liquidity by central banks along several dimensions. The drastic shortening of funding maturities in markets caused a demand for longer-term funding from central banks by financial institutions. Similarly, the dry-up of funding backed by less liquid assets generated a rationale for LA against a broader range of collateral and, in some markets, for the support of collateral values. A number of jurisdictions with domestic banks reliant on foreign currency funding, such as Sweden, also experienced a discrepancy between liquidity demand and supply

in the currency dimension, which central banks addressed by lending in foreign currency. Taken together, the crisis response was characterized by providing LA to a broader circle of counterparties at the required maturities against a broader set of eligible collateral, and in the required currencies.

To summarize, both the location of liquidity needs and potential discrepancies between the liquidity demand and the type of liquidity supplied by central banks can pose challenges in reaching the market participants in need with the available tools and procedures. In the next section, we discuss why the stigmatization of central bank lending facilities poses an important obstacle in reaching the market participants most in need of liquidity.

4.1.3 The problem of stigma

Stigma may impair the functioning of several elements of central banks' lending facilities that are important for the effectiveness of the LA framework.

"[The problem of stigma is associated with a concern of financial institutions] that their recourse to [certain central bank lending facilities], if it became publicly known, might lead market participants to infer weakness" (Bernanke 2009, p.3)

This concern originates from an adverse selection problem²¹ and can impair the participation in and, hence, the functioning of central bank facilities.

During the GFC, the problem of stigma posed a significant challenge. We first discuss some anecdotal evidence that underpins the relevance of the problem of stigma. Thereafter, Box 1 summarizes the empirical evidence for the stigmatization of central bank lending facilities and reviews the theoretical underpinnings.

In August 2007, the U.S. dollar money market was abruptly disrupted. Despite a lowering of the discount window rate and the spread over the Federal Funds rate,²² financial intermediaries were reluctant to borrow from the Federal Reserve (Fed). As a consequence, the Fed's efforts to improve funding liquidity showed limited success. To address this problem, the Fed introduced the new Term Auction Facility (TAF) alongside the Discount Window Facility (DWF) in December 2007. While the DWF is a standing facility where liquidity is provided on demand

21 The term "adverse selection" was originally used in insurance. It describes a situation where an individual's demand for insurance is positively correlated with the individual's risk of loss.

22 The spread over the fed funds rate was reduced from 100 basis points in July 2007 to 50 basis points in August 2007 and to 25 basis points in March 2008.

at a fixed discount rate, the TAF is an open market operation using a competitive auction mechanism.²³

Also the effectiveness of the Bank of England's lending facilities was impaired by stigma (Bank of England, Winters Report 2012). In part, this can be attributed to the penalty rate for lending from the DWF. However, it was also problematic that information on the DWF activity was prone to rapid leaks to the media. Following such a leak on the evening of September 13, 2007, for example, the BBC reported that Northern Rock was to seek access to emergency liquidity via the Bank of England's DWF on September 14. This has been seen as instrumental in its failure. In the words of Mr. Applegarth, CEO of Northern Rock at the time:

"[On September 13] we were actually still funding — not fully funding, and duration was noticeably shorter, but we were still funding. ...[We] had two or three months' worth of liquidity. ...The problem we had was you could not tell how long the markets were going to be closed and it was a reasonable and proper thing to do to put a backstop facility in place. ...Ironically, it was the announcements and the leaking of the backstop that caused the retail run and it was the retail run that reduced our liquidity." (House of Commons Treasury Committee 2008, p. 17)

This statement highlights how stigma can hamper central banks' ability to provide liquidity. Whenever wholesale or retail investors have some residual uncertainty about the effectiveness of the backstop provided by the central bank²⁴ or fear of being diluted by more senior claims of central banks, then investors may have an incentive to withdraw after learning about discount window activity. Given that troubled banks know about the risk of a media leak when requesting access to the DWF, they may want to delay a request and see if they can manage their problems differently without having to rely on the LLR. From the viewpoint of a liquidity provider or a regulator, such a delay may not be desirable and socially costly for at least two reasons. First, the troubled bank cannot fulfill its role in providing private liquidity to its customers and, second, ELA at a later point in time is likely to require the central bank to assume a higher credit risk.

23 In Section 5 we will discuss in more detail how OMOs can help to deal with the problem of stigma and other obstacles in reaching the market participants most in need of liquidity.

24 For instance due to a lack of credibility in the backstop for operational or legal reasons.

BOX 1 – Stigmatization of central bank lending facilities

Evidence Armantier et al. (2011) provide empirical evidence for the willingness of banks to pay a premium of 44 basis points on average in TAF auctions from March 2008 onwards to avoid borrowing from the Fed's DWF, which increased after the Lehman bankruptcy to 143 basis points. The magnitude of stigmatization of the DWF was substantial. It amounted to a deliberate increase in the banks' borrowing costs by up to 32.5 percent of their net income during the crisis, in order to avoid accessing the stigmatized standing facility.

In the Eurozone, the stigmatization of the European Central Bank's (ECB's) lending facilities was less severe, because the usage of the ECB's standing facility, the marginal lending facility, was less rare in normal times than the usage of the Fed's DWF. Nevertheless, there is evidence that the ECB lending facilities may also have experienced some stigmatization. Cassola et al. (2013) find that banks were willing to borrow at average premia of up to 30 basis points over the average overnight unsecured interbank lending rate (EONIA) via the ECB's regular Main Refinancing Operations (MROs) by the end of 2007, which indicates a stigmatization of the ECB's marginal lending facility.

Theory The stigma is associated with a classical adverse selection problem (see, for instance, Ennis and Weinberg 2013). It arises if banks have favorable private information on the quality of the assets on their balance sheet, which they cannot signal to the interbank market. In such a setting the recourse to the central bank's DWF, if observed by other market participants, can impair a bank's ability to obtain market funding. This is because other market participants then believe that the bank's assets are likely to be of bad quality even if the unobserved quality is good. As a result, the behavioral response of an individual bank with severe liquidity problems is to try to avoid recourse to the DWF. La'O (2014) argues in a model with predatory trading that a term auction facility with a competitive auction format, such as the Fed's TAF, may be an effective policy tool in crisis times. TAF provided liquidity through a competitive auction format, which was designed in a way as to create an outcome where the winning bidders are the ones with the highest financial strength. In this way, and different to the DWF, TAF achieves a high level of participation.

4.2 Other challenges

Alongside the challenges encountered during episodes of idiosyncratic or systemic liquidity stress, the regular conduct of liquidity provision also involves relevant challenges from the viewpoint of central banks. We next discuss the availability and pricing of central bank lending facilities more generally, as well as collateral frameworks and the exit from LA.

In their regular conduct of liquidity provision, central banks have the objective to encourage private liquidity provision against a broad set of collaterals and to achieve an appropriate distribution of liquidity (see Section 2.4), which is considered to play an important role as a lubricant for the financial system. Hence, central banks face a balancing act between the availability of public liquidity and the dangers from crowding-out private liquidity. While lending more freely may have a positive and supportive effect on private liquidity provision and help the central bank to obtain valuable market information through regular liquidity operations, it may also be associated with an impairment of private liquidity provision. Furthermore, the reliance of financial institutions on private liquidity provision is frequently associated with a positive market disciplining effect since peer monitoring can reduce moral hazard problems (see Section 2.2). For this reason, the availability and pricing of liquidity provided by central banks plays an important role.

The pricing and haircuts of central bank collateral frameworks can be associated with distortions in credit allocation. Traditionally, sovereign debt is an important source of HQLA for central bank refinancing operations. Since central bank liquidity operations can have an effect on secondary market prices (Chapman et al. 2011; Ashcraft et al. 2011), preferential treatment of sovereign debt or other types of debt like covered bonds in central bank collateral frameworks may have wider implications for credit allocation in the economy. Hence, eligibility of certain types of collateral and haircuts play are important policy choices that feed back to markets and influence credit and investment decisions.²⁵

During and after the GFC, it became apparent that liquidity problems of individual financial institutions or certain parts of the financial system can persist for several months or years (Dobler et al. 2016), with institutions relying on LLR LA over an extended period. Such a scenario occurs, for instance, when central banks, due to financial stability concerns, are reluctant to adjust the pricing of liquidity in a way that would facilitate an exit from LA. This poses additional challenges for central bank balance sheet risk management and may impair market discipline.

²⁵ In Section 6 we discuss in detail the trade-offs for liquidity provision stemming from collateral frameworks and their impact on the credit allocation, market discipline, and the central bank balance sheet risk management.

5 Dealing with the challenges

In this section we discuss ways to deal with some of the challenges for central bank liquidity provision discussed so far in the context of the central bank policy tool kit (Table 1). Again most of the discussion is framed against the backdrop of the GFC. The focus is on central bank policy responses during the crisis. A key avenue in addressing challenges related to idiosyncratic and systemic stress scenarios is to consider a broadening of the scope of liquidity provision along different dimensions. We continue by discussing in Section 5.1 how some central banks attempted to provide a backstop to the broader financial system by dealing with a shortage of private sector collateral. Thereafter, Section 5.2 discusses how the reach of central bank LA can be improved by broadening LA along certain dimensions. Finally, Section 5.3 discusses elements of the standard policy tool kit that may be prone to stigmatization as well as modifications to central bank lending facilities to overcome the problem of stigma.

5.1 Dealing with a shortage of eligible collateral

The scarcity of unencumbered collateral held by the private sector during the GFC was addressed by several central banks by, at least temporarily, relaxing their collateral requirements, in particular, for their most effective instrument of LA, the open market operations. Furthermore, it was made easier to pledge certain mortgage-loan and non-mortgage loan portfolios, as well as non-marketable collateral. The *market-wide* or *systemic* shortage of private sector collateral to a large extent also required *market-wide* LA. As discussed in Section 2, the supply of public liquidity to markets is distinct from the supply of funding for individual institutions. LA to certain markets is aimed at supporting core collateral values of financial institutions by means of an outright purchase of assets and repurchase agreements. Such an intervention may be warranted if the intermediation of liquidity to the wider financial system comes to a halt and collateral values are undervalued due to asset fire sales and harmful liquidity spirals. In 2007-2009, the Federal Reserve acted as such a *dealer- or market-maker-of-last-resort* by supporting collateral values of core assets that were important for the functioning of the dealer-based financial system.

While most of the modifications to central bank lending facilities have been discontinued after the GFC, some modifications prevailed. For instance, some central banks officially introduced contingent or so-called dormant, facilities in their liquidity frameworks in order to have them available in the event of severe liquidity shortages in the financial system. Alongside other modifications, the Bank of England introduced a Contingent Term Repo Facility, which is designed to

be activated in response to a market-wide stress scenario. In Box 4 at the end of Section 5, we give some details on the new Bank of England liquidity insurance framework. Another example is the Bank of Canada, which also introduced a Contingent Term Repo Facility. The Bank of Canada sees this new facility as part of its flexible operating framework that allows for the contingent provision of overnight or term-funding beyond primary dealers (Bank of Canada 2015). Moreover, the Bank of Canada also foresees contingent relaxations to the collateral requirements that can be activated in periods of financial distress. The standing facility of the Bank of Canada has now a clause that allows it in crisis times to fully lift the requirement that only 20 percent of the pledged collateral can consist of Canadian-dollar non-mortgage portfolios.

5.2 Adjusting liquidity assistance to changing needs

As mentioned previously, a specific challenge related to the fact that some of the market participants most in need of liquidity were several steps away from the circle of ordinary central bank counterparties and, hence, severely affected by the banks' reluctance to provide liquidity to each other. To address this problem, some central banks widen the circle of eligible counterparties during and after the GFC. The most prominent example of extending the reach of central bank LA at the beginning of the crisis was the granting of a bank holding company license to Goldman Sachs and Morgan Stanley. This occurred over a single weekend after the Lehman failure in September 2008 and gave the broker-dealer subsidiaries of the two investment banks access to the Fed's Primary Dealer Credit. Notwithstanding, the small circle of counterparties for OMOs, together with the stigmatization of the DWF, severely limited the reach of the Fed's LA during the crisis.²⁶ The Fed responded by creating the TAF, which offered funding to a wider set of counterparties. The auctions for credit at longer maturities were each accessed by around 50-90 banks.²⁷

Other central banks have taken similar initiatives to widen the circle of eligible counterparties during and after the crisis. For example, the Bank of Canada introduced in April 2008 the Overnight Standing Purchase and Resale Agreement facility for primary dealers as a complement to the standing facility, which is only available for participants in the Large Value Transfers System. This newly

26 Notably, the counterparty arrangements differ substantially across jurisdictions (see Table 1 in Chailloux et al. (2008)). At the time of the GFC, the Federal Reserve granted direct liquidity assistance to around 7,500 credit institutions via the standing facility, while only 20 primary dealers could participate in open market operations. This contrasts with the counterparty arrangement of the ECB where 2,400 credit institutions participated in the standing facility and 1,700 banks participated in open market operations. In the Eurozone, the creation of a new facility was not necessary since the ECB was able to provide liquidity through its MRO to a large number of banks.

27 See archive section of <http://www.frbdiscountwindow.org>.

introduced facility effectively widened the access to the Bank of Canada's SF and was kept in place after the GFC. More recently, the Bank of England responded by permanently extending the circle of eligible counterparties to include, e.g. market infrastructures.

Besides the attempts of central banks to deal with the location of liquidity demand by widening the set of eligible counterparties, the type of liquidity demand in terms of maturities and currencies also played an important role during the GFC. In Sections 5.2.1 and 5.2.2 we discuss how these two issues can be dealt with in the context of the central bank policy tool kit.

5.2.1 Liquidity assistance at longer maturities

In normal times, central bank liquidity is offered almost exclusively at short maturities of one week or less. Most of it occurs via central bank reserve management and fine-tuning operations. This picture changed drastically during the GFC when financial institutions had difficulties raising the desired term-funding from U.S. dollar money markets. As a result, there was a high demand for term-funding provided by central banks. Thus the Fed, the ECB and others started to offer funding at longer maturities via OMOs. For instance, TAF funding was offered at 4 week maturities starting in December 2007 and then extended to 12 weeks in August 2007. Similarly, other central banks also provided term-funding at maturities up to 6 month or more.

From a conceptual viewpoint, it may not be immediately obvious why central banks did not just continue to provide liquidity at shorter maturities in the required amounts and against a wider range of collateral. In principle, a commitment to extend the availability of sufficient short-term funding should suffice to provide a credible backstop to the financial system. However, the ample supply of term-funding at longer maturities is perhaps the most effective way to eliminate any concern by financial intermediaries with an elevated maturity mismatch that extraordinary LA (and the terms thereof) may only be temporary. Furthermore, the provision of term-funding may reduce the need for potentially problematic public announcements by central banks that promise cheap liquidity over a longer time horizon and, thereby, increase flexibility.

5.2.2 Liquidity assistance in foreign currency

During the GFC, the importance of LA in foreign currency also became accentuated. This was largely dealt with through various OMOs. In this section, we first review extraordinary lending in USD by major central banks during the crisis and the reasons underlying the necessity of such an intervention. Thereafter, we

discuss the implications for today's LA and the emergence of regular USD facilities operated by some European central banks.

After the failure of Lehman, the Fed spearheaded a coordinated crisis response by major central banks with the help of *central bank currency swaps* - a foreign exchange (FX) derivative that is used by central banks to provide liquidity in their own currency to one another. In December 2007, the Fed established swap lines with the ECB and the Swiss National Bank over 24bn USD. During 2008 the swap lines were massively extended. They developed into a swap network after the Fed established further swap lines with the Bank of Canada, Bank of England, Bank of Japan, Sveriges Riksbank, Reserve Bank of Australia, and others.²⁸ Eventually, the total authorized amount grew to nearly 620bn USD. Box 2 gives a summary of the recent history of central bank currency swap lines.

The case of Sweden is well-documented (Goodhart and Rochet 2011; Bryant, Henderson and Becker 2012) and serves as an illustrative example of how market-wide emergency liquidity support in foreign currency can be engineered. In Sweden, "the basic problem [during the crisis] was one of liquidity, in particular a shortage of foreign currency, especially USD, liquidity" (Goodhart and Rochet 2011, p. 19). In fact, more than half of the liquidity assistance provided by the Riksbank in 2007 and 2008, as depicted in the expansion of the Riksbank's balance sheet in Figure 3, was in USD. Box 3 gives a detailed account of the Riksbank's emergency dollar lending.

While the Riksbank and most other central banks discontinued the USD liquidity assistance in 2009 after the crisis started to abate, a group of major central banks with globally systemically important banks in their jurisdictions established regular lending facilities in USD. Specifically, the Bank of Canada, the Bank of England, the Bank of Japan, the ECB, and the Swiss National Bank now conduct regular USD repos. Prior to May 2014, USD funding was offered at 3-month maturities, which was then reduced to 1-week maturities. This USD lending is facilitated by swap agreements with the Fed. The intended purpose is to improve the resilience of global U.S. dollar money markets and to mitigate financial distress by providing a timely access to USD for globally important banks. Notably, the Bank of Japan also has a number of bilateral swap agreements with other central banks in the region.²⁹

Looking ahead, swap agreements remain an important pillar of global financial stability and the actual usage thereof typically has to be approved ad hoc.

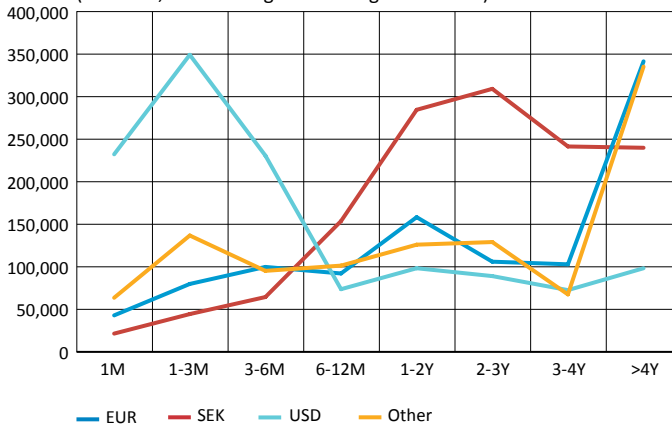
28 See Goldberg et al. (2011) for a review of the Fed's swap lines during the financial crisis. For an up to date list of currency swap arrangements see: http://www.cfr.org/international-finance/central-bank-currency-swaps-since-financial-crisis/p36419#!?cid=from_interactives_listing.

29 http://www.boj.or.jp/en/intl_finance/cooperate/index.htm.

Traditionally, swap lines have been triggered by the need for bilateral LA to an individual institution, but the use of swap lines for LA to the market via OMOs can also become relevant.

For the case of Sweden, the reliance of Swedish banks' on foreign currency funding remains an important factor. Of the total funding of the four major Swedish banking groups, wholesale funding accounts for approximately 50 percent, of which some three quarters consist of funding in currencies other than SEK. This can be seen in Figure 4, which depicts the maturity and decomposition of the average outstanding funding volume in the money and bond market by the four major Swedish banks in 2015. Notably a large part of the outstanding funding volume with a time till maturity below one year consist of money market instruments, such as certificates of deposit and commercial paper.

Figure 4. Duration and currency decomposition of the outstanding funding volume by the four major Swedish banking groups
(Mio. SEK, 2015 averages excluding bail-in debt)



Source: The Riksbank

In the money market (maturities below 1 year), USD is the dominant funding currency, while SEK and EUR play more important roles as funding currencies in the bond market (maturities above 1 year).³⁰ Absent a swap agreement with the Fed, this poses a potential challenge for the management of future shortages of funding liquidity. "A way to minimize the risk is for the Riksbank to maintain a foreign currency reserve" (Nyberg 2011, p. 10), which can be seen in Figure 3.

³⁰ See Hilander (2014) and Juks (2015) for detailed studies.

Box 2 – FX swap lines during the crisis

While central banks could provide unlimited LA in their domestic currencies during the crisis, their ability to provide liquidity in foreign currency was limited by the amount of foreign currency reserves they held. To address this problem, many swap lines were set up between central banks.

U.S. dollar swaps In particular, the demand for USD increased among European banks during the GFC, resulting in heightened volatility in U.S. interest rates. In December 2007, the Fed extended swap lines to the European Central Bank (ECB) and the Swiss National Bank (SNB), allowing the Fed to address stress in the short-term funding markets without having to fund foreign banks directly.

Soon after the collapse of Lehman Brothers in September 2008, the Fed expanded the size of its swap lines with the ECB and SNB, and extended new swap lines to Bank of Canada, Bank of England and Bank of Japan. Following shortly after this, the Fed extended further swap lines to the central banks of Australia, Denmark, New Zealand, Norway, and Sweden.

During the course of the crisis, some central banks also provided swap lines to certain economies, in which intensification of stress would risk triggering unwelcome spillovers to the rest of the world economy. For example, the Fed extended swap lines to Brazil, Mexico, Singapore, and South Korea in October 2008 with such considerations in mind.

Euro zone The ECB established swap lines with the Riksbank in December 2007. In October 2008, the ECB launched additional swap lines to the SNB and Danmarks Nationalbank. In the years leading up to the crisis, both Swedish and Danish banks funded themselves to a large extent in foreign currencies. In 2008, this source of funding became increasingly unreliable. However, the FX reserves in Sweden and Denmark proved insufficient to meet the increased demand for foreign currency when the banks subsequently turned to the central banks for assistance. In 2009, the ECB swap lines were therefore called upon to provide the Riksbank and Danmarks Nationalbank with euros (EUR). At about the same time, the ECB called into use its swap line with the SNB to provide the ECB with Swiss francs (CHF). In December 2010, the ECB also established a swap line to the Bank of England. It was put in place primarily as a precautionary measure to ensure that the Central Bank of Ireland would have access to pounds sterling (GBP), but was never called into use.

Swiss francs and euros to Poland, Hungary and Latvia Before the outbreak of the crisis, many households in countries such as Poland and Hungary had taken

out foreign-currency-denominated mortgages because of the lower interest rates available on these loans. During the crisis demand for CHF and EUR from the Hungarian and Polish banks that issued the loans drove up borrowing costs in these currencies. In response to this, the SNB provided CHF through swap lines to the central banks of Poland and Hungary. Moreover, the ECB agreed to provide EUR to Hungary, Latvia, and Poland. Initially EUR was only provided through repurchase agreements, in which bonds rather than currency are held as collateral, but eventually the ECB extended a normal swap line to Hungary.

Nordic countries During the GFC, Scandinavian central banks provided some swap lines in EUR to neighboring countries to support financial stability in the region. For example, the Riksbank agreed to provide EUR to the central banks of Latvia, Estonia, and Iceland. Danmarks Nationalbank provided EUR to the central banks of Iceland and Latvia, and Norges Bank provided EUR to Iceland. This bilateral cooperation was established to avoid negative spill-overs during the crisis, because circa 80 percent of the Latvian and circa 90 percent of the Estonian banking system is owned by banking groups headquartered in Sweden, Norway, and Denmark. Moreover, Nordic countries provided Iceland with 2.5bn USD in loans to Iceland during the crisis. This and the swap lines provided could be seen as a natural complement to the cooperation with Sweden, Norway, and Denmark through the Nordic Council, an inter-parliamentary body in place since 1952.

Box 3 – The Riksbank’s emergency USD lending

Conduct The Riksbank’s USD lending to a number of Swedish intermediaries started in the weeks after the Lehman bankruptcy and the first auctions took place in October 2008, culminating in a monthly peak volume of 30bn USD in May 2009. Before the swap lines with the Fed were in place, the Swedish lender-of-last-resort crisis response was backed up by the foreign currency reserves of the Riksbank and, importantly, by the cooperation of the Swedish National Debt Office. In fact, as early as October 2007, the Swedish National Debt Office issued debt in foreign currency and guaranteed some of the borrowing activity of Swedish banks in USD. This lending in foreign currency was accompanied by liquidity provision in Swedish kronor (SEK) and by cuts in the repo rate.

Underlying reasons The necessity to provide extraordinary liquidity assistance in foreign currency arose because the Swedish banking system and, in particular, the four largest banks relied heavily on funding from U.S. dollar money market. This short-term wholesale funding was used to fund assets denominated in foreign currency, but also to fund SEK assets. “The Swedish banking system had, like many others, increased its credit expansion much faster than its (domestic) deposit base; indeed it had done so somewhat faster than in many other countries... The withdrawal of short-term USD (and to a lesser extent EUR) funding was particularly acute for those European banks whose solvency was thought by the market to be at risk. In the Swedish case this was particularly so for the two banks with substantial lending operations in the Baltics, Swedbank and SEB.” (Goodhart and Rochet 2011, p.19-20).

5.3 Facilities prone to stigmatization and ways to mitigate the problem

In the light of the evidence discussed in Section 4.1.3, it is apparent that standing facilities (discount window; marginal lending facility) and ELA are most prone to stigma. For the example of Sweden, SFs are designed in a way that discourages from active usage not only because of the pricing, but also due to the small market size which makes it close to impossible to keep a rare activity of the Riksbank's on-demand facility secret.³¹ Although the pricing of SFs may indeed affect the magnitude of the stigma, in some circumstances banks seem to be willing to go to considerable lengths to avoid public liquidity support (see Box 1).

However, ad-hoc contingent open market operations may also be stigmatizing if individual banks refuse to participate, because this creates a situation of a dis-advantageous selection. This concern is especially relevant in an environment with a small number of eligible financial institutions where the abstention of few individual banks can create a stigma for their peers who may want to participate.

One way to mitigate the problem of stigma is to make the use of central bank facilities more commonplace and less dramatic. More regular participation in central bank facilities in normal times could possibly alleviate some of the stigma. This is one of the objectives of the Bank of England's recently modified liquidity insurance concept and especially the so-called *Indexed Long-Term Repo* (ILTR) facility, which foresees the provision of term-liquidity also in normal times and allows for a dynamic adjustment of the liquidity supplied by the central bank if warranted. We describe the ILTR facility in more detail in Box 4.

More generally, the regular participation of a wider circle of counterparties in certain lending facilities reduces the likelihood of disadvantageous selection. Open market operations are a flexible policy tool to address these objectives. Specifically, an acute stigmatization of lending facilities can be dealt with by tailoring the terms and conditions of regular OMOs or by introducing newly designed OMOs. The former approach was taken by the ECB via the extension of its regular OMOs, while the latter approach was taken by the Fed via the introduction of the new Term Auction Facility (see Box 1). In principle, the pricing and haircuts of central bank lending facilities can be made attractive enough to encourage a large number of market participants to participate, thereby minimizing the stigma. Such an approach, however, is likely to come with some drawbacks that we discuss in Section 6.

Besides the broadening of the scope of liquidity provision by extending open market operations, a further way of reducing stigma would, in principle, be to

31 See Selin and Åsberg Sommar (2014).

restrict the disclosure of the actual use of liquidity facilities. For instance, in the U.S., the Fed discloses under the Dodd-Frank Wall Street Reform and Consumer Protection Act (2010) the detailed discount window activity only with a lag of two years. While this may help to limit the problem of stigma, other elements of the Dodd-Frank Act introduce reporting requirements that heighten “borrowers’ concerns that the public, their creditors, or their counterparties could learn about their borrowing and conclude that the bank is in trouble” (Fisher 2016, p. 11). Irrespective of such legal constraints, a lesson from Northern Rock is that it may in practice not be easy to cover up the use of e.g. SFs, in particular in a small system such as the Swedish one.

Finally, another relevant aspect when attempting to conduct discreet LA is to allow financial institutions to borrow HQLA instead of reserves from the SF, as is the case for Bank of England’s DWF, for example (see Box 4). In this way, LA is potentially less likely to be detected. This is because the increase of reserves in a closed system inevitably implies that other banks will end up with higher reserves and notice that another bank has received LA. In many institutional settings as well, an increase of reserves may show up faster in public statistics than the lending of HQLA. Moreover, an advantage of lending HQLA is that it allows the central bank to also provide LA to a financial institution that is not part of the large-value payment system without having to rely on a correspondence bank. Lastly, foreign currency LA also can be provided in the form of lending foreign currency denominated HQLA as opposed to foreign currency cash.

Box 4 – The Bank of England’s Sterling Monetary Framework

Facilities in the published framework The Bank of England (BoE) offers some facilities for liquidity provision in the normal course of implementing monetary policy. The BoE’s reserves averaging (currently not in use) and Operational Standing Facilities are both primarily designed to keep overnight market interest rates in line with the central bank’s policy rate. At the same time, these facilities may serve as a means to manage unexpected frictions in the payments system due to, e.g. technical problems. Like other central banks, the BoE also provides intraday liquidity to ensure smooth functioning of the payments system. In light of its experience from the GFC, the BoE has also developed three facilities for the explicit purpose of *liquidity insurance*– the Indexed Long-Term Repo, Discount Window Facility and Contingent Term Repo Facility. Transparency The BoE lays down a high-level strategy for its role as LLR. While the information about the non-crisis framework is published in detail, the information about ELA is restricted to some guiding principles. Moreover, the BoE is ex-ante transparent about the existence of contingent facilities and the high-level strategy for the use thereof.

Indexed Long-Term Repo The BoE offers funds with a *6-month maturity* via an Indexed Long-Term Repo operation *once each calendar month*. Counterparties The operations are aimed at banks, building societies and broker-dealers with a predictable need for liquid assets. Collateral Eligible counterparties are able to borrow against three different sets of collateral, levels A, B, and C.³² Pricing The rate charged in ILTR lending is indexed to the BoE policy rate, so participants do not have to take a view on the future path of the rate. It also allows the BoE to reduce its exposure to market risk.³³

Discount Window Facility The DWF is a bilateral on-demand facility. It is aimed at institutions experiencing a firm-specific or market-wide shock. It allows participants to borrow HQLA (gilts) in return for less liquid collateral in potentially large quantities and for a variable term. Counterparties The DWF is available

32 Level A = certain high-quality highly, liquid sovereign securities; Level B = high-quality liquid collateral, including other sovereign, supranational, mortgage and corporate bonds; Level C = less liquid securitizations, own-name securities and portfolios of loans.

33 Participants bid by submitting a nominal amount and a spread to Bank Rate expressed in basis points against a specific collateral set. The auction is designed to provide some flexibility with regard to the total quantity of funds being made available and the proportion of funds that is lent against a particular set of collateral. The mechanism depends on the interaction of the demand for funds, shown by the pattern of bids received, and the BoE’s preferences for supplying funds.

to banks, building societies, broker-dealers and Central Counterparty Clearing Houses (CCPs). *Collateral* Banks, building societies and broker-dealers are able to borrow gilts in the DWF against the full range of eligible collateral, while CCPs may only borrow against Levels A and B collateral. Participants can raise cash by lending the gilts in the market or by using them as collateral in the ILTR for example. *Pricing* The DWF fees charged are set at a premium to the market in routine circumstances but should offer participants affordable liquidity in less normal conditions.³⁴

Contingent Term Repo Facility The Contingent Term Repo Facility (CTRF) is a (dormant) liquidity facility that the BoE can activate in response to market-wide stress of an exceptional nature. *Counterparties* The CTRF enables the BoE to provide additional sterling liquidity to banks, building societies and broker-dealers. *Collateral* The BoE lends against the full range of eligible collateral, comprising Levels A, B and C. *Pricing* Participants bid by submitting a nominal amount and spread to Bank Rate.³⁵

The BoE’s Sterling Monetary Framework is published in the Red Book on the BoE’s website: <http://www.bankofengland.co.uk/markets/Pages/sterlingoperations/redbook.aspx>

34 The fee reflects the type of collateral used, to avoid providing a subsidy for illiquid collateral relative to the market, and the size of the drawing, to incentivize repayment when borrowings are no longer needed. For broker-dealers and CCPs, the cost of drawing in the DWF will be agreed with counterparties on a bilateral basis at the time of drawing, to reflect the collateral used and the size of the drawing. The BoE may lend sterling cash instead of gilts if, for example, government bond repo markets do not function properly. The BoE will lend sterling cash to CCPs in the DWF as standard. DWF drawings by banks, building societies and broker-dealers have a maturity of 30 days, while drawings by CCPs have a maturity of five days. All drawings are repayable at any point. Eligible collateral should be delivered or pre-positioned at least a day before a drawing. Participants are strongly encouraged to keep sufficient eligible collateral at the BoE at all times to ensure they are able to draw in from the DWF quickly should the need arise. Participants considering use of the DWF are strongly encouraged to discuss this with the BoE at an early stage.

35 The auction’s pricing mechanism uses a so-called ‘uniform price’ format, in which all successful bidders pay the lowest accepted spread (the ‘clearing spread’). The BoE indexes the rate charged to Bank Rate and would expect collateral used in CTRF operations to have been delivered or pre-positioned.

6 Pitfalls and trade-offs for public liquidity provision

In this section, we discuss the trade-offs related to dealing with the challenges to LA described previously. While there are unambiguously positive effects of public liquidity provision on the behavior of financial institutions through the LLR's contribution to the resilience of the financial system (as discussed in Section 2), there are also a number of behavioral aspects that may be associated with negative or unintended implications. Section 6.1 discusses these behavioral aspects and ways to mitigate them. Thereafter, Section 6.2 addresses the risks to central bank balance sheets and ways to manage these risks with a focus on collateral frameworks. Then Section 6.3 discusses issues related to the monetary policy dimension of liquidity provision. Finally, Section 6.4 summarizes key trade-offs going forward.

6.1 Ways to mitigate unintended behavioural implications

We first highlight in more detail the unintended behavioral aspects and then discuss how these aspects can be dealt with, so as to achieve the goals of a central bank as public liquidity provider outlined in Section 2.4. The most relevant negative or unintended behavioral aspects related to public liquidity provision are a potential impairment of both private liquidity provision and market-discipline, leading to risk-taking, as well as to distortions in credit allocation.

As outlined in Section 2.2, public and private liquidity supply are not perfect substitutes. Without any regulatory intervention, an increase of public liquidity supply in normal or in crisis times is likely to crowd-out the private liquidity supply. This crowding-out effect arises because individual financial intermediaries have less incentive to maintain costly liquidity buffers consisting of reserves and other HQLA when a central bank provides liquidity against a wide range of securities. The crowding-out of private liquidity may in principle be beneficial if it allows financial intermediaries to freely channel resources to illiquid long-dated real investments without creating other distortions. Such distortions or costs may, however, arise when private liquidity provision is positively associated with the financial system's resilience against adverse shocks or if it facilitates LLR operations such as the ELA solvency assessment (Santos and Suarez 2016). In addition, private liquidity provision may play an important role when it comes to the merits of *market discipline*, or more generally, to curtail *risk-taking*. Specifically, public

liquidity provision may have adverse behavioral implications if it facilitates higher risk-taking in the financial sector due to *moral hazard*.

The use of wholesale short-term funding can have advantages, as it helps to smooth out unexpected liquidity needs resulting from drawn credit lines or retail deposit withdrawals. Furthermore, short-term wholesale funding may play a role in enhancing market discipline, because lenders can monitor banks and refrain from rolling over debt when banks engage in risky lending activities (Calomiris and Khan 1991).³⁶ Thus, a crowding-out of private liquidity provision by public liquidity may have unfavorable implications in terms of reduced market discipline. On the other hand, a policy of restrictive liquidity provision during normal times, combined with a policy of very expansive LLR LA during crisis times, may incentivize market participants to build up an over-reliance on short-term funding during normal times that may prove harmful in crisis times. In the extreme, an expansive public liquidity backstop may create perverse incentives that undermine solvency and give rise to financial turbulence (Haltom and Lacker 2014).

The so-called *too-big-to-fail* problem plays an important role in this context. Large and inter-connected individual institutions may not behave prudently, knowing that the LLR or government will assist in case of liquidity and solvency problems, in order to prevent adverse system consequences. This type of *collective moral hazard* differs from the previously discussed moral hazard problems in the context of private liquidity systems (see Section 2.1). Fahri and Tirole (2012) and Keister (2016) argue that the maturity transformation in the financial sector forces authorities to act as a LLR, which creates a *collective risk-shifting* of private banks that, for instance, engage in investments that create correlated portfolio risks.

A popular way to try to mitigate potential moral hazard problems related to ex-post interventions in periods of financial distress is “*the constructive ambiguity approach*” (Enoch et al. 1997). The key idea is to maintain ambiguity about potential bailout policies in future periods of financial distress. In this way financial intermediaries cannot fully rely on the existence of bailouts should they face distress. Furthermore, constructive ambiguity about the bailout policies can reserve central banks some valuable discretion. The resulting policy uncertainty may in principle have a mitigating effect on excessive risk-taking by financial institutions and incentivize private liquidity provision. Furthermore, it can help to preserve some of the merits of market discipline (Freixas 1999). However, the effectiveness of the constructive ambiguity approach has been questioned in the

36 The practical importance of this positive disciplining effect of short-term funding is, however, a moot point. In particular, when banks have large exposures to tradable securities, the disciplining effect is likely to play a smaller role, with the short-term debt leading to inefficient liquidations (Huang and Ratnovski 2011).

light of the GFC, and we will come back to it when describing the key trade-offs for public liquidity provision in Section 6.4.

When it comes to mitigating potential unintended distortions that give rise to different forms of moral hazard and risk-taking, the calibration of collateral frameworks also plays an important role in curtailing moral hazard if calibrated conservatively or, instead, impair market discipline if applied too freely. This is because financial institutions may be inclined to pledge their lowest quality collateral with the central bank during times of system-wide financial distress, with potential implications for market discipline and for the solvency assessment. During a crisis, an insufficient conditioning of LA on solvency risk can be an obstacle to financial sector deleveraging and the reduction of balance sheet risks (Acharya and Tuckman 2014).

In addition, the collateral frameworks of central banks do not only influence the asset-side maturity decomposition of financial intermediaries, but they can also distort the allocation of credit in the economy at a given maturity. If the funding of certain types of illiquid long-dated assets is favored by central bank collateral frameworks, then this may fuel an over-investment in these long-dated assets by making them more liquid (Nyborg 2015). The generally low haircuts on sovereign debt and on certain assets such as mortgage loans could impede the role of financial intermediaries to engage in maturity transformation by causing an under-investment in certain long-dated private assets such as corporate loans.

As Nyborg (2015) argues, the ECB's full allotment policy for its MROs may serve as an example. While it may be useful for extraordinary LA in the light of stigmatization to extend MROs at a fixed rate with full allotment (see Section 4.1.3), such a policy can give rise to a segmented market where the lowest qualities are exclusively used to borrow from central banks. Hence, a prolonged policy intervention of this type may not only affect the credit allocation, but also give rise to a moral hazard problem through the impairment of market discipline (Acharya et al. 2015). Hereby, also the exposure of banks and central banks to sovereign debt received considerable attention. This is in part due to the European sovereign debt crisis, which erupted in late 2009. From a behavioral viewpoint, the sovereign-banking nexus implies that financial intermediaries can have an incentive to over-expose themselves to domestic sovereign debt, which they can use as collateral to access the central bank facilities for liquidity provision. Such incentives can result from a classic risk-shifting (exposure to joint failure states of sovereigns and intermediaries), regulatory arbitrage, or moral suasion (Acharya and Steffen 2015). However, the ability to pledge sovereign bonds with the central bank at a small haircut is essential for such incentives to play out fully. In effect, small or no haircuts on sovereign debt may not only pose

risks for central bank balance sheets, but also distort credit towards sovereigns and away from investments in the private sector. Hence, central bank liquidity facilities that foresee too small a haircut for sovereign debt may induce financial intermediaries to over-invest in sovereign debt even absent the aforementioned sovereign-banking nexus.

More generally, haircuts and pricing play a key role when it comes to the calibration of collateral frameworks. Conservative haircuts and less favorable pricing make it less attractive to financial institutions to pledge certain types of collateral. Thus, haircuts and pricing are important tools in limiting a potential impairment of private liquidity provision, as well as in dealing with moral hazard.³⁷ Another tool is to apply constraints that limit the quantity of certain types of collateral that an individual counterparty can pledge with the central bank. Hereby, the distinction between normal and crisis times is important. While a conservative calibration of the collateral framework is appropriate during normal times and during idiosyncratic stress events, a systemic liquidity stress event may require the LLR or MMLR to lend *widely* to financial institutions. To do so, the LLR may attempt to support core collateral values by buying and selling freely at a sufficiently wide, but not too wide, spread around the prices that would prevail in normal times (as opposed to conservative crisis time collateral values). Hereby, the clear aim of a MMLR is to reduce risk premia and improve the funding conditions of financial intermediaries.³⁸

As a result, central banks face a difficult balancing act. Achieving all goals at all times is challenging and can involve difficult trade-offs. The design of facilities and the crisis response need to take many factors into account. It is worth noting, however, that perhaps the most important tools to mitigate unintended behavioral implications are outside the tool kit of central bank liquidity provision: the regulatory frameworks for financial markets and financial institutions (e.g. bank capital regulation and liquidity regulation).

6.2 Risks to central bank balance sheets

It is well known that LA bears considerable risks for a LLR. During a financial crisis, the decomposition and size of central bank balance sheets typically undergo

³⁷ See also discussion on the potential moral hazard problem related to the discount window penalty rate in the light of Bagehot's classical LLR doctrine and its modern pendant of a MMLR who provides liquidity at a wide bid-ask spread around the price that would prevail in normal times (Section 2.4).

³⁸ During the episode of quantitative easing after the GFC, some central banks changed the decomposition of their balance sheets towards riskier assets. Such a policy influences both the relative supply and price of safe assets, as well as the central bank's risk exposure (Cecchetti 2009).

drastic changes.³⁹ LA often entails the extension of loans to the private sector on a large scale. Symptomatically, the resulting drastic changes in balance sheet decomposition can be associated with substantial financial risk for the central bank. We can distinguish between credit risk, interest rate risk and currency risk. Credit risk is associated with any type of LA and is related to the counterparty's creditworthiness and to the quality of the collateral. Interest rate risk arises with the provision of term-liquidity and currency risk arises when either the collateral is denominated in foreign currency or when a central bank conducts foreign currency LA.

In normal times, central banks traditionally only lend against high-quality collateral – predominantly against government bonds. More recently, some central banks have started to offer active lending facilities that accept a wide range of collateral also in normal times. The most prominent example is the aforementioned ILTR facility of the Bank of England (Box 4). In general, lending against a wider range of collateral exposes to more credit risk. This is true for normal times and even more so for crisis times. Hence, the central bank has to strike a difficult balance between providing an effective backstop to the financial system and risk management.

When it comes to risk management, the solvency assessment is a core problem for central banks (as described in Section 4.1.1) and entails a number of challenges and difficult trade-offs. This is true for emergency lending to individual institutions (ELA) and perhaps even more so, when it comes to an extraordinary market-wide liquidity support in a period of financial distress (MMLR). In the former case of ELA, the solvency of the counterparty may be in question and the central bank (potentially together with the financial regulator and the treasury) is willing to accept any type of collateral, including equity in the distressed institution with the resulting exposure to potential losses.⁴⁰ In the latter case of market-wide liquidity provision, the MMLR may relax lending terms (e.g. widen the collateral requirements at moderate haircuts) to tackle a scarcity of private sector collateral, as described in the previous sections. Such a relaxation of lending terms might constitute considerable risks for the central bank balance sheet given the potentially large magnitude of interventions.

An additional concern for the central bank's solvency assessment during times of system-wide financial distress is that private banks may be inclined to use their lowest quality collateral for borrowing from central bank facilities, as discussed

39 See Cecchetti (2009) for a detailed description of the evolution of the Fed's balance sheet decomposition during the early stage of the global financial crisis, and Borio and Nelson (2008) for a study on the Euro Area, Japan, the United Kingdom, Canada, Australia and Switzerland.

40 Well documented examples are Kaupthing Bank Sverige AB (the Swedish subsidiary of the Icelandic bank) and Carnegie Investment Bank AB, which both received ELA from the Riksbank in October 2008 (Bryant et al. 2012).

in Section 6.1. The main instrument to deal with credit risk on the central bank balance sheet is the use of sufficiently conservative haircuts that allow for substantial falls in collateral values, but at same time facilitate liquidity provision to the financial sector. In this way central banks can not only attempt to address the unintended behavioral implications discussed previously, but also limit their exposure to counterparty risk.⁴¹

6.3 The monetary policy dimension

There is a debate about how sharp a line one should (or could) draw between monetary policy and financial stability (e.g., Borio (2014), Billi and Vredin (2014), Stein (2013), Svensson (2016)). This debate is related to the possibility of using micro- and macroprudential tools (and monetary policy) to mitigate credit booms and thereby reduce the probability and intensity of a financial crisis looking ahead. At the same time, the interaction between monetary policy and liquidity policy, which is most relevant during episodes of financial instability, has received relatively less attention. In this section, we discuss potential pitfalls that may arise if the distinction between monetary and liquidity policy becomes blurred during financial crises, or if the objectives of public liquidity provision conflict with the objectives of monetary policy.

The link between monetary and liquidity policy is evident from our discussion in Sections 2.5 and 3.5. While central bank liquidity provision is an important aspect in assuring a well-functioning transmission mechanism of monetary policy in affecting market interest rates and economic activity, the use of extraordinary open market operations in relation to the fulfillment of the central bank's role as a LLR during periods of financial instability may pose challenges. Specifically, a blurring of the distinction between monetary and liquidity policy may arise if extraordinary OMOs are used over a longer time horizon so that regular OMOs used to steer the overnight interest rate become indistinguishable from liquidity support to the wider financial system.

Furthermore, conflicts between monetary policy and liquidity policy objectives may emerge when flexibility on the future policy rate path is desirable from a monetary policy viewpoint, while a commitment to an expansive and cheap overnight liquidity provision is desirable from a financial stability viewpoint. One way to address such conflicts is to introduce longer-term liquidity providing operations with maturities up to several months (see, e.g., the Fed's TAF or the ECB's LTRO) that

41 In this context it is also worth mentioning that central banks may have an informational advantage vis-a-vis the private sector as they can draw from detailed regulatory information when assessing the solvency of their counterparties. This informational advantage further underpins the role of central banks as natural liquidity providers discussed in Section 2.2.

preserve monetary policy flexibility on short-term rates. A different challenge may arise especially for small open economies if expansive liquidity operations cause depreciation pressures on the domestic currency that counteract monetary policy objectives, creating a tension between financial stability and monetary policy.

6.4 Trade-offs going forward

We next highlight some key trade-offs that have been shown to be relevant from the recent GFC experience and are likely to shape the policy discussion going forward.

6.4.1 Constructive ambiguity vs. ex-ante transparency

As mentioned earlier, constructive ambiguity is one way to mitigate potential moral hazard problems related to ex-post interventions in periods of financial distress. A key policy question is whether central banks should be ex-ante transparent about the availability of LA, and if so how much. In practice, there are substantial differences in the transparency of central banks on the availability of contingent (or 'dormant') facilities that could be activated in stress scenarios and, more generally, on the lending conditions for certain contingencies.

One can distinguish between ex-ante transparency about the high-level strategy for LA and the framework for LA. While the aim of the former is to give some high-level guidance to market participants on what to expect from the LLR in certain contingencies, the latter entails the communication of more specific information about the available facilities and the terms and conditions thereof. While the majority of central banks remain rather opaque about contingent facilities, some central banks have introduced explicit *contingent* or *permanent* dedicated facilities for LA with differing degrees of transparency about the lending terms. For instance, the Bank of Canada and the Bank of England have introduced the aforementioned Contingent Term Repo Facility after the GFC. Both central banks provide some high-level guidance regarding the activation and use of the CTRF. An example of a permanent dedicated facility for LA is the Committed Liquidity Facility (CLF) of the Reserve Bank of Australia introduced in 2015. The CLF gives financial intermediaries access to a special lending facility in exchange for an up-front fee. Besides its permanent nature, the CLF differs from the CTRF in that it offers term-liquidity at predetermined prices and quantities to participating counterparties. Thus, it can be said that there is a high degree of transparency about this part of the LA framework.

Contingent facilities may be seen as part of a flexible operating framework to ensure an effective crisis response looking ahead. Besides, the availability of contingent facilities in periods of systemic liquidity stress may improve the

resilience of financial markets and reduce the problem of stigma. This is because financial intermediaries may be more willing to provide private liquidity to one another when they are sure that they can rely on a backstop by the LLR. Hence, transparency and disclosure are not only important when it comes to potential moral hazard problems related to the design of a central bank's lending facilities and the contingency planning for LLR interventions. In fact, it may also have relevant implications when it comes to the provision of an effective backstop to the financial system. However, moral hazard remains a concern and its potential costs have to be limited and balanced against the benefits of ex-ante transparency. Moreover, an advantage of constructive ambiguity about the existence of contingent facilities may be that the policy maker retains a higher degree of flexibility and discretion.

It is useful to distinguish between bailouts of individual institutions that are struggling and systemic liquidity stress events. While it is easier for a LLR to credibly commit not to bail out individual institutions in certain states of the world, it becomes difficult to credibly commit not to bail out private financial institutions in periods when market confidence is impaired. Similarly, it is almost impossible to credibly commit not to bail out systemically important institutions. Hence, there is a serious time-inconsistency problem surrounding the constructing ambiguity approach. Symptomatically, constructive ambiguity went quickly out of fashion during the GFC (Domanski et al. 2014). After the failure of Lehman, the too-big-to-fail problem outweighed potential solvency concerns during liquidity operations. From a theoretical viewpoint, Goodhart and Huang (2005) argue that contagion risk not only affects the LLR policies of a central bank, but also the disclosure policies. Specifically, the LLR faces a trade-off between moral hazard related costs and the contagion risk. The optimal LLR policy of the central bank may be time-varying and non-monotone in the size of a bank.

In sum, the trade-off between the benefits and costs of constructive ambiguity and transparency is multi-dimensional. The multi-dimensionality arises because central banks can choose varying degrees of transparency for different facilities. In practice, the potential benefits and costs of constructive ambiguity-type communication policy crucially depend on the design of facilities and on credibility. If the LLR lacks credibility, it is impossible to solve the moral hazard problem since market participants inevitably form expectations about potential bail outs.⁴² As a result, the right balance between the advantages of rule-based and ad-hoc elements of a central bank's framework for LA, as well as the communication thereof remain an important challenge.

⁴² In fact, not being ex-ante transparent about the strategy for LA may cause market participants to form too favorable expectations about bail outs and, thereby, amplify the moral hazard problem.

6.4.2 Outreach vs. credit risk and market discipline

The overarching goal of central bank liquidity policy to provide a backstop and to reach the market participants in need of liquidity may entail the broadening of the scope of public liquidity provision along several dimensions during an episode of financial instability. All dimensions of broadening have the potential to close certain gaps in existing frameworks for LA as discussed in Section 5. What is important, however, is to balance these advantages against potential pitfalls.

The widening of the access to LA in terms of institutional eligibility and the widening of the range of eligible collateral pose substantial challenges to central bank credit risk management. Central banks usually lend to a limited circle of counterparties that act as intermediaries and redistribute liquidity in the financial market. Lending to a smaller circle of counterparties against highest-quality collateral has the advantage that counterparties and collateral qualities can be monitored more closely. Instead, a widening of the access to LA requires very careful management of the central bank collateral framework, in order to contain the credit risk assumed by the central bank. This problem is compounded when private sector collateral is negatively affected by distressed markets (see Section 4.1.1). Similarly, central bank lending at longer maturities and in foreign currencies during episodes of financial instability involves additional risks for the central bank. The anticipation of a broadening of public liquidity provision along these dimensions in systemic stress events can impair market discipline and create moral hazard problems for the aforementioned reasons. While the potential costs may be reduced by carefully calibrating the collateral frameworks and the pricing of central bank lending facilities, it is important to balance the benefits of widening the access to LA in systemic stress events against the implications for central bank balance sheet risk.

The pricing of central bank lending facilities in itself may, however, give rise to a trade-off for the LLR who needs to balance the advantages of a favorable pricing of the lending facilities, such as a reduction of a problem of stigma and the reduction of market distress, against the potential negative implications related to moral hazard and a distortion of the credit allocation. To this end, a lending facility with ex-ante pricing such as the CLF may be attractive. The CLF can be seen as costly liquidity insurance and was introduced in the light of a shortage of HQLA in Australia that may cause a high liquidity premium.⁴³ In a 2013 speech, Jeremy Stein entertains the idea that a CLF may also be appealing in an environment without a shortage of HQLA if the pricing of the facility is calibrated in such a way that there is a low usage in normal times and high participation in crisis times,

⁴³ The Basel Committee allows Australian banks to count their costly access to the CLF towards the fulfillment of the regulatory liquidity buffer.

thereby reducing the problem of stigma (Bech and Keister 2013). While one may argue that a CLF does not solve the moral hazard problem, it remains to be said that the up-front fee can be balanced against the LLR's potential costs ex-post.

In sum, central banks face a number of trade-offs related to transparency, the scope of central bank liquidity provision, the collateral frameworks and the pricing of lending facilities. This section sets out a number of pitfalls that need to be balanced against the benefits of certain policies. Furthermore, we offer some indication on how some of the pitfalls may be addressed so as to reduce the costs and unintended implications of central bank LA.

7 Further challenges ahead

Regulatory, structural and technological developments in the financial system create new challenges for central bank liquidity provision. In this section, we try to look ahead and discuss some of these new developments, and the potential challenges they bring along. Some developments pose specific concerns for the Swedish financial system.

7.1 Challenges for liquidity in connection with resolution

The GFC triggered intensive activity among international standard setters to reform the regulatory framework with a view to increase the resilience of the financial system and, in particular, to eliminate the too-big-to-fail dilemma. Besides enhancing, for example, capital and liquidity buffers, considerable efforts have been devoted to achieving effective resolution regimes that would force shareholders and creditors to take a greater responsibility for losses instead of, in effect, making taxpayers foot the bill for bank failures. At the same time, a new resolution regime aims to make it possible to wind down or reconstruct a failing bank in an orderly fashion so that critical functions can be maintained and without causing disruptions to the rest of the financial system.

The primary mechanism that is supposed to accomplish these twin goals is called “bail-in”. This is essentially the ability to write-down some of the bank's debt to unprotected creditors and/or convert the holdings of these creditors into equity (after the original equity holdings have been wiped out). This allows, in principle, the bank to be instantly recapitalized whilst authorities are given some time to decide on the further treatment of the failing bank (see Box 6 on a new resolution regime).

While the new resolution framework may, in principle, reduce the risks to taxpayers and mitigate the moral hazard problem by enhancing the enforcement of market discipline by investors, it provides little guidance on the provision of

central bank liquidity in connection to resolution. From the perspective of central banks, the link between LA and the timing of the resolution trigger is delicate with important implications for central bank balance sheet risk management. In addition, LA to an insolvent financial institution undergoing resolution may be subject to strict EU-wide restrictions on State aid⁴⁴ and monetary financing.⁴⁵

Moreover, the higher risk of unsecured debt holders to be bailed in is likely to make them less likely to lend to banks in a period of financial distress, thereby creating an amplifying mechanism. Such an amplifying mechanism can also occur when more assets of private banks become encumbered during a period of extraordinary market-wide LA. On a different matter, the resolution frameworks may also increase the tendency to rely on central bank LA from other authorities, simply because central bank LA in principle enables forbearance, such as postponing decisions to trigger resolution, or delaying the practical execution of resolution by responsible authorities.

7.1.1 ELA before resolution

As mentioned, there is a delicate link between LA and the timing of the resolution trigger. Notably, the BRRD does not regulate what happens when a bank to which the central bank has granted ELA (on the presumption that its liquidity needs are merely temporary) is suddenly deemed to be “failing or likely to fail” by the relevant authority and thus passed on to the resolution process. Since it is typical in the nature of emergency situations that ELA will sometimes have to be granted with less than perfect foresight and therefore without knowledge of the true value of pledged collateral, it would seem important that the status of central bank debt in resolution is clarified. To the extent that the true value of the collateral does not fully cover a central bank credit, there is a distinct possibility that the central bank’s remaining claim would be bailed-in at the very moment the bank is placed in resolution. In light of central bank mandates, such an outcome may be problematic for several reasons.

First, it would imply that the central bank takes over a task that is essentially one that belongs to the central government, that is, to deal with insolvent banks. Besides being questionable from a perspective of the monetary financing prohibition, increasing the potential loan loss on the central bank’s balance sheet could undermine incentives to extend ELA in future. Second, it would not seem appropriate that public funds, which are essentially meant to salvage the bank

44 The European Union (EU) Article 107 of the Treaty on the Functioning of the European Union defines and sets restrictions on “State aid” measures (or Government subsidies) that confer, through public resources, economic advantages to selected entities, affecting trade between EU Member States.

45 See Article 123 of the Treaty on the Functioning of the European Union.

from temporary liquidity problems, in effect are expended to bail out private creditors.

A state guarantee backing central bank ELA could possibly be instrumental in dealing with the first problem. However, to mitigate the second problem, it would presumably be necessary to also give central bank claims seniority over other claims in the hierarchy of creditor claims. In general, to reduce costs to society, it would also seem important that the decision to trigger resolution is transparent, and that responsible authorities are discouraged from delaying this decision.

7.1.2 ELA in resolution

A bank in resolution may also be in need of funding liquidity in order to pay its debts as they fall due. The liquidity need is primarily governed by the type of actions that the resolution authority intends to take vis-à-vis the distressed bank, for example, what tools it intends to use (see Box 5). In the base case, the bank's liquidity needs will be satisfied by the market, possibly contingent on a guarantee issued by the resolution authority. However, it may take some time before sufficient confidence is restored to once again make market funding accessible to the bank undergoing resolution. Therefore, at least in the initial stages, the public sector might have to supply liquidity. Thus, central bank ELA may also become an option in resolution.

In Sweden, and in other EU countries, it may, however, prove difficult to reconcile the central bank task of providing ELA to failing banks with the prohibition of monetary financing, especially if the company is already placed in resolution. In Swedish law, the insolvency concept is based on forecasts of a company's future solvency. This means that a bridge institution or a company in resolution may be considered solvent if the resolution measures aim to make the company survive and able to honor its obligations.

Certainly, a large, failing bank is likely to be taken care of by the resolution authority in a so-called "open-bank" resolution, which means that the bank will be able to continue to operate as the same legal person as before and would be recapitalized using the bail-in tool. In such open-bank resolutions, the solvency assessment would not be a big concern. However, there may also be instances when the resolution measures are not set on survival of the company's present legal entity, but rather on selling part of the business and then passing on the rest of the company to bankruptcy proceedings. Whether a central bank credit ends up in a legal entity that survives resolution or in a part that is going into bankruptcy may thus have crucial implications for the solvency assessment.

Box 5 – A new resolution regime

FSB and BRRD In November 2011, the Financial Stability Board (FSB) published the document "Key Attributes of Effective Resolutions Regimes for Financial Institutions" (Henceforth: "Key Attributes"). The document contains recommendations to jurisdictions with global systemically important financial institutions (G-SIFIs). These recommendations were used as a basis for, *inter alia*, a legislative proposal put forward by the EU Commission, which, after intensive negotiations, resulted in the European Parliament's and the Council's Bank Recovery and Resolution Directive (BRRD) being adopted by the European Parliament and the Council of Ministers on 15 April 2014 and 6 May 2014 respectively. The BRRD entered into force on 1 January 2015.

While the FSB Key Attributes pertain to the rather exclusive set of G-SIFIs, the BRRD provides a framework pertaining to basically all credit institutions and investment firms in the EU. The purpose of the BRRD is not only to provide effective tools for reconstructing or winding down failing institutions, but also to avoid individual institutions developing problems that could necessitate resolution. BRRD therefore contains provisions not only about resolution, but also about preparations for this procedure and precautionary supervisory measures.

Provisions on crisis prevention The provisions on crisis prevention include both preparations for resolution and purely supervisory measures. There will be new requirements for the establishment of recovery plans and resolution plans, as well as the possibility of requiring institutions to remove obstacles to an effective resolution. Early intervention, including the appointment of a temporary administrator, is also part of the crisis prevention framework. Early intervention gives the supervisory authorities the opportunity to prevent a deterioration of the institution's financial position to the point where resolution is the only alternative. The crisis prevention work will also include the option of writing down and converting debts that can be included in the capital base and requiring institutions to have sufficient liabilities suitable for bail-in.

Resolution The principal aim of resolution is to reconstruct or wind down financial institutions that fail without causing serious disruptions to critical services. Resolution can thus be seen as an alternative to bankruptcy or liquidation. The BRRD stipulates that resolution authorities should be responsible for managing the procedure and ensure that the purpose of the procedure, which is primarily to address serious disruptions in the financial system, is achieved in

the best possible way. In Sweden, the National Debt Office officially became the designated resolution authority on 1 February 2016.

When an institution is placed under resolution, control of the institution is transferred to the resolution authority. The resolution decision also entails a number of other legal consequences such as prohibiting the seizure of assets. The resolution authority also has the right to stop the fulfillment of contracts or require fulfillment. One of the main reasons for placing a failing institution under resolution is that the continuance of its activities is essential to avoid serious disruptions in the financial system. Therefore, either the activity has to be transferred to a financially sound party or the company has to be reconstructed. There are four resolution tools for this purpose:

1. **The sale-of-business tool**, which allows the resolution authority to sell assets, liabilities and shares in an institution under resolution to a private purchaser.
2. **The bridge institution tool**, which allows the resolution authority to transfer assets, liabilities or shares from the institution under resolution to a temporary bridge institution controlled by the resolution authority.
3. **The asset separation tool**, which allows the resolution authority to transfer assets to a specially established asset management company for gradual sale in the market. This tool may only be applied in conjunction with another resolution tool.
4. **The bail-in tool**, which allows the resolution authority to write down the liabilities of an institution under resolution and/or convert them to shareholdings.

The resolution authority's use of resolution tools is based on a number of powers enabling it to intervene in an institution under resolution and take action against its owners and creditors. In certain circumstances, these powers may also be used independently, without associating them with a particular tool. Before the resolution authority uses any tool or power that may lead to any creditor losses, the resolution authority is to take measures forcing owners to bear losses first and fully. This is to maintain the order of precedence that would have applied if the institution had instead been forced into bankruptcy.

Resolution involves intervention in individuals' rights. For this reason, there are a number of provisions that limit and impose requirements on the resolution procedure in order to preserve a fundamental right to property for different stakeholders. One important provision of this kind is the requirement for an assessment of whether any owner's or creditor's financial outcome is worse than in a normal insolvency or liquidation procedure. If so, the affected party has a right to compensation.

7.2 Cross-border challenges

The increased cross-border activities are not only a concern because they constitute a channel for international liquidity spillovers,⁴⁶ but they are also relevant when it comes to liquidity assistance to subsidiaries of foreign banks and to foreign CCPs that fulfill an important role for the functioning of the payments system. The international dimension raises both questions about the importance of international cooperation in LA and about the burden-sharing in case of potential losses from public liquidity provision that accrue in different jurisdictions. These issues are particularly relevant for Sweden with its relatively large financial sector (see Figure 1 in Section 2) that is characterized by a high degree of internationalization and connectedness, as can be seen in Box 6.

The high degree of cross-border integration of the banks in the Nordic-Baltic countries requires close cooperation among authorities in the region. For a long time, there have been supervisory colleges for the four major Swedish banks. Moreover, since 2010 there is a Memorandum of Understanding (MoU) in place between relevant authorities – basically central banks, supervisory authorities and finance ministries – regarding cooperation in relation to crisis management. However the new resolution framework has instigated a need to review and further develop the arrangements for cross-border cooperation. For example, the FSB Key Attributes recommend the formation of firm-specific Crisis Management Groups (CMGs) and the attainment of firm-specific cross-border cooperation agreements (COAGs) for G-SIFIs. In 2012, a Nordea-specific CMG was established. The EU BRRD takes the cooperation requirements even a step further, providing a broad framework for cross-border cooperation on issues related to resolution. Recently, the Swedish National Debt Office, in its capacity as designated resolution authority in Sweden and consolidating resolution authority, formed, in accordance with BRRD, resolution colleges for the four major Swedish banking groups.

The cross-border cooperation challenge is of course also highly relevant for central banks. Cross-border banking groups will have obligations and thus liquidity needs in different currencies. Liquidity shortages may occur that could require close cooperation and coordination among central banks. The MoU between Nordic central banks that has existed since 2003 is currently being reviewed.

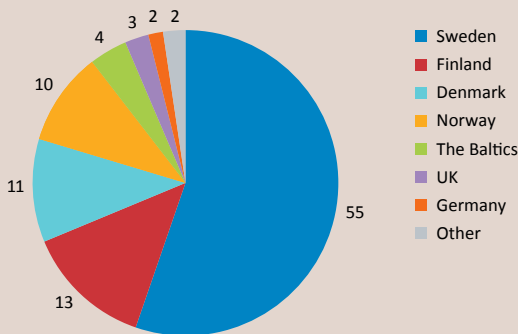
46 See IMF Spillover Report (2014,2015), and Bruno and Shin (2015a,2015b).

Box 6 – Cross-border activities of Swedish banking groups

The four major Swedish banking groups (Handelsbanken, Nordea, SEB, and Swedbank) conduct a significant part of their operations outside Sweden – primarily in other Nordic countries and in the Baltics. Around 47 per cent of the four major banking groups' lending to the public is to customers abroad. Figure B6.1 below depicts the geographic distribution of the Swedish banking groups' lending to the public.

Among the Swedish banking groups, the Nordea Group is the largest one. Nordea, being on FSB's list of G-SIFIs, has the largest proportion of lending to borrowers outside Sweden among the Swedish banks. About 76 per cent of Nordea's lending is to the general public abroad, and only less than a quarter to the Swedish public. The other three major banking groups have an average of one quarter of their operations abroad.

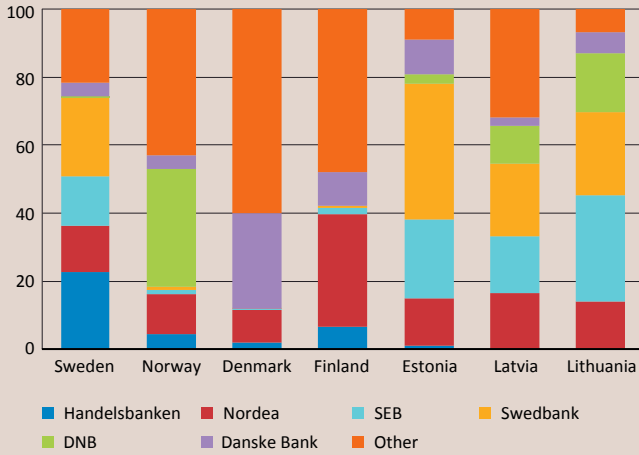
Figure B6.1. Total lending to the public by the four major Swedish banking groups, geographic distribution (percent), March 2016



Source: The Riksbank

The significant presence of Swedish banks in other Nordic and Baltic countries make them effectively systemically important in these countries. Figure B6.2 below depicts the four major banking groups' market shares in the Nordic and Baltic countries. Notably, also Danish bank *Danske Bank* and Norwegian bank *DNB* (shaded areas) have significant cross-border activities in the Nordic-Baltic region besides the four major Swedish banks.

Figure B6.2. Market shares measured by total lending to the public
Percent



Notes. Sweden: Nov 2015; Source: Statistics Sweden

Norway: Q4 2014; Source: Norges Bank

Denmark: Q3 2015; Source: Danmarks Nationalbank

Finland: Q3 2015; Source: Bank of Finland

Estonia: Q4 2014; Source: Estonian Banking Association

Latvia: Q3 2015; Source: Association of Latvian Commercial Banks

Lithuania: Q3 2015; Sources: Central Bank of the Republic of Lithuania;
Association of Lithuanian Banks

A particular circumstance that speaks in favor of enhancing cooperation among central banks is the fact that the Nordea Group has initiated plans to make changes to the bank's corporate structure. The plan is to move from the present group structure, where foreign operations essentially are carried out by separate legal entities incorporated in the other Nordic countries acting as foreign subsidiaries to the Swedish parent bank, to (largely) a branch structure, where foreign operations are carried out by branches of a single, Swedish entity. Such a branch structure increases the Swedish overall potential liability in case Nordea finds itself in dire straits financially. The presumption that the Riksbank will be primarily responsible for potential LA will be stronger, which emphasizes the need to ensure that liquidity in relevant currencies will be available. In a situation where foreign exchange markets are still functioning well, swapping SEK into the desired currencies will not be a concern. However, in a severe crisis scenario where foreign exchange markets are adversely affected, this may prove challenging. Some precautionary measures, such as having swap agreements drawn up between the Nordic central banks, or reinforcing or rebalancing the Riksbank's currency reserve with the relevant currencies, may need to be considered in some circumstances (Sveriges Riksbank 2016).

7.3 Challenges in relation to liquidity to financial market infrastructures

One implication of the changed regulatory framework for the financial sector is the increased necessity to carry out derivatives trades through a central counterparty clearing house (CCP) rather than "over-the-counter" (OTC). This, in turn, has increased the systemic importance of the CCPs providing this service. The extent to which existing burden-sharing arrangements and other arrangements among CCP members/owners should be supplemented with regulatory requirements and, in particular, new central bank liquidity arrangements, is something that is currently being discussed among regulators and central banks. For instance, the Bank of England has already made some arrangements explicitly available for CCPs (see Box 4 on Bank of England's Sterling Monetary Framework in Section 5). As is the case with liquidity facilities aimed at banks, arrangements aimed at market infrastructures and other institutions also entail difficult trade-offs that need careful consideration.

7.4 Challenges due to advances in financial technology

Technological innovation is an (increasingly) important factor behind structural changes in the financial sector. In the payments services area, the technology

for mobile payments has become an important competitor to other payment methods. As a result of the development of blockchain technology, digital currencies, such as bitcoin, have evolved as an alternative to currencies issued by central banks,⁴⁷ in particular in cross-border transactions.⁴⁸ Traditional securities trading has increasingly been challenged by automated trading processes, such as high-frequency trading. In asset management, the use of automated algorithms is gaining ground at the expense of traditional portfolio management methods. In credit services, crowd-funding and peer-to-peer lending have gradually become an alternative to bank lending.

Naturally, advances in financial technology (FinTech) bring about new opportunities, and in many ways they are likely to be welfare-enhancing by providing more efficient business models and more diversity among financial service providers and products. However, at the same time, FinTech innovations can introduce new risks for individual agents as well as for the financial system as a whole. So far, the risk debate has mostly focused on integrity risks, such as concerns over cyber security⁴⁹ and money laundering (bitcoins), and to some extent operational risks.

Not least the emergence of digital currencies has given rise to a whole host of existential questions for central banks, concerning their role as guardians of the payments system and their national currency, and as makers of monetary policy. Several central banks, such as the Bank of Canada, the Bank of England and the Fed are currently experimenting with blockchain technology to implement digital versions of their national currencies.

More recently, FinTech developments have also sparked discussions on potential financial stability implications. An example is the rapidly growing market for crowd-lending and peer-to-peer (P2P) loans.⁵⁰ In this market, investors have to trust the information and credit ratings provided by the P2P platforms. This trust is particularly relevant since a large market segment of P2P lending is currently uncollateralized consumer credit. It has been shown that investors' perceptions about the underlying credit risk can vary a lot in the crowd-lending market (Bertsch et al. 2016), which can make it prone to confidence shocks after adverse

47 See, e.g., Boel (2016).

48 Blockchain is basically a distributed ledger in which transactions performed around the same point in time are stored as blocks on computers connected to the network. The ledger grows as the chain of blocks increases in size. Each new block of transactions has to be verified by the network before it can be added to the chain. This means that each computer connected to the network has full information about the transactions in the network.

49 In 2016, Bangladesh Bank was the victim of a cybercrime that could have resulted in the loss of nearly USD 1bn (see, for instance, Mallet and Chilkoti 2016).

50 Peer-to-peer (P2P) lending is the practice of lending money to individuals or businesses through online services that match lenders directly with borrowers.

news.⁵¹ Therefore, a loss in confidence may lead to a sudden dry-up of credit origination and destabilize the market for securitized P2P loans. Provided that the crowd-lending market continues to gain importance, such a loss in confidence in P2P lending can have relevant negative spill-overs to the banking sector and disrupt the supply of credit to the economy. From a central bank perspective, LA in support of the market for securitized P2P loans may become a potential policy response to such a scenario.

On top of this, there are reasons to keep a keen eye on the potential effects of some FinTech advances on procyclicality, concentration risks, and on banks' liquidity risks resulting from increased automation. Lately there have been discussions about the potential consequences of so-called *portal aggregators* that are able to automate the allocation of deposits between different banks. In theory, such applications could give rise to self-enhancing patterns of deposit re-allocation. More precisely, if deposit allocation algorithms move enough deposits from one bank to another, it might trigger more algorithms to do the same. In other words, we may have a systemic liquidity crisis on our hands more quickly than we previously could imagine.⁵² According to the traditional view, liquidity provision by the central bank would play an important role for restoring market confidence in times of liquidity stress. When a bank run is fueled by automatic algorithms rather than by the sentiments of individual depositors and investors, the central bank's role as provider of LA may need to adapt. After all, what does an algorithm care about confidence?

8 Conclusions

This article attempts to offer a review that could help enhance our understanding of the role of central banks as providers of public liquidity. We discuss various challenges for the effectiveness of central bank lending facilities against the backdrop of the global financial crisis of 2007-2009. These challenges help to identify potential gaps in existing mechanisms and frameworks governing liquidity assistance. Moreover, we investigate how the available liquidity policy tool kit can be used to deal with the challenges. Thereby, we also highlight modifications to existing central bank facilities. Based on the empirical and theoretical literature, we point at trade-offs faced by policy makers and describe potential pitfalls, such as unintended implications for the behavior of financial market participants that may arise from the availability of certain central bank lending facilities. Lastly, we

51 A scandal at LendingClub (the largest U.S. P2P platform for consumer credit) in May 2016 illustrates this (see, for instance, Corkery 2016).

52 A similar phenomenon has been pointed out in the case of automated stock market trading as one of the main reasons behind the 2010 Flash Crash (De Nederlandsche Bank 2015).

attempt to look ahead and outline some specific challenges posed by more recent structural, regulatory, and technological developments in the financial system.

Going forward, the right balance between the advantages of rule-based and ad-hoc elements of central bank frameworks for LA, as well as the communication thereof remain an important challenge. Similarly, the calibration of the collateral frameworks and the pricing of facilities pose important trade-offs. Measures to reach market participants in need of liquidity and to deal with the problem of stigma have to be balanced against potential pitfalls.

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Appendix

Table A.1. Definition of key terms

| Term | Definition |
|--------------------------------------|---|
| central bank liquidity | central bank money or securities that serve as collateral in money markets |
| central bank currency swap | a foreign exchange derivative that is used by central banks to provide liquidity in their own currency to one another |
| central bank money | financial institutions' deposits at the central bank (also known as reserves or settlement balances) |
| Emergency Liquidity Assistance (ELA) | liquidity provision to an individual financial institution that is illiquid and lacks sufficient eligible quality collateral |
| funding liquidity | captures the ease and cost at which financial institutions raise cash to make their immediate payments, either by borrowing in the markets or by selling assets, which depends on the sensitivity of margins and on collateral valuations |
| High-Quality Liquid Assets (HQLA) | HQLA comprise cash; central bank money; marketable securities by sovereigns, central banks, non-central government public sector entities, the Bank for International Settlements, the International Monetary Fund, the European Commission, or multilateral development banks; government or central bank debt issued in domestic currencies |
| LA to market | supporting core collateral values of financial institutions by means of an outright purchase of assets and REPOs |
| liquidity | captures the ease of transferring future income from long-dated assets into current income |
| Liquidity Assistance (LA) | supply of liquidity to the private sector with the objective to help its counterparties overcome unusually severe liquidity shortages or to improve the liquidity of dysfunctional markets |
| Liquidity Coverage Ratio (LCR) | the stock of unencumbered HQLA divided by the projected total net cash outflows over the next 30 calendar days has to exceed 100 percent |
| liquidity premium | forward rate minus expected future short-term interest rates |
| liquidity risk | captures the financial risk stemming from the difficulty of selling an asset quickly without affecting the price |
| LLR and MLLR | captures central bank LA to financial institutions in reaction to an abnormal increase in liquidity demand that is not met by private liquidity provision |
| market liquidity | captures the ability to execute large security transaction rapidly with a limited impact on market prices |

| Term | Definition |
|---------------------------------|---|
| MLLR | captures central bank LA to the market |
| monetary policy transmission | process through which monetary policy decisions transmit to the economy and the price level |
| Net Stable Funding Ratio (NSFR) | the available amount of stable funding divided by the required amount of stable funding has to exceed 100 percent |
| private liquidity provision | private financial institutions providing liquidity to one another |
| public liquidity provision | liquidity provided by the central bank or other public entities like the deposit insurance fund or the central government |
| runnable liabilities | short-term liabilities without insurance or backing from the government that are considered to be prone to withdrawal or roll-over risk |
| technological liquidity | captures the degree of reversibility of physical investments |