19 Liquidity Management and Regulation

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Liquidity's a mystery; it's very rarely seen,
It strikes and then is gone again, its getaway is clean,
And despite forensic evidence and great deductive flair,
The conclusion's inescapable, Liquidity's not there!

Liquidity, Liquidity, there's nothing like liquidity,
Its presence gives you confidence, its absence gives timidity,
You own perhaps a property, you own perhaps a share,
But once you've lost your credit card, Liquidity's not there!

Your understated opulence inheres in what you wear,
But in the end, you face the fact, Liquidity's not there!"
extract from "Liquidity, The Accounting Cat" by John Clarke

19.1 Introduction

"Liquidity is the ability to fund increases in assets and meet obligations as they come due. Within this definition is an assumption that obligations will be able to be met "at reasonable cost"." http://www.bis.org/publ/bcbs136.pdf.

Liquidity risk has always been an important issue for banks, but the problems experienced in the GFC by major banks (and financial markets) brought it into greater prominence and led to the introduction of new regulation as part of Basel 3.[1] But it is not just banks that face and need to manage liquidity risk, and so the following section considers the pervasiveness of liquidity risk. The following section outlines some of the lessons learnt from the GFC about liquidity risk and its management. This is followed by a consideration of how liquidity risk arises in banks, including an exposition of the Diamond-Dybvig model which explains how the nature of bank deposits can lead to the extreme liquidity risk event of a bank "run". Principles and practices of liquidity management are then considered. Because banks play a special role in the financial sector and rely on access to deposits at the Central Bank for ultimate liquidity, the role of Central Bank liquidity management is then considered. Last, but by no means least, the liquidity regulations introduced in Basel 3 are outlined, and some of their consequences discussed.

[1] The Basel Committee had issued a liquidity management sound practices guide in 2000 (updated in 2008).

19.2 The Pervasiveness of Liquidity Risk

Banks are generally viewed as the financial institutions most subject to liquidity risk as a result of taking short term and at-call deposits and making longer term illiquid loans. But liquidity risk arises for many other types of financial institutions.

Mutual Funds and Liquidity Risk

An *open-end mutual fund* which invests in illiquid assets such as property or mortgage securities and allows investors to redeem their investments at short notice (next day) at the Net Asset Value has significant liquidity risk. The inability to sell those assets quickly without losses implies a need to maintain some adequate level of liquid assets to deal with withdrawals. Unfortunately this principle has not always been adhered to, and such funds have had to impose a freeze on withdrawals in times of stress. In Australia, this occurred in the early 1990s for property trusts and mortgage trusts[2] and this was repeated in the Global Financial Crisis when many such trusts had to freeze redemptions – with those freezes lasting quite some years. ASIC provides information on frozen funds here.

A 2020 *FRB FEDs Notes* paper by Aramonte et al makes the point that mutual funds create liquidity by providing investors with next day access to funds even though the underlying assets may not be easily saleable with rapid settlement. Investors expecting large outflows to occur from mutual funds, requiring forced asset sales (due to low liquid asset holdings) which depress net asset values may run in order to be first in line and avoid losses. They estimate the sensitivity of fund NAVs to measures of aggregate market liquidity and find that there were marked changes in this sensitivity for high-yield bond and bank-loan funds following the onset of the Covid-19 crisis. This suggests that such funds would be particularly vulnerable to adverse shocks in market liquidity, potentially transmitting those shocks into the asset markets in which they have investments.

International Standard Setters have produced guidance on liquidity management requirements for mutual funds. In 2013, IOSCO set out principles for liquidity risk management in collective investment schemes, and in 2017 the Financial Stability Board addressed liquidity concerns as one item in its consideration of structural vulnerabilities in asset management activities. The Covid-19 crisis also created liquidity problems globally for open-ended mutual funds and for financial stability, reflecting a "dash for cash" and "front-running" by investors concerned about asset values, prompting the IMF to produce a report with recommendations on liquidity management practices

[2] Estate Mortgage Trust was a high profile example. Its promoters (subsequently jailed) had wrongly claimed to be able to provide high returns for investors from investing in low risk mortgages. This Nov 9, 2002 AFR article provides an overview of the whole sorry tale, involving investors losing over half of their investments.

and regulation for such funds. They recommend a "waterfall" approach to strengthening liquidity risk resilience of funds involving (in order of operation): stronger liquid asset buffers; partial, temporary, "lock-in" powers; offers to make redemptions "in-kind" (ie of assets held by the fund) rather than via cash; and finally "gating" (prohibition) of outflows (or applying discounts to NAV) in systemic circumstances. In such circumstances, provision of emergency liquidity support by Central Banks (via asset purchases and special lending facilities) would also be relevant.

To operate an open-ended scheme giving investors a right to withdraw at any time the provisions of the Corporations Act (Section 601) essentially require that the scheme be "liquid". This is defined as having at least 80 per cent of its assets in bank deposits, bank bills, marketable securities or "prescribed property", or property where the RE reasonably expects realisation at its market value can be achieved within some specified period. MIS which invest in listed equities, bonds or money market instruments will generally meet this requirement. But where investments are in structured products or unlisted securities, where markets may become illiquid, the requirement is less clear. The legislation also provides for schemes not offering continuous withdrawal rights the ability to offer members a right to withdraw from time to time.

Of course, managed investment schemes listed on the ASX (which are "closed-end funds") do not have the same liquidity requirements. If investors wish to liquidate part or all of their investment that can be done by sale to other investors via the ASX. One consequence, however, is that prices of units in the scheme can differ (sometimes quite substantially) from the value of the underlying assets held by the scheme. ETFs (see here for an explanation) were developed as a solution to this problem.

Superannuation Funds

In principle, liquidity risk for superannuation funds should be very low. The only members with a right to redeem super balances for cash are (generally) those in retirement (or more specifically those above the preservation age – which ranges between 55 and 60 depending on date of birth). For individuals below the preservation age, balances can be transferred to another fund – but this is not a very common occurrence.

So, particularly given the ongoing influx of cash from regular super contributions from employers, the need for holding cash to meet possible member withdrawals is relatively low – unless the fund has a high proportion of retired members. Nevertheless, super fund managers argue that liquidity management is important because of the possibility of members changing their investment options and thus requiring the fund to sell some types of assets and buy others.

Of course, there can be unexpected shocks, such as during the Covid crisis when the Government allowed individuals suffering financial hardship to withdraw up to $20,000 from their accounts. While some expected that this would cause liquidity problems for the funds, there was no evidence of that happening, although APRA has identified areas for improvement in liquidity risk management.

Conduits and SIVs and liquidity risk spillovers

In the GFC, liquidity problems arose with ABCP conduits which held long term assets, such as RMBS or CDOs, financed by issuance of short term (eg 90 day) commercial paper. Inability to replace maturing paper at reasonable cost at a time when selling the assets held to meet maturing liabilities would have involved major losses and thus led to default on meeting those obligations. Many banks who were sponsors of such conduits were, or felt, obliged to provide support to the conduits, transferring the losses from falling asset values back onto bank balance sheets. (Indeed, the provision of a liquidity facility by a bank will generally be needed to convince investors in CP that the issuer will be able to meet repayments in the event that new CP investors cannot be attracted to replace maturing paper).

In Australia NAB had significant exposure to conduits that had been established for funding both NAB-originated and non-NAB-originated securities. Standby liquidity facilities were heavily drawn upon by the latter group of conduits (as shown in the 1998 Annual Report (Table 1, p113). Consequently, the bank ended up being effectively the funder of the conduit assets and bearing the losses associated with declines in their value. (Fair value of the assets was assessed at $A 3.7 bill versus carrying value of $A 4.7 bill. A statement of claim for a shareholder class action based on inadequate disclosure by the bank provides quite a bit of detail, and was settled by the bank for $A 115 mill). Accounting practices were changed at the time to have such conduits consolidated in the bank's accounts.

19.3 Liquidity disruptions: Lessons from the GFC

The GFC brought liquidity risk management into sharp focus, and prompted significant regulatory change and increased recognition of how interrelationships between financial institutions and capital markets could generate liquidity crises threatening stability of the financial system.

The possibility that financial markets could "freeze" due to widespread increased uncertainty about asset quality was not generally considered, but was evidenced in the GFC with closure of ABS commercial paper markets, closure of securitization markets, delays in loan syndication completions and underwriting exposures, and interbank market disruptions. Banks faced liquidity problems

because of exposures to off balance sheet SIVs/conduits which they had sposored arising from various types of liquidity or credit guarantees (or sometimes providing support due to reputational concerns).

As noted by the U.S. FDIC (August 2008) "Increased use of liability-based and off-balance sheet strategies has elevated the liquidity risk profile..." "Some institutions have underestimated the difficulty of obtaining or retaining funding sources during times of financial stress."

This was reflected in the fragility of collateralized funding mechanisms such as use of Repos, margin lending, securities lending. Repo financing of asset holdings, involving purchasing securities and pledging them as security for short term funding, in particular created problems with asset price declines causing liquidity problems. This occurred via margin calls prompting asset sales into depressed markets and interconnectedness though re-use of securities as collateral transmits system liquidity problems

Significant liquidity creation had occurred prior to the GFC in "shadow banking", such as Asset Backed Commercial Paper (ABCP) issued by SPVs (SIVs, conduits) etc. These suffered "Funding liquidity risk" in the form of an inability to roll-over maturing short term funding. In some cases there was a failure of untested liquidity management arrangements such as Extendible Commercial Paper (XCP)

Within the regulated banking sector there were disruptions to interbank markets for liquidity. There was significant unwillingness to lend and hoarding of liquidity due to uncertainty about counterparty risk. This was a "typical" imperfect information induced credit rationing response, reflecting Inability to distinguish good from bad risks.

For banks, a number of lessons became apparent. First, banks' Internal Funds Transfer Pricing Systems did not adequately price the cost of liquidity provision to business units. Second, contingent liquidity support for SPVs was not adequately reflected in liquidity planning. Third, reputational risk is a source of liquidity and solvency risk which can arise in both wholesale and retail markets.

For the authorities, while Central Banks provided facilities for access to liquidity, there was in some countries, a reluctance to access official liquidity support due to concerns about being tainted as institutions-at-risk.

19.4 Bank Liquidity Creation and Liquidity Risk

Liquidity creation is one of the core features of banking, best exemplified by the taking of short term deposits and making of longer term loans. (For example, the ANZ 2016 Annual Report (p136) showed ANZ had only $155 billion out of $675 billion of assets maturing within one year, while $627

billion of liabilities matured within one year). Relying on the "law of large numbers" the risk that one depositor will withdraw funds on any day is hopefully balanced by the possibility that another depositor will provide funds, enabling the bank to maintain its holdings of longer term assets, and meet any net outflows from:

- small holdings of cash (often referred to as liquid asset reserve management)
- proceeds of sales of marketable securities (market liquidity)
- funds raised by borrowings in wholesale markets (funding liquidity).

Liquidity creation by banks occurs in a range of other ways, summarised below. An important one is the provision of lines of credit (loan commitments, overdrafts) to customers, enabling them to access funds should they be needed. (Such facilities may be on a committed basis, or a "best efforts" basis – which poses greater risk (of non-availability) for the customer). Credit card limits also fall into this category. Short term loans also provide liquidity for customers – for example repurchase agreements enable bank counterparties to finance holdings of long term assets by using those as collateral for short term loans. (Banks may also use repos to borrow short term to fund their own holdings of long term securities).

Sources of Bank Liquidity Risk*

(a) Liquidity creation via asset- deposit liability maturity mismatch.
(b) Interbank settlements as part of the payments process
(c) Customers drawing on liquidity facilities (overdrafts, loans approved but not yet drawndown, credit cards, lines of credit, CP liquidity backstop guarantees),
(d) variations in loan repayments from expected (based on pre-payment experience)
(e) Reliance on ability to roll-over capital markets funding / volatility of short term money market funding
(f) Default on expected repayments
(g) Collateral /margin call demands
(h) Unexpected payments due to counterparty exercise of derivative contracts
(i) Lags or inability to on-sell underwritten securities
(j) Market "freezing" for complex securities held and thought to be marketable
(k) Cross-border / FX transactions

* Compiled from a range of sources

Some examples of the way in which banks could create liquidity risk include:

- Writing a put option on shares in company XYZ
- Providing a customer with a credit card
- Creating a Special Purpose Vehicle which issues Asset Backed Commercial Paper backed by mortgages originated by the bank
- Taking a long futures position on an organized exchange
- Transacting in OTC derivatives where collateral agreements have been put in place to mitigate credit risk

Some academics[3] have argued that it is natural for banks to combine the granting of loan commitments with taking transactions deposits because doing so may reduce the costs of managing overall liquidity risk (via holding of low yielding cash) if the risks of outflows associated with each are not perfectly correlated. KRS's counterfactual is a situation where each of the functions (of liquidity insurance to customers) are provided by separate institutions, and is thus partly advanced as an explanation for why deposit taking and lending are combined in one institution (a bank). They argue that historically, customer access to cash via lines of credit (overdrafts) and via deposits were viewed as very similar. In a closed system, if one customer drew on a line of credit to make a payment to another individual who deposited the proceeds the bank would have no change in its cash holdings.

Kashyap et al (2002) argue that imperfect correlation between usage of lines of credit and deposit withdrawals mean that banks can save on liquid asset holdings (reducing the foregone higher returns available from less liquid assets) relative to deposits and commitments being provided by separate institutions.

They test this by looking at cross sectional correlation of unused commitments and transactions deposits for banks in the USA, and find a positive correlation. Gatev and Strahan examine whether having higher commitments reduces the riskiness of banks with high levels of transaction deposits, using bank stock-return as their measure of risk. They find this to be so, and that for banks with low transactions deposits, more unused commitments increases risk.

19.5 The Diamond & Dybvig (and other) Models

Diamond and Dybvig. (JPE, 1983) developed a model of the rationale for, and consequences of, bank liquidity creation. Fundamental to this is the "sequential service" (first come first served) nature of bank deposit liabilities which leads to the possibility of bank "runs" not due to "fundamentals". They discuss measures to prevent or deal with runs including deposit insurance and bank "holidays" (closing the doors).

The intuition underpinning the model is as follows:

- Investors (depositors) desire liquidity, entrepreneurs have projects that are illiquid and require longer term loans
- Banks, provide liquidity insurance to investors while making illiquid loans (which can be liquidated at a cost to meet liquidity demands)

[3] Kashyap et al (2002), Gatev and Strahan (JFE 2009)

- "First come first served" nature of deposits means that if a depositor believes there is excessive liquidity demand of others and consequent loan liquidations which may lead to losses and inability to get full value of deposit at later date, she should withdraw deposit (even if funds not wanted till later date).

Diamond (FRBR, 2007) provides a simplified exposition of the model as shown in Figure 1.

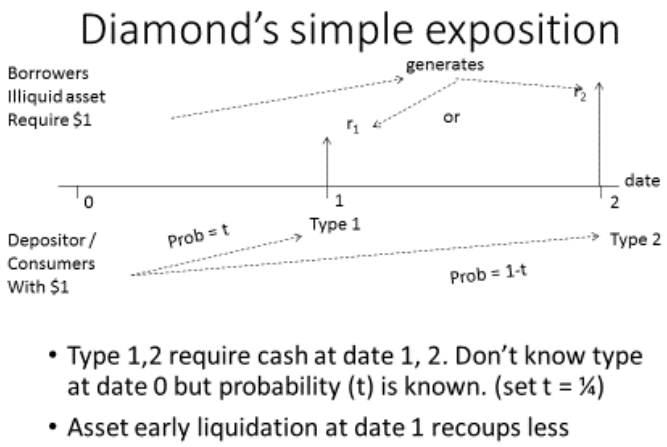

FIGURE 1: THE DIAMOND-DYBVIG FRAMEWORK

Individual depositors have utility given by $U(c_1)$ or $U(c_2)$ depending on whether they turn out to need date 1 or date 2 consumption with probabilities t and 1-t. Assume t = 0.25, a discount rate of zero, and form of the utility function of U(c) = 1 – (1/c).

Direct holding of the illiquid (entrepreneur's project) asset gives expected utility of $tU(r_1) + (1-t)U(r_2)$ where r_1 and r_2 are returns from liquidating the asset at date 1 and date 2 respectively.

Assume the illiquid asset generates $r_1 = 1$ at date 1 or $r_2 = R = 2$ at date 2 and is the only asset available to investors. Banks however are able to create a liquid asset (to be shown) which generates $r_1 > 1$ or $r_2 < R$. Assume the returns on the bank liquid asset are $r_1 = 1.28$, $r_2 = 1.813$)

Investor expected utility from the illiquid asset = 0.375

(= 0.25*(1-1/1) +0.75*91-1/2) = 0.25 x 0 + 0.75 x (1/2).)

Expected utility from the liquid asset (bank deposit)

= (0.25)x(1-1/1.28) +0.75x (1-1/1.813) = 0.391 > 0.375.

This is preferred due to risk aversion (and less dispersion of outcomes r_1, r_2)

The bank liquidity creation ability arises from the following. It invests in the illiquid asset (with $r_1 = 1$ or $r_2 = 2$), it offers withdrawable deposits with $r_1 = 1.28$ or $r_2 = 1.813$. It will need to liquidate some of

assets at date 1 to meet Type 1 cash needs (the proportion is t = 0.25). Thus it will liquidate 32 of 100 to get \$32 and pay 25 x\$1.28 = \$32. There are 68 illiquid assets left which will generate 68x\$2 which is just sufficient to pay 75 x \$1.813 to remaining depositors at t=2.

This is a (Nash) equilibrium. If all believe 25% will withdraw at date 1, the bank can meet promises and only Type 1's will withdraw (Even if a storage asset exists giving \$1 at next date, then if illiquid asset date 1 liquidation gives 1-τ <1, the bank can hold some of storage asset and liquidate less of illiquid asset. Individuals can't do as well as this since they have an all or nothing date 1 liquidity need).

Bank runs can arise for the following reason. It is assumed that depositor type is unknown at date 0 and non-verifiable at date 1, so that banks and customers can't design a contract based on outcome of depositor type. Also, the bank can't prevent Type 2's withdrawing at date 1.

Suppose f % withdraw at date 1. The payout is $r_1 f$ and $1-r_1 f$ illiquid assets are left, which generate $(1-r_1 f)R$ at date 2 for (1-f) type 2 depositors remaining. If f>t, it is optimal for Type 2's to withdraw r_1 at date 1 and store if $r_2(f) < r_1$. If f* is forecast of f, good equilibrium is f* = t. However, suppose f* ≥ 0.79, the bank needs to liquidate all investments to honour $r_1 = 1.28$, so that zero is left at date 2. If all individuals believe f* = 0.79 or greater they will all withdraw, such that f* = f = 1 is "run" equilibrium – self fulfilling prophecy.

There are thus two equilibria which are locally stable. The first, f* a little above t = 0.25, doesn't induce type 2 to withdraw early and there are still enough illiquid assets left to mean that the date 2 outcome is better than withdraw and store.

The second is where $r_1 > r_2(f^*) = [1-(f^*.r_1)]R/(1-f^*)$ which induces type 2 withdrawal. For R =2, $r_1 = 1.28$, the critical f* = 0.5625.

Hence runs require a significant shift in beliefs, but can be prompted by anything which induces large change in f*. D&D refer to this a "sunspot" equilibrium (reflecting ancient beliefs that these presage some significant event).

Extensions and Qualifications

D&D's simplified model makes a number of assumptions, some of which have been challenged by subsequent literature (see Shell and Zhang (MD, 2020) for a recent contribution which provides information on some of the prior studies) , others of which are of minor import to the model's results. These include:

- No uncertainty about date 2 illiquid asset payoff
- No agency /hold-up problems involving entrepreneur effort
- Why sequential service feature?
- Why banks – why can't consumers invest directly and transact via capital market to obtain liquidity?

- Information assumptions

Preventing Bank Runs

D&D discuss a number of ways in which bank runs have been prevented

Historically one approach was a temporary suspension of convertibility of deposits into cash, by for example closing the doors of the bank. They suggest that a credible threat to suspend convertibility may prevent runs because, in the context of their model, the date 2 promised amount not then threatened.

Since the 1930s another approach has been the provision by governments of deposit insurance. In the context of the D&D model, this removes risk of the date 2 promised amount. They argue this is preferable to suspension of convertibility if the proportion of type 1's is stochastic (otherwise closing of doors creates hardship for type 1's and the bank is able to undertake greater maturity transformation).

A third approach has been Central Bank liquidity provision to banks which are (believed) solvent but illiquid. This is generally referred to as the Lender of Last Resort (LOLR) role of the Central Bank. In general the maxim here has been that attributed to Walter Bagehot in his 1873 book "Lombard Street: A Description of the Money Market", which can be summarised as "central banks should lend early and freely to solvent but illiquid banks, against good collateral and at high rates".

Note that both deposit insurance and Central Bank liquidity facilities have the potential to create moral hazard.

Other Theoretical Models

There are many academic papers focusing on features of banking related to liquidity. Here are some comments on a few of them

Calomiris & Khan (AER, 1991) - They ask, why is there use of a sequential service model? Sequential service gives depositors incentive to collect information and monitor and exit first if failure likely. Hence this enables bankers to commit to a promised set of payoffs

Diamond and Rajan, (JPE, 2001) – They note that bank fragility is due to demand deposits. This enables banks to credibly commit to using loan monitoring skills and expertise (acquired knowledge) to overcome the borrower hold-up problem (since the bank can take over the borrower's project at date 1 and continue to date 2 with less reduction in outcome than if individual depositors were to do so).

Brunnermeier and Oehmke (JOF, 2013) -They argue that financial institutions may use excessive short term finance, as a result of a "maturity rat race". The argument is that banks, for example, can borrow from multiple counterparties at different maturities to fund long term investments. Equilibrium involves inefficiently short maturity with excessive maturity mismatch, unnecessary rollover risk, and possibility of creditor runs. Why does this occur? Shorter term creditors can redeem funds earlier if negative information arises, or demand a higher roll-over rate – these dilute longer term claims, ie there is a form of externality. Hence shorter term creditors will accept a lower interest rate and if positive news arrives, the bank can roll-over at a better rate. There is thus an incentive for the bank to attract shorter term debt.

Note that this "rat-race" is not based on competition between banks – it is the outcome of a bank dealing with its creditors (depositors). Important to their model is that (a) banks cannot commit to a particular maturity structure of liabilities when dealing with potential creditors and (b) creditors are not able to observe the bank's maturity structure.

Acharya, Shim, Yorulmazer (RFS, 2011) – They focus on strategic liquidity management – having cash to buy fire-sale assets (failed banks), means an increase liquidity in crisis times. This has merit since fire sale prices are below fundamentals due to "cash in the market pricing" (see Allen and Gale (JEEA, 2005)). In contrast a bias towards low liquidity in good times given a belief that high yielding risky assets can be used as collateral. They consider that the design of LOLR policy (lend to insolvent banks v lend to solvent banks v lend to solvent banks conditional on liquid asset holdings) will affect bank liquidity policy (both directly, but also by affecting fire sale opportunities).

Brunnermeier and Pedersen (RFS, 2009) – They note that financiers fund speculators, via collateralised loans, who provide liquidity in asset markets. The speculator constraint is that their capital (NW) must exceed margins required. Financiers set margins based on VAR (or some other risk calculation). Market illiquidity arises from a gap of price from fundamental value. If financiers know prices are less than or greater than fundamental value and expect it to return, they reduce margins on long (short) positions which is stabilising behaviour. If financiers don't know the fundamental value, margins increase with price volatility, and can increase with market illiquidity. An asset demand shock can lead to fragility and spirals – the Price (Loss) - Margin Spiral.

19.6 Managing Liquidity Risks

The global sub-prime crisis of 2007-8 emphasized the importance of liquidity management in banking (and other organizations) and the potentially disastrous risks which exist. The Basel Committee issued (June 2008) its "Principles for Sound Liquidity Management and Supervision".[4]

Banks face three main liquidity management issues reflecting different planning horizons

- day to day liquidity management of transactions arising through the payments system and other cash flows
    - ensuring adequate "cash" is available at customer outlets (branches, ATMs) to meet withdrawals;
    - Having sufficient settlement account balances at the Central Bank to meet anticipated settlements – with the development of Real Time Gross Settlements (RTGS) this has changed from previous times when the focus was on overnight settlement balances;
- short term funding issues and dealing with imbalances and crises
    - Projecting likely net withdrawals/inflows (due to maturing deposits, loan drawdowns, customer transactions etc) on future dates such that actions can be taken to ensure the availability of adequate liquidity as these dates approach.
- longer term balance sheet funding issues
    - As the time horizon involved gets longer, liquidity management morphs into "funding" and capital management arrangements.

There are a range of techniques available for these purposes, but an important component is that of "stress testing". One such test which most regulators will require is for financial institutions to demonstrate that they are able to survive a "name crisis" in which their ability to access key sources of funds dries up for a number of days.

Typically a bank will forecast future expected cash flows – over range of horizons from daily to years (funding needs). For short term horizons the bank will need to ensure that expected outflows < expected inflows + available marketable assets + discretionary access to external sources of funds. Use of stress tests/scenario planning is a way to (hopefully) ensure sufficient safety margin. Also, the bank might set limits on cumulative cashflow mismatches (net funding requirement) over various horizons.

Generally some form of "maturity ladder" is used – mapping expected future cash inflows and outflows against future dates to determine expected net positions. Complications include: treatment of at-call deposits, expected loan approvals and timing of loan drawdowns, seasonal effects on loan/deposit balances etc. Conservatism suggests using the latest possible date for discretionary loan repayments, earlier dates for discretionary cash outflows, conservative roll-over assumptions etc.

[4] In February 2008 it published "Liquidity Risk Management and Supervisory Challenges"

Liquidity management involves financial institutions implementing strategies of "self-insurance" or "purchased insurance" against shortfalls of cash required to meet current and forthcoming obligations in a variety of ways. These are sometimes referred to as asset liquidity management and liability management approaches respectively. In the former the bank will hold sufficient liquid assets relative to total assets to act as a buffer from which cash outflows can be met (but giving reduced weight to assets with high price volatility). In the latter the bank relies on access to funds via the interbank/wholesale market (and possible sales of less liquid securities). The optimal mix will reflect the relative costs incurred in using each approach and the risks associated with each.

Table 1 provides information on possible assumptions which might be required in stress testing, and which illustrate ways in which liquidity problems might arise.

TABLE 1: STRESS TESTING LIQUIDITY RISK: POSSIBLE ASSUMPTIONS

asset market illiquidity and the erosion in the value of liquid assets
the run-off of retail funding
the (un)availability of secured and unsecured wholesale funding sources
the correlation between funding markets or the effectiveness of diversification across sources of funding
additional margin calls and collateral requirements
funding tenors
contingent claims and more specifically, potential draws on committed lines extended to third parties or the bank's subsidiaries, branches or head office
the liquidity absorbed by off-balance sheet vehicles and activities (including conduit financing)
the availability of contingent lines extended to the bank
liquidity drains associated with complex products/transactions
the impact of credit rating triggers
FX convertibility and access to foreign exchange markets
the ability to transfer liquidity across entities, sectors and borders taking into account legal, regulatory, operational and time zone restrictions and constraints
the access to central bank facilities
the operational ability of the bank to monetise assets
the bank's remedial actions and the availability of the necessary documentation and operational expertise and experience to execute them, taking into account the potential reputational impact when executing these actions
estimates of future balance sheet growth.
Source: Basel Committee: BCBS144

Potential sources of liquidity include the following:

- Holding "cash" or near-cash assets. This is generally perceived to be expensive, one reason being that rates of return on liquid assets are lower than on illiquid assets. In theory, that should not be a problem, but in practice providers of funds to the institution do not adjust downwards their required rates of return sufficiently to reflect the lower risk associated with higher liquidity. As financial markets have developed, cash holdings have fallen as a form of

liquidity management – although there has been clear evidence of a flight to cash (such as Central Bank deposits) during the uncertain times of the sub-prime crisis.

- Holding readily marketable securities (financial assets). The sub-prime crisis has exposed the shortcomings in such a strategy for coping with market wide liquidity crises. It involves taking on market risk (due to volatility in the market prices of those assets), with the risk of having to sell into a depressed market. In a time of crisis, when many organizations are pursuing the same strategy, the cost can be significant – and particularly so if markets freeze up as has happened during the crisis.
- Holding securities which can be pledged as collateral for short term borrowings. The repurchase (repo) market, in which securities are sold and simultaneously repurchased for delivery at a future date, has become an important tool for liquidity management of this sort.
- Having in place lines of credit or other arranged borrowing facilities. The ability to draw on a committed line of credit or overdraft facility from another institution will typically involve incurring some cost for establishment and maintenance of that facility in addition to the cost of borrowing. Another option is to have facilities in place which enable the organization to issue securities (such as commercial paper) into the capital market. In some cases this may also be achieved by having an option attached to existing securities on issue which enables the issuer to extend their maturity.
- Having at-call or short term loans outstanding to other entities which can be called to provide cash when needed. The risk here is that such loans involve counterparty risk – and calling such loans may increase the likelihood of default if there is widespread stress in the financial market. Often, such loans may be collateralized by marketable securities pledged by the borrower against the loan (such as via a loan made as a reverse repo). This reduces the risk of the borrower defaulting, but leads to potential exposure to market risk if default occurs and the value of the security has declined. Consequently, ensuring that margin requirements are continually met and the value of collateral maintained above the loan value becomes an important operational requirement.
- Having sufficient credit rating and standing with potential counterparties to be able to borrow at short notice in inter-bank markets. This is an important component of daily liquidity management in which banks with projected surpluses and deficits in their desired settlement account balances at the Central Bank trade with each other to correct those imbalances.
- For banks, the ability to access “Lender of Last Resort” loans or use discount window facilities at Central Banks provide further potential, albeit costly, sources of liquidity.
- Table 2 provides more detail on potential sources of “funding liquidity”

TABLE 2: POSSIBLE SOURCES OF FUNDING LIQUIDITY

- deposit growth
- the lengthening of maturities of liabilities
- new issues of short- and long-term debt instruments
- intra-group fund transfers, new capital issues, the sale of subsidiaries or lines of business
- asset securitisation
- the sale or repo of unencumbered, highly liquid assets
- drawing-down committed facilities

- borrowing from the central bank's marginal lending facilities.

Source: Basel Committee: BCBS144

Liquidity risks can arise from specific individual products or business lines, meaning that an overall framework is required for total liquidity management. Some of these risks can arise from contingent commitments – which may be contractual or non-contractual (where the reputational costs of not meeting that commitment are sufficiently severe as to make them effectively contractual). Liquidity risks and credit counterparty risks are inherently interrelated, and liquidity risk can easily transform into solvency risk for an institution.

Some questions which financial institutions need to address in examining their liquidity management arrangements include the following:

- How is liquidity risk of new (and existing) products to be measured?
- What liquidity risk costs should be incorporated into the funding costs of products (and how do internal systems achieve this – see Chapter 15)?
- How are all potential liquidity risks (such as contingent commitments and lines of credit provided) appropriately incorporated into centralized liquidity planning and management?

For Central Banks and Prudential Regulators, questions which warrant attention include:

- What are the appropriate structures for liquidity support facilities which Central Banks provide to individual institutions (lender of last resort, rediscount window etc)?
- How should system liquidity management techniques be designed (such as use of securities lending v repos; allowable collateral etc)?
- Can liquidity creation outside the banking sector and based on activities such as repos and securities loans be adequately controlled by use of traditional Central Banking weapons?
- What are some possible early warning signs of institutions facing liquidity problems? Table 3 provides some suggestions.

TABLE 3: EARLY WARNING INDICATORS

- rapid asset growth, especially when funded with potentially volatile liabilities
- growing concentrations in assets or liabilities
- increases in currency mismatches
- a decrease of weighted average maturity of liabilities
- repeated incidents of positions approaching or breaching internal or regulatory limits
- negative trends or heightened risk associated with a particular product line, such as rising delinquencies
- significant deterioration in the bank's earnings, asset quality, and overall financial condition

- negative publicity
- a credit rating downgrade
- stock price declines or rising debt costs
- widening debt or credit-default-swap spreads
- rising wholesale or retail funding costs
- counterparties that begin requesting or request additional collateral for credit exposures or that resist entering into new transactions
- correspondent banks that eliminate or decrease their credit lines
- increasing retail deposit outflows
- increasing redemptions of CDs before maturity
- difficulty accessing longer-term funding
- difficulty placing short-term liabilities (eg commercial paper)

Source: Basel Committee: BCBS144

Liquidity Risk Disclosures

Since liquidity risk of a bank is important, there is an argument that disclosures should be made which enable investors to assess the extent of such risk. On the other hand, the potential for bank runs suggests that there needs to be care taken in the form and nature of disclosure to avoid increasing such risk.

The Basel Committee provided a list of possible disclosures shown in Table 4. Since that time, APRA has mandated liquidity risk disclosure by those Australian banks which operate under the Liquidity Coverage Ratio (LCR) requirement (explained later). Much of that disclosure relates to data showing how the banks are complying with the LCR and Net Stable Funding Ratio (NSFR) requirement, and minimum requirements are set out in Attachment F of APS 330. However, the banks are also encouraged to disclose information about their exposures to, and management approaches to, liquidity risk, and each of the banks provides some such information in the Basel Capital and Risk Disclosures found on their websites – although in some cases it does not go very far beyond reporting the numbers required for LCR and NSFR calculations! (NAB's Liquidity and Funding Risk Management Framework, for example, is described (briefly) on page 60 of its 2020 full-year pillar 3 report).

TABLE 4: POSSIBLE LIQUIDITY RISK MANAGEMENT DISCLOSURES

the aspects of liquidity risk to which the bank is exposed and that it monitors
the diversification of the bank's funding sources
other techniques used to mitigate liquidity risk
the concepts utilised in measuring its liquidity position and liquidity risk, including additional metrics for which the bank is not disclosing data
an explanation of how asset market liquidity risk is reflected in the bank's framework for managing funding liquidity
an explanation of how stress testing is used
a description of the stress testing scenarios modelled
an outline of the bank's contingency funding plans and an indication of how the plan relates

to stress testing
the bank's policy on maintaining liquidity reserves
regulatory restrictions on the transfer of liquidity among group entities.
the frequency and type of internal liquidity reporting
Source: Basel Committee: BCBS144

Bank Liquidity Management Theory

It is possible to find theoretical models of bank liquidity management as far back as Edgeworth (1888)[5]. The approach adopted there and in subsequent papers was to view liquidity management as a trade-off between the opportunity cost of holding lower yielding liquid assets (to meet possible deposit outflows) and the penalty incurred if outflows exceeded available liquid assets. The penalty could be thought of as the cost of last resort loans from the Central Bank, or the need to borrow from other banks at higher interest rates, or to sell some assets at discounted prices. A formal analysis uses the following notation: f(X) is the probability distribution of deposit outflows (X); D is total deposits; R is liquid assets (reserves) held; r is the excess of the yield on loans over holding liquid assets; and p is the penalty per unit of shortfall of liquid assets relative to withdrawals. A risk-neutral bank will choose R such that the marginal cost (r) of an extra dollar of reserves equals the expected marginal benefit. That latter amount is p x prob(X>R) = $p\int_R^D f(X)dX$. The optimal level of liquid asset holdings X can be determined from solving r = $p\int_R^D f(X)dX$ once f(X) specified, and various comparative static results can derived.

A number of immediate results follow from this simple model. First, the more volatile are outflows, the higher will be reserve holdings. Second, the higher the interest rate available on reserves the greater will be the amount held (particularly relevant given the "Quantitative Easing" experience of recent years. While the US Fed has purchased large amounts of assets, the reserves this has injected into the system have been held by US banks – rather than leading to increased credit expansion). Third, the penalty cost of accessing the LOLR may include more than just the interest cost but a reputation effect, and in the GFC in some jurisdictions the nature of Central Bank liquidity facilities impeded use of such borrowings. Fourth, the penalty cost could be contingent on the state of the financial system, such that in good times individual banks underestimate the credit spread costs of raising wholesale funds or discounts required to sell marketable assets in a crisis – leading to inadequate holdings of liquid assets. This was arguably the case in the GFC and provides some rationale for liquidity regulations imposed since then.

[5] Edgeworth, F.Y., 1888, The mathematical theory of banking, Journal of Royal Statistical Society 51, March, 113-127.

19.7 Banking Sector Deposit and Liquidity Creation

There is an important feature of bank liquidity creation at a banking system level. Because bank deposits are used as money (most payments taking the form of transfers from the bank account of the payer to the account of the payee) a loss of deposits by one bank does not necessarily mean a loss of deposits by the banking system as a whole. (Even when the payee invests the proceeds in some non-bank financial institution (NBFI), for example, that leads to an increase in the NBFI deposit with its bank). The banking system will only lose deposits when: (a) the depositor withdraws cash from the bank (and that is not redeposited in some bank by a subsequent recipient); (b) the payee is the government which uses the RBA as its banker; (c) the payee uses the funds to purchase a security from the central bank; (d) the payee uses the funds to reduce loans outstanding to its bank.

Even if the payee is a foreigner there will be no change in bank deposits unless the Central Bank]intervenes in the foreign exchange market to prevent a freely floating exchange rate. The reason is, put simply, that to make a payment to a foreigner the payer will need to buy foreign currency from some other party who will place the AUD amount received in their bank account. (In reality, the process is obviously more complex than this involving the banks as intermediaries in the foreign payments process – but the outcome is essentially the same).

These system–wide effects are also relevant for understanding the link between aggregate bank lending and the scale of bank balance sheets. When a bank approves a loan it effectively "writes up" both sides of its balance sheet temporarily as follows. The borrower's loan amount is a bank asset, and the borrower draws the loan by offering a liability of the bank (via cheque or electronic transfer) to another person. If the borrower's counterparties were customers of the same bank, then their deposits would increase, and the bank would have an equal increase in both assets and deposit liabilities. More likely, however, where the counterparties were customers of other banks, it would be the other banks whose deposits increased and this would be matched by a transfer of cash from the original lending bank to those other banks. (This occurs via transfers between the Exchange Settlement Accounts held by banks at the Reserve Bank). Banking system deposits would have increased by the same amount of the initial loan.

If all banks went on a lending spree, would the process have a limit, or would bank deposits in aggregate keep expanding to finance their lending? No, because all banks would find their cash holdings relative to deposits shrinking (because of the increase in the latter). This creates a liquidity risk for each that they might find themselves with net deposit outflows that they had insufficient cash holdings to be able to meet. But potentially the growth in lending and deposits arising from a burst of "animal spirits" among bankers could be much more than desired from a macro-economic or system stability perspective (particularly if the loan quality was declining). And the process

operates in reverse if bankers reduce loan outstandings due to pessimism, amplifying the credit contraction and leading to economic slowdown.

The "Money Multiplier"

The "macro" analysis above was reflected in the historical popularity of the "money-multiplier" approach to determination of the money supply (which has long since fallen out of fashion). Defining the money supply (M) as cash held by the public (C) plus their bank deposits (D), a relationship could be derived between M and "base money" (B) which equalled bank cash reserves (R) plus (C) – ie liabilities of the Central Bank. By assuming that the public's cash/deposit holdings c =(C/D) were a constant, and that bank reserve ratios r = R/D) were constant, some simple algebra leads to the money multiplier relationship:

$$M = \frac{(1+c)}{(c+r)}B$$

This simple model (or identity) suggests that the Central Bank can control the money supply by controlling the stock of base money through open-market operations – if c and r are constant. In practice, those assumptions don't hold, but the relationship does provide insights into major determinants of bank deposit changes. It also reinforces the point that, while bank lending may create deposits (as outlined above), that process will be constrained by either a limited supply of base money and bank reserves and willingness of banks to operate with lower reserve ratios (r).

As well as macro-economic concerns about the role of bank lending in contributing to or amplifying business cycles, bank liquidity issues are also a concern for systemic stability systems. In particular, banks faced with significant deposit outflows and a liquidity crisis may be forced to engage in "fire sales" of marketable securities, pushing down market prices of such securities and, via losses incurred, running the risk of a liquidity crisis becoming a solvency crisis. (Calling in loans from customers, can have similar effects by prompting defaults and losses for the bank where the underlying collateral is insufficient to meet the promised loan repayment).

Measuring Liquidity Creation

Given that liquidity creation is generally recognised as one of the key functional roles of banks, obvious questions are: how do we measure the amount of bank liquidity creation at any point in time; how does it vary between banks and what do such variations imply; how does it vary over time; how have regulations affected the amount of liquidity creation? Perhaps because "liquidity" is a somewhat amorphous concept, and not necessarily independent of economic conditions, there had not been much attention paid to these empirical questions until a study by Alan Berger and

Christa Bouwman (RFS, 2009). Since then a number of studies have used variants of their approach and developed alternatives[6] to try and answer some of those questions posed above.

Berger and Bouwman's approach can be illustrated as follows.

- Classify all bank balance sheet and OBS positions as liquid, semi-liquid, illiquid based on product category ("Cat") and maturity ("Mat")
- Assign weights to activities:
  - Assets: illiquid = ½ ; semi-liquid = 0; liquid = - ½
  - Liabilities: liquid = ½, semi-liquid = 0; illiquid = - ½
  - Off-balance sheet: illiquid guarantees = ½
- Combine bank activities according to liquidity weights.

For example, a position of an illiquid asset financed by a liquid liability would get a score of 1 indicating maximum liquidity production, whereas an illiquid asset financed by an illiquid liability would score 0 indicating no liquidity production.

They find, *inter alia*, much liquidity created off-balance sheet, largest banks create most of liquidity (in USA), some positive correlation between liquidity creation and bank M/B ratios.

Bai et al (JF, 2018) adopt an approach in which the individual bank liquidity measure term Liquidity Mismatch Indicator (LMI) can be aggregated to provide a sector wide measure relevant for macro-prudential policy. Whereas the weights used in B&B are time invariant, the Bae et al weights incorporate measures of market liquidity and liquidity premia which vary over time. They find that banks with high liquidity underperform (in stock market terms) during stable periods but not in crisis periods. The LMI index is calculated by assuming that counterparties (on both sides of the balance sheet) act to extract the maximum cash possible in a time of crisis, and is a "liquidity weighted" sum of asset and liabilities. The weights reflect this assumption and also that the bank will determine its liquidity position optimally.

19.8 How does the Australian system liquidity approach work?

Current arrangements date from 1997, although there has been a very significant change to arrangements since March 2020. Before 1997 a special group of authorised short term money market dealers acted as intermediaries between the RBA and others. That system also involved complex "float" arrangements (the timing of debits and credits due to deferred settlement) creating a number of complications for short term system liquidity management by the RBA.

Fundamental to the operation of the Australian financial system are the r*ole of ESA (Exchange Settlement Account) balances and the target cash rate*[7]

[6] One such approach was proposed by Brunnermeier et al (NBER, 2009. This has been applied by Bai et al (JF, 2018),

ESA's are the transactions accounts held by banks (and some others) at the Reserve Bank through which settlements with other banks arising from the operation of the payments system are made. Transactions of customers with the government (tax payments etc) which uses the RBA as its banker will also impact a bank's ESA, as will transactions by the bank (or its customers) with the RBA (such as purchases or sales of government securities). Those types of transactions (with government and the RBA) will lead to changes in the aggregate level of ESA balances. Only banks and some others have ESA accounts (ultimate liquidity) with the RBA. Other NBFIs (including smaller ADIs such as credit unions) have bank deposits as their transactions accounts.

ESA balances are in aggregate something of a "closed system". Transactions between banks simply redistribute the existing stock of ESA balances between the banks. Similarly if a bank customer makes a payment to a customer of another bank via electronic means or cheque, the credits and debits to those customer bank accounts lead to interbank transfers of ESA balances. However if a bank customer decides to hold more notes and coins rather than bank deposits ESA balances are likely to decrease – with the composition of RBA liabilities changing to be less ESA balances of banks and more notes and coins on issue. The word "likely" is used above because the outcome will depend upon how banks react to an outflow of notes and coins. If they seek to replenish their cash holdings then they will receive that cash from the RBA with payment made by a reduction in their ESA balance.

The other potential "leakage" from the system is if the RBA intervenes in the foreign exchange market to affect the exchange rate. If, for example, it buys USD from a bank, it will credit the bank's ESA with AUD. But FX transactions between members of the private sector (banks and others) simply affect ownership of the stock of ESA balances. The buyer of USD will make AUD payment to the seller involving a debit (credit) to the buyer's (seller's) AUD bank accounts and an exchange of ESA balances between the two banks involved.

The RBA sets its target cash rate at its monthly Board meeting (1st Tuesday of each month) based on its macroeconomic analysis, as the key instrument of monetary policy. The cash rate is the rate at which banks lend ESA funds unsecured to each other overnight. Bank ESA accounts at the RBA are used for interbank settlements resulting from the pattern of payments flows in the economy. The structure of interest rates paid on ESA and charged for ESA "overdrafts" has historically (until March 2020) ensured that actual cash rate varies hardly at all from the target rate. The RBA calculates and

[7] See here for a discussion of RBA market operations and this RBA article which explains the importance of the "interest rate corridor".

reports the actual cash rate as a weighted average of the lending transactions which occur. The cash rate has served as an "anchor" for the entire term structure (yield curve) of interest rates, with longer term and private sector rates generally responding to movements in the cash rate (or to changes in how the market expects the cash rate will change). Figure 2 shows the relationship between the cash rate and the 90 day bill yield

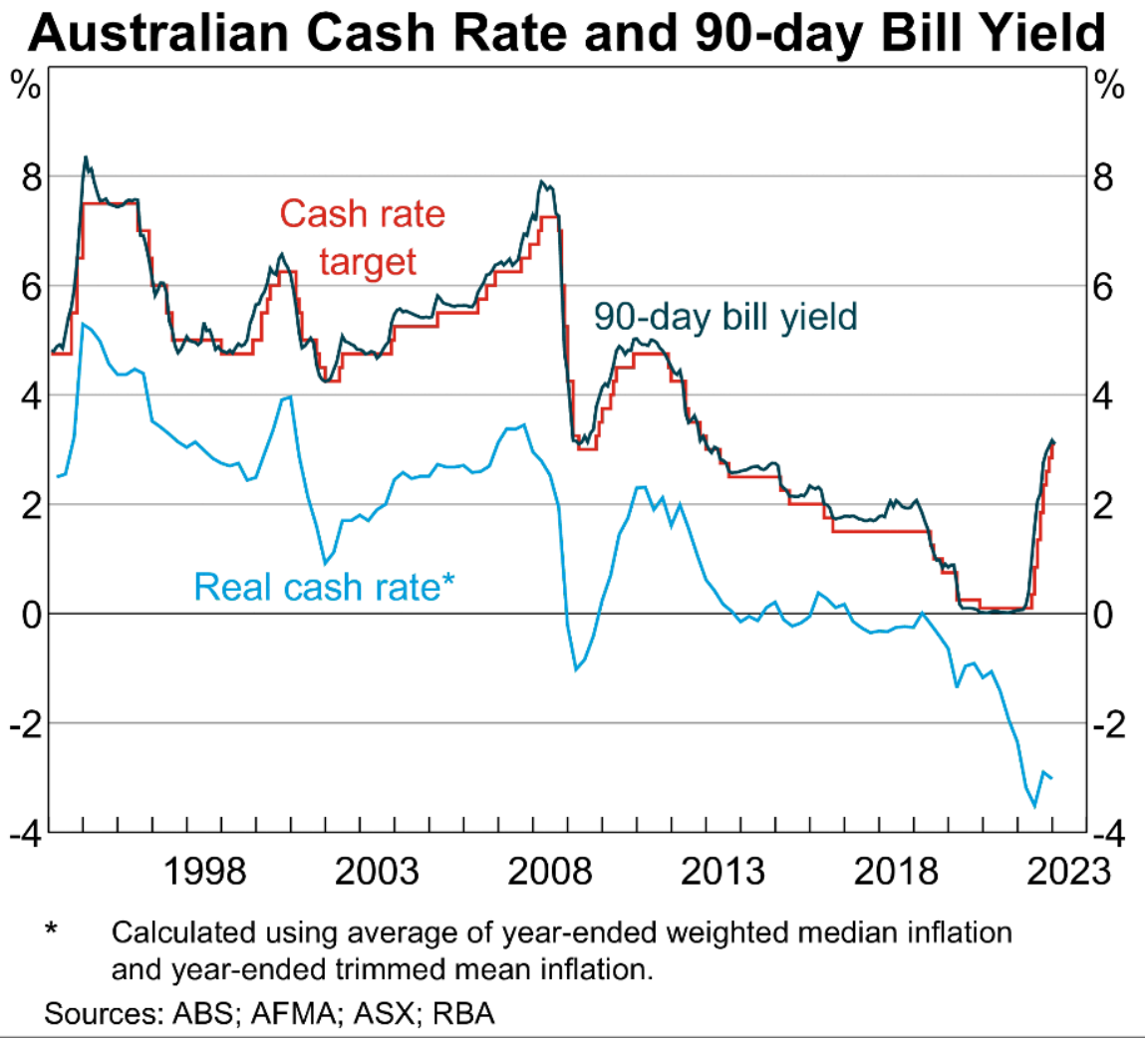

FIGURE 2: SHORT TERM INTEREST RATES (SOURCE: RBA CHART PACK)

The RBA makes a daily morning projection of expected net settlements during the day– ie the expected change in ESA funds arising from settlement between the RBA and banks of transactions. (Prior to changes in November 2013 these were changes arising from previous day low value transactions which were batch settled at 9.00am. Since then "direct entry" transactions are settled in batches during the day and overnight, as explained in this speech by the (then) Assistant Governor (Financial Markets) Guy Debelle.)

Relevant "exogenous" transactions which change aggregate ESA balances are:

- government transactions with the private sector (taxes, expenditures) – the RBA is the government banker
- governmentt bond issues and redemption of maturing bonds
- RBA FX transactions
- currency demand
- unwinding of past RBA repos

Generally there is a system cash deficit (ie ESA balances would fall without RBA action) and the RBA makes announcement at 9.30 of intended repo transactions (market operations), inviting bids from the private sector to sell government (or other) securities to the bank in exchange for credits to bank ESA balances. It makes further announcements of dealing intentions during the day if its forecast of the aggregate flows needs adjustment.

High value interbank transactions are settled on a real time gross settlement (RTGS) basis during the day.

For each bank there is a need to manage its ESA (cash) position. Based on knowledge of likely interbank and "exogenous" transactions banks can forecast their likely end of day ESA position. If a deficit is projected, they will want to participate in RBA repo tenders (selling securities to the RBA) to obtain cash (ESA funds). But they also need to manage their daily ESA balance. The RBA has a number of arrangements which facilitate that (as follows).

- In general, (until March 2020) ESA balances pay the target cash rate minus 25 bp. (Since November 2013 some agreed small "buffer" of ESA funds to meet intraday payments receives the cash rate). Overnight borrowings from the RBA involve a charge of the cash rate plus 25 bp. This "corridor" (-25bp, + 25bp) gives an incentive for banks to borrow/lend ESA funds among themselves overnight and keep actual ESA balances as low as possible.
    - Because the RBA adjusts the supply of ESA balances to meet projected aggregate needs, competition between banks as lenders/borrowers keeps the actual rate roughly (virtually) equal to the target cash rate. This is partly conventional – and reflects the small number of parties each likely to be on the opposite side of a transaction in the future and thus there being limited long term gains from hard bargaining.
    - The November 2013 changes increased the preferred size of bank end of day ESA balances from around $1 billion in aggregate (but with a big spike in demand in the GFC – for which the RBA increased supply to accommodate) to around $20-30 billion. Figure 3 shows the spike, but also indicates how trivial that was compared to the massive increase in bank ESA balances from 2020 till 2023. This arose from those changes involving direct entry transactions being settled on a net basis in batches during the day and overnight rather than in one batch settlement the next morning. Batch amounts to be settled after banking hours are not known when interbank cash market closes.

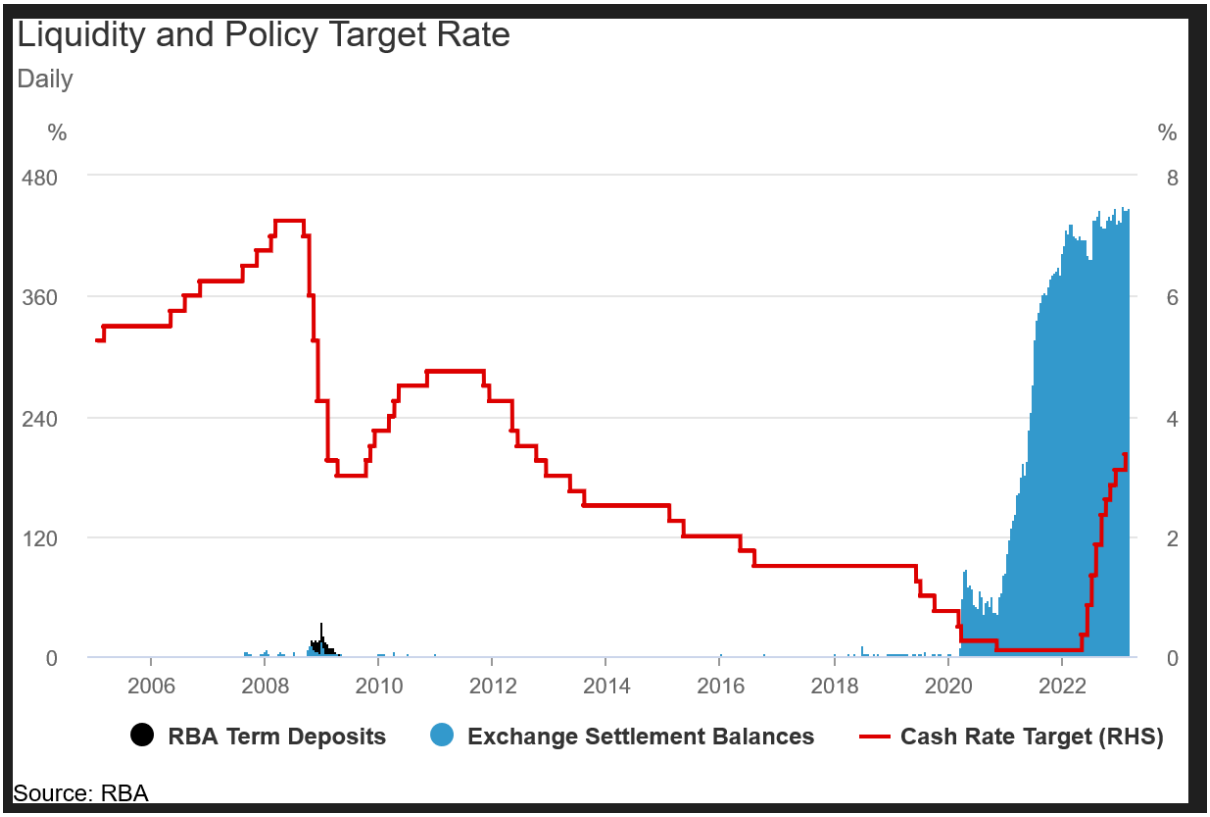

FIGURE 3: SURPLUS ESA BALANCES

- During the day, the pattern of settlements for an individual bank could see it gain or lose ESA funds temporarily. That can be managed by doing "open" repos with the RBA to obtain ESA funds. The RBA sets a pre-determined maximum amount of open repos for each bank. Such open repos and any matching holdings of ESA funds both use the cash rate – so there is no penalty from borrowing via repo and holding proceeds in an ESA. ("Adjusted ESA balances" = actual balance minus open repos at the cash rate, were little changed from actual ESA balance prior to Nov 2013 changes). But if the repo is left in place overnight the borrowing cost on the amount in excess of ESA balances is the cash rate plus 25 bp.

Repo Transactions (Until March 2020)

For the morning "auction/negotiation" – the RBA indicates quantity and maturity preferences. Data on outcomes are shown in RBA Bulletin Statistics (Table A3) – there were different repo rates for general (government) v other collateral up until changes in Nov 2013, since when no distinction is made between type of collateral in dealing intentions. (Different repo margins do apply).

Originally acceptable collateral was only Australian Government and Semi-Government securities, AAA Supranational debt was allowed from 2000, and foreign governments, bank bills and CDs (of third parties) acceptable from 2004. Marked expansion of allowable collateral occurred during the GFC. This included: ADI debt > 12 month from mid Sept 2007 (with a haircut of 9%); RMBS/ABCP (AAA/P1 rating) if >90% full doc mortgages, from third parties (haircut 10%+); "Self securitisations" were permitted in 2008. The range of maturities of repos was also expanded markedly. Whereas

previously RBA repos were generally quite short term, the range was expanded out to 9 months or more.

AOFM Securities lending facility

The AOFM will lend specific CGS to the RBA which will then repo that security against a repo from a dealer using general collateral (any CGS) with dealers (ie the dealer gets a specific CGS in exchange for any CGS). This enables dealers to make two way markets in specific CGS. But the Repo rate on specific CGS = cash rate - 300bp versus repo rate on general collateral = cash rate, ie a significant penalty for dealer. A safety valve but with strong incentive not to use.

The March 2020 changes and implications over 2020-2021

For many years, the financial markets have focused on the monthly announcements of the RBA regarding its cash rate target, with market indicators such as the Overnight Indexed Swap (OIS) rate reflecting market expectations of what, if any, changes the RBA would make. The actual cash rate (the rate paid and received between banks for overnight borrowing and lending of Exchange Settlement Account (ESA) balances held at the RBA) never deviated from the RBA's announced target.

Things have changed markedly since the RBA broke with "tradition" and announced an out-of-cycle change in the cash rate (from 50 bp to 25 bp p.a.) on March 20. The nexus between the target and actual cash rate has broken. Within three weeks the actual cash rate (calculated by the RBA as a weighted average of actual transactions) had fallen to the 13-14 bp range (with very few transactions outside that range). And often there were insufficient transactions in the overnight market to calculate a reliable average cash rate figure. The same pattern persisted when the RBA subsequently reduced the cash rate to 10 bp. Figure 4 shows, *inter alia*, the OIS30 day rate which reflects market expectations of the average cash rate over the next 30 days – and that initially stabilised at around 13-14 bp p.a., before dropping to around 3 bp when the cash rate target was reduced to 10bp.

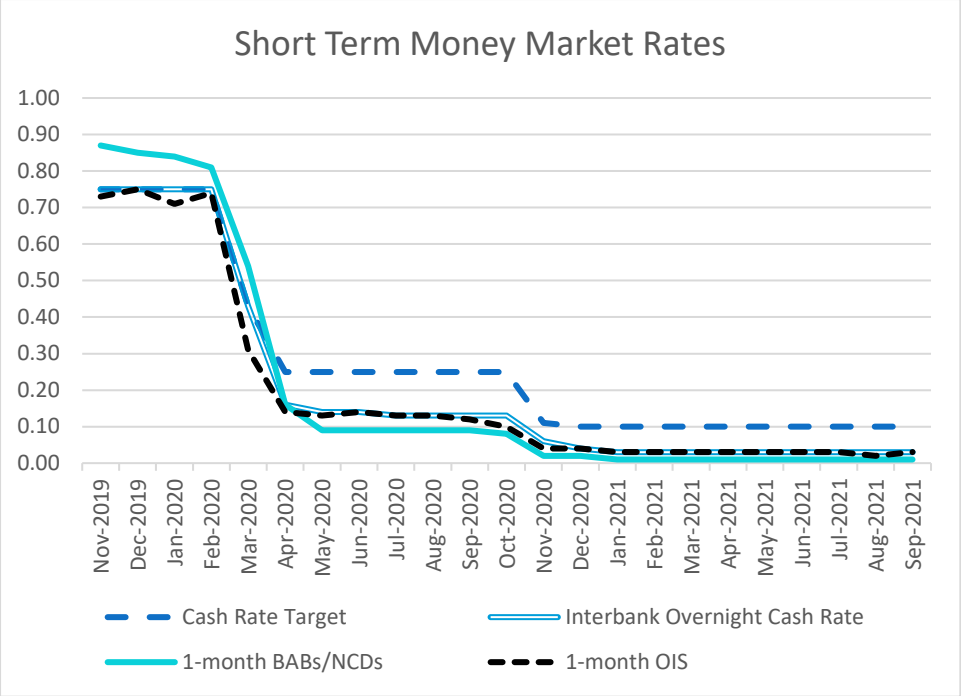

FIGURE 4; AUSTRALIAN MONEY MARKET RATES (SOURCES: RBA STATISTICAL TABLES F1)

What has also changed is the behavior of the banks' ESA balances, which are their "cash" holdings for meeting and receiving payments to and from other banks – and borrowed and lent between them at the actual cash rate. Since late 2013 the total of ESA balances for all banks was generally around $25-30 billion. The total soared to a peak of over $100 billion in April, since declining to be in the region of $60 billion (more than double pre-March levels).

So, the obvious questions are: why has this happened, does it make the cash rate virtually irrelevant, and if so, is that a temporary crisis situation or more permanent?

The causes of these developments can be traced to several main factors. (Speeches by senior RBA officials, Debelle and Kent provide information). First, the increase in liquidity (reflected in the higher ESA balances) means that banks have less need to borrow cash in the interbank market, reducing the interest rate they are willing to pay. But in years past, the RBA would have used its market operations (selling government bonds via repurchase agreements) to withdraw that liquidity from the market, reducing ESA balances, until the actual cash rate met their target rate.

So, the second component of the explanation must lie in some changes in the RBA behaviour. And there have been several which are explained in this 2021 speech by Deputy Governor Debelle. One is a change in the interest rate the RBA pays banks on their ESA balances. Previously it was the cash rate less 25 bp, which under the target of 25 bp would have meant a zero rate. But the bank initially changed that to a flat rate of 10 bp, which meant that the actual cash rate had a floor of 10 basis points – why lend surplus funds to another bank at less than 10 bp when you can get a rate of 10 bp

from the RBA? In November 2020 when the cash rate target was lowered to 10 bp, the interest rate on bank's surplus ESA balances was reduced to zero. The actual cash rate has sat below the 10 bp target at around 3 bp in 2021 (on the relatively few days when there have been any transactions in the overnight market).

But that still doesn't explain why the RBA doesn't soak up the excess liquidity to get the actual cash rate up to its "target". A major reason is the uncertainty created by the Covid-19 Crisis. There have been large injections of liquidity into the economy by Government support measures and in those conditions the RBA has felt it appropriate to maintain a high level of system liquidity. Two other changes are also relevant here.

One is the decision to also adopt the same "target" as the cash rate target for the yield on 3 year government bonds. And therein lies an immediate problem of two targets and one instrument! If there is any underlying tendency for the 3 year bond rate to go above the target, the RBA needs to buy bonds from the market – increasing their price and lowering their yield, and injecting liquidity into the market.

Is it likely that a target of the same rate for the cash rate and three year bonds is consistent with underlying economic forces? Maybe – in the Covid crisis circumstances there are too many uncertainties to be definitive, and the RBA is influential in affecting financial markets! Pre-crisis though, the 3 year bond rate has tended to lie above the cash rate (although sometimes below) in the order of 15-20 basis points over the last five or so years. So it is hardly likely that scoring a bulls-eye on both targets is possible and that something has to give – in this case achieving the cash rate target. When the 3 year bond rate target was 25 bp, the actual cash rate sat at around 13-14 bp – just above the effective floor for the cash rate of 10 bp points (which was the rate paid on ESA balances). When the target was changed to 10 bp, the actual cash rate sat at around 3 bp. This 7 bp spread is quite a bit lower than the historical average bond-cash yield spread of 15-20 basis points.

In addition, the RBA has also adopted a different focus in its targeting of short term interest rates. As explained in the August Statement on Monetary Policy, the focus of the RBA has turned to stabilizing the repo rate – the interest rate at which banks borrow short-term funds (ESA balances) from the RBA by a sale and repurchase agreement involving government securities. Since late April 2020, when the cash rate target was 25 bp that rate stuck steadily at 18 basis points before falling in November 2020 to stick at the same 10 bp figure as the cash rate target.

To achieve that, the RBA has suspended its prior practice of effecting sufficient OMO transactions (mainly via repos) to achieve its target liquidity consistent with the target cash rate. Up until the start of March its actual daily dealings were typically (with a few major exceptions) the same as (or

within a couple of percent of) its announced intentions at the start of the day. Those announced intentions were calculated to change aggregate liquidity to a level consistent with bank cash market demand and supply equilibrating the actual cash rate at the bank's target level.

But from March 2020 onwards, the reverse has happened. Announced daily intentions of the amount to be dealt are hardly related at all to actual dealings. Indeed, since April 2020 till July 2021 the announced "intended" amount has been stuck at $1 billion each and every day, and the actual amount has varied all over the place (but substantially less most of the time in 2021). Rather than fixing a quantity to be dealt, the quantity dealt has been varied such that the repo rate (the interest rate at which banks are borrowing from the RBA using the repo mechanism) has remained constant at initially 18, and since November 2020, 10 basis points.

Why the shift in approach? One reason may be that the RBA deals in repos for its market operations at varying maturities, mostly between one and three months since the shift. By allowing demand to determine the volumes traded at different maturities, they are stabilizing the repo rates (which can be regarded as risk free rates) over that range of maturities. In contrast, the cash rate is for the shortest maturity possible (overnight) and the link between it and longer term rates is likely to have become tenuous in the current crisis.

Reflecting the change in approach (and market conditions) the relationship of the 30 day bank bill rate to the cash rate has changed markedly as shown in Figure 4.

The availability of cheap repo financing, and surplus liquidity, has led to very cheap short term borrowing rates for banks in the market. In fact the 30 and 90 day bill rates (which should incorporate some default risk premium) have been slightly below the equivalent term OIS rates (which are risk free rates)!

One complication influencing these various rates is the impact of the Major Bank Levy (of 6bp). The base for the levy is all liabilities other than non-insured deposits, with bank ESA holdings also deducted in calculating the levy base. The MBL means that the cost of raising funds such as via bank bills of CDs is 6 bp pa higher than the rate paid which makes the overall cost marginally below the RBA repo rate. It is unclear exactly what the effect of the MBL is on the cost of funds raised by way of RBA repo. For a bank borrowing by means of a repo with the RBA, the MBL has, in the first instance, no effect – since the additional borrowing will be offset by the funds received generating an increase in ESA holdings in calculating the levy base. However, once those funds are used for loans, and if this leads to a decline in the bank's ESA balances, then the repo borrowing adds to the MBL base. But since another bank then gains an increase in its ESA balances, the system level of ESA

balances has increased as a result of the repo transaction, so no aggregate increase in the MBL base has occurred. How this plays out in aggregate is not clear.

Similar issues arise in the context of overnight cash rate lending. A lender of ESA balances will experience an increase in the MBL base (as a result of no longer having those balances), while the borrowing bank will have no MBL base change – since its increased borrowings are matched by the increased ESA balances. This change in the MBL base simply reflects the consequences of increased inter-bank borrowing rather than being a peculiar feature arising from the role of ESA balances. (If, for example Bank A lent to bank B which also lent to bank A, the MBL base would increase since it is based on a gross, rather than net, debt calculation).

So, the RBA had not needed to drop the cash rate to zero to achieve lower short term funding costs for the banks. It has achieved essentially the same outcome via its change in operating procedures and targeting the repo rate – at the cash rate "target".

The reversal of cash rate policy in 2022

In 2022 the RBA, worried by a surge in inflation and the possibility of excess demand, embarked on a series of increases in the cash rate. (It also ceased its program of purchases of longer term bonds aimed at keeping longer term interest rates low). At its May meeting it increased the target cash rate from 0.10 per cent to 0.35 percent. Subsequent increases during the year saw the cash rate reach 3.10 per cent by end 2023, with a further increase to 3.35 in February. The number of actual overnight interbank cash rate transactions remained very low, since most banks had high levels of liquidity, reflected in the extremely high ESA balances shown in Figure 3. For the larger banks their Liquidity Coverage Ratios (LCR) declined slightly over 2022, but remained well above the minimum requirement of 100 at 132 in September 2022. (And this was occurring at the same time as the Committed Liquidity Facility (CLF) was being phased out). Likewise, smaller institutions subject to the Minimum Liquid Holdings (MLH) minimum requirement of 9 per cent experienced a slight decline but remained at almost double that minimum.

19.9 Basel Liquidity requirements

The liquidity regulations introduced as part of Basel 3 as implemented in Australia are summarised here and here. There are two main components, the LCR and the NSFR applying to larger banks. For smaller banks and ADIs there is a simpler approach known as the Minimum Liquidity Holdings (MLH) approach which is outlined first.

MLH regime

The Basel standards provide for Alternative Liquidity Arrangements, and flexibility of regulators to adopt alternative approaches for non-internationally-active banks. In Australia smaller ADIs operate under the Minimum Liquidity Holding (MLH) regime. For this their holdings of HQLA must exceed 9% of "Liabilities" (on-balance sheet liabilities (including equity) and irrevocable commitments, less the capital base). (This is roughly equivalent to 9% of assets). Over the last 15 years, the average MLH ratio has been in the order of 15%, increasing in 2021 to around 20% (APRA's QADI statistics provide information).

HQLA for the MLH approach is defined somewhat differently to that for the LCR approach and comprises: (a) cash; (b) securities eligible for repurchase transactions with the Reserve Bank; (c) investment grade bank bills and CDs issued by ADIs (d) deposits (at call, within two business days) held with other ADIs net of placements by the other ADIs; (e) any other securities approved by APRA.

It is worth noting that compared to the LCR regime: (a) the maturity structure of liabilities is not considered; (b) the MLH approach provides a greater range of eligible liquid assets – many of which will pay higher returns than the HQLA allowable under the LCR. Thus a smaller institution may be disadvantaged by liquid asset holding requirements relating to both long and short term liabilities, but advantaged by the greater range of liquid assets permitted.

Liquidity coverage Ratio (LCR):

The original January 2013 Basel document introducing the LCR is *bcbs238.* A summary description of the LCR is provided here.

The LCR requires banks to have adequate HQLA (High Quality Liquid Assets) to withstand a stress scenario – and avoid fire sales of private sector securities which can drive prices down and create price-margin spirals. Only HQLA (in Australia, limited to government securities) are seen as suitable securities in this regard.

The Basel Committee has developed requirements based on a 30 day stress scenario (using GFC experience) which was announced in December 2010 and revised in January 2013. International phase-in requirements involved meeting a level of 60% of the requirement by January 2015 increasing to full compliance by January 2019. In Australia, APRA specified that full implementation would commence in January 2015.

The specific LCR requirement is that:

$$\frac{Stock\ of\ HQLA}{Total\ net\ cash\ outflows\ over\ next\ 30\ calendar\ days} \geq 100\%$$

Annex 4, of bcbs238 defines the various categories of eligible HQLA (as shown below) and imposes limits on the use of certain types of HQLA assets, and specified that the value of certain assets used in the calculation should be given "haircuts". (For example, a covered bond with a value of $100 would only be included in the calculation to a value of $80, reflecting a haircut of 20%). The HQLA must be *unencumbered* such that there are no restrictions on using it to obtain cash.

HQLA 1 – cash, central bank deposits, government securities

HQLA 2A – Multinational agency bonds with 20% risk weight, corporate bonds rated AA or above, covered bonds: allowed up to 40% HQLA with haircut of 20% applied

HQLA 2B (at national discretion) RMBS rated AA or above, corporate debt (BBB^- - A^+ rating), ordinary (non-financials) shares: allowed up to 15% HQLA (and haircuts)

APRA Prudential Standard 210 is similar to the Basel standard. However, APRA has decided not to recognise HQLA2B assets to be eligible for inclusion. At the time of the introduction of APS 210 this meant that there was a shortfall of CGS & semis (State government securities) available due to past government budget surpluses. Banks held around $180 bill, and would have needed an extra $300 bill to meet the LCR requirement. If banks were required to purchase that amount of securities from the limited stock available, this] would have placed significant pressure on bond prices given demand from domestic and foreign institutional investors. Consequently, the Committed Liquidity Facility (CLF), described below, was introduced as a complement, but has been terminated since 2023 due to increased availability of government debt.

TABLE 5: APRA PRUDENTIAL STANDARD 210 HQLA CATEGORIES

HQLA1	Currency, Central Bank deposits, Marketable securities issued by government or multinational agencies with zero credit risk weight, well-traded, liquid, in same currency as for liquidity calculation	At market value without haircut
HQLA2A	Marketable, well traded, securities of sovereigns etc with 20 % risk weight. Non-financial institution, plain vanilla, corporate debt (including CP) and covered bonds (issued by others) with recognised credit rating of at least AA- and well traded	Maximum of 40 per cent of HQLA in form of HQLA2A + HQLA2B, 15 per cent haircut to market value
HQLA2B	If recognised by APRA, RMBS (subject to 25% haircut) issued by other ADIs with rating of at least AA, traded in deep liquid markets, with underlying mortgages having LVR<80%; Some corporate debt and equity with a 50% haircut.	Maximum of 15 per cent of total HQLA
Committed Liquidity	Prior to abolition of CLF at start of 2023, amount of CLF available to each bank was determined annually by	Qualifying collateral must be RBA repo-

Facility	APRA; amount included is: Min(CLF, assets held as eligible CLF collateral)	eligible, market value and haircuts applied, adjustments applied where bank engages in secured transactions with other counterparties.

A feature of the LCR is that it can fall below 100% during stress period. (This avoids the taxi-rank fallacy[8]).

The stress scenario involves: assumptions about outflows of retail deposits, loss of wholesale funding and short term secured funding, requirements to post collateral if downgraded or from market movements, drawings on liquidity facilities etc. But it also anticipates some inflows and need to continue making some types of loans (eg retail loans – so it only counts 50% of net cash inflow from retail loan repayments.

There is a very detailed list of assumed "run-off" rates given in Annex 4 of BCBS 238, reflecting the diverse range of activities and arrangements with customers made by banks. Most relevant however are: retail deposits and those of small businesses (<30 days) are assumed to have "run-off" rates of between 3 per cent (if insured) and 10 per cent, with no run off for longer term deposits. In contrast, run-off rates for large non-financial corporates are set at 40 per cent, and those of financial institution counterparties at 100 per cent.

Thus $$\begin{matrix} Net \\ Cash \\ Outflows \end{matrix} = \begin{matrix} Expected \\ Cash \\ Outflows \end{matrix} - Min\left[\begin{matrix} Expected \\ Cash \\ Inflows \end{matrix} ; \begin{matrix} 75\%\ of\ Expected \\ Cash \\ Outflows \end{matrix}\right]$$

where the expected amounts are based on GFC experiences.

There are a number of Implications from the introduction of the LCR regime.

One is the pricing of deposits to alternative customer types. Because of the differential liquid asset holding requirements, it can be expected that, via their funds transfer pricing schemes, banks will offer higher interest rates on deposits that are "stickier". Lower deposit interest rates will be offered on less sticky deposits such as from other financial institutions relative to retail rates because of the

[8] The "taxi-rank" fallacy involves an analogy with a town mayor imposing a requirement that no taxi could leave a train station taxi-rank unless there was a second taxi also there. Arriving passengers would then always find a taxi there – but would not be able to leave if only one taxi was there. The analogy is that minimum liquid asset holdings makes that amount unavailable for use as liquid assets.

requirement to hold more lower- yielding HQLA. The effect has been substantial (see Davis and Maddock (AER, 2019) for analysis), with estimates of a differential between rates offered to individuals compared to financial institutions (such as super funds) of 60 bp or more (prior to the near-zero rates during the Covid Crisis).

A second is the nature of deposit terms and conditions. In Australia, it has been traditional for customers to be able to "break" term deposits (ie request early withdrawal) with the only penalty allowed to be charged by banks being non-payment of the full interest which had accrued over the period. Because there was no penalty in terms of principal amount involved, this may be insufficient to prevent customers demanding early repayment of term deposits in a period of crisis. Consequently, there was a need for a change in legislation to allow imposition of notice of withdrawal conditions (eg 31 days) on term deposits while still allowing those deposits to be treated as "basic deposit products" (for which there are no PDS requirements nor special staff training required). ASIC provided relief from the existing legislative requirement in December 2014 (extended in 2016) and many banks have introduced 31 day notice of withdrawal requirements for early withdrawal of term deposits.

Greater use of notice of withdrawal deposits is another consequence. A deposit which requires 31 days notice before withdrawal has a zero assumed run-off rate, thus does not trigger a required liquid asset holding. (Of course, once notice has been given it then falls into the less than 30 day maturity category). The benefit compared to a fixed term deposit is that the latter will automatically roll into the less than 30 day category with the passage of time.

Another effect is upon the demand for and pricing of HQLA. It could be expected that the induced demand for government debt by banks would lead to reduced returns on government debt due to increased competition with other investors and a limited supply. The introduction of the CLF reflects that concern.

Finally, the requirement that some part of a bank's funding be held in low-yielding liquid assets could be expected to lead to an offsetting increase in the yield required on other assets (ie loan interest rates) if the cost of the bank's funding is unaffected. APRA provided an estimate of the impact on loan interest rates to be in the order of a few basis points as shown below.

APRA estimate of cost of Basel 3 LCR/CLF (from RIS statement)

Assume increase in voluntary liquid asset holdings post crisis from $98 to $305 billion, Basel increases that to $435 billion. (Mix of HQLA and assets eligible for CLF)

Cost of carry – liquid asset return less funding cost: 100bp for HQLA, 15bp for CLF assets

$ bill cost then expressed as % (b.p) of liquid assets, and as % of illiquid assets (increase in interest rate required to offset carrying cost. (eg 8.6bp = $1.8bill/illiquid assets). Liquid assets of $435bill = 17% total assets, so illiquid assets = 0.83*$435bill/0.17. (Incremental cost = 2.9 bp)

	Pre-crisis		Without Basel III liquidity		With Basel III liquidity	
	2007 ($bn)	Cost (bp)	2013 ($bn)	Cost (bp)	2013 ($bn)	Cost (bp)
HQLA1	6	100	95	100	135	100
CLF assets	92	0	210	15	300	15
Cost of carry in $bn		0.06		1.26		1.80
Weighted average cost over HQLA in bp		6.1		41.4		41.4
Cost over non-liquid assets in bp		0.4		5.6		8.6
Incremental difference in bp				5.3		2.9

TABLE 6: LCR RUN-OFF ASSUMPTIONS - SUMMARY OF APRA PRUDENTIAL STANDARD 210

Run-off rate (%)	Cash outflow category (for liabilities with actual possible maturity < 31 days)
	Retail cash outflows and qualifying SME deposits
5	Stable deposits (covered by FCS and customer relationship exists)
10	Less stable retail deposits
25	Higher run-off less stable retail deposits (not FCS covered and/or on-line account, rate-sensitive, no customer relationship)
	Unsecured wholesale funding
5	Operational deposit balances fully covered by deposit insurance
25	Operational deposit balances not fully covered by deposit insurance
	Non-operational deposits from non-financial corporations, sovereigns, central banks, PSEs, MDBs and SMEs of greater than AUD 2m:
20 or 40	If fully covered (not covered) by deposit insurance
100	All other non-operational deposits (eg financial institutions)
100	Unsecured debt issuance
	Secured funding
0	Secured funding transactions backed by HQLA1 or CLF eligible debt securities
15, 25, 100	Secured funding transactions (based on quality of collateral and counterparty)
100	· All other secured funding transactions
100	**ABCP, covered bonds, funding exposures to SPVs, conduits etc**
100	**Increased liquidity needs related to derivatives and other transactions** (cash outflows, potential collateral provision needs and calls on collateral held etc)
5 - 100	**Undrawn Committed credit and liquidity facilities** (lowest rates for retail, highest for non-bank financial institutions)
	Other contingent funding obligations
5	Revocable credit and liquidity facilities
Historical Average	Trade finance related obligations (average of recent 12-month period) Non-trade finance guarantees/letters of credit (50% of average) Debt buybacks (10% or 5% for Australian securities)
5	Non-contractual obligations related to structured products and managed funds
Variable	Issuers with an affiliated dealer or market maker Other non-contractual contingent funding obligations (To be set by APRA for each ADI after consultation with the ADI)
100	**Other contractual cash outflows**

Is the LCR well founded?

The approach adopted places the onus for liquidity insurance upon the banking sector and private financial markets. The LCR approach does not envisage the banking system relying (at least initially) upon the safety valve of RBA liquidity provision via repurchase agreements etc. The logic of the approach can be questioned, in so far as it applies to system wide crisis scenarios rather than individual bank difficulties.

Consider a situation in which a liquidity crisis occurs and banks respond by selling their holdings of government securities. Such widespread action will push the prices of those securities down and their yields up, which is unlikely to be a desirable outcome in such a situation from the perspective of the RBA. Consequently, there is likely to be RBA operations in the cash market to inject liquidity by purchasing government debt or by repurchase agreements based on those or other eligible securities.

Consequently, the merits of an approach which assumes that the market can ensure enough liquidity in a crisis situation seems contradictory to the likely outcome, when the only ultimate provider of liquidity – the Central Bank – is likely to have to act. To the extent that this is the case, the exclusion of other repo-eligible securities from the LCR calculation can be questioned. To the extent that the LCR is aimed at ensuring individual bank liquidity adequacy in a time of individual stress, there are also some questions which should be posed. First, are requirements based on a system-wide stress scenario appropriate? Second, the exclusion of a range of private sector assets from the calculation seems less warranted since their values would be little impacted by sales by one bank only.

The dilemma here is that the LCR appears to be one instrument aimed at achieving two objectives – one being individual bank liquidity adequacy in a single-name stress situation and the other being system wide liquidity adequacy in a generalized crisis scenario. A long standing tenet of policy formulation is that at least as many instruments are required as there are objectives if those objectives are to be fully met, rather than being constrained by a trade-off.

Committed Liquidity Facility (CLF) – for banks subject to LCR

The CLF was abolished at the start of 2023, and this discussion is simply to give historical perspective.

The Basel standards permit the use of Alternative Liquidity Approaches (ALA) if a country has inadequate HQLA available to banks to meet the LCR requirements. The options included: a CLF type facility; use of foreign currency HQLA; greater use of level 2 HQLA with increased haircut. But regulators would need to have arrangements in place to limit bank reliance on these rather than HQLA1.

When the LCR was introduced, APRA decided that the only HQLA assets it would accept for meeting LCR requirements were government debt (HQLA1). At the time, there was a substantial shortage of government debt available to banks (given past budget outcomes and high foreign demand for Australian government debt). So a CLF at the RBA was introduced in 2015 and details are provided by Bergmann et al (RBA, 2019) and here.

Under the CLF arrangements, the 14 (or so) banks which operate under the LCR regime have had the ability to meet part of their LCR requirement by having access to a specified amount of RBA short term repo funding for meeting liquidity needs. The aggregate amount of CLF facilities available is determined by APRA and the RBA based on the assessed available supply of HQLA to banks – and the size of the CLF has fallen since it was introduced as government budget deficits have increased the supply of government debt. The total amount is allocated among the banks, based on an assumption that they will meet some minimum proportion of LCR requirements by holdings of HQLA.

For the privilege of having a CLF, banks were initially charged a fee of 15 bp p.a. on the amount available to them. Should they need to access the CLF, the borrowing cost was set equal to the cash rate +25bp. From January 2020 the fee was increased to 17 bp and then again increased in January 2021 to 20 bp. In setting this fee, the bank is attempting to avoid distorting bank demand for HQLA to meet the LCR. Too high a fee would lead to increased demand for government debt and push their interest rates up. Too low a fee would, in a sense, subsidise banks by enabling them to avoid holding lower yielding government debt (rather than other assets). Setting the available aggregate amount of CLF in response to availability of debt and bank buffers for LCR levels aims to balance these forces.

To meet the requirements for substituting CLF for HQLA in calculating their LCR, banks must hold on their balance sheet repo-eligible securities at least as large (including allowances for margins applied if repos occur) as their CLF allocation. The RBA publishes a list of repo eligible securities (and issuers) which includes: foreign government and supra-national authorities, Australian government securities, Bank bill and CD issuers, ADI securities, RMBS, CMBS, ABS, other AAA rated securities, ABCP. Internal securitisations are also repo-eligible and the larger banks have taken advantage of this to parcel up mortgage loans into tranches for securitisations which are held on balance sheet for meeting CLF requirements.

Brischetto and Jurkovic (RBA, 2021) explain why the size of the CLF was reduced over time and fees increased since 2019 in reflection of the larger stock of government debt available as liquid assets to banks, and noting the actual LCR of banks (including large increase in ESA balances) being well above

the required minimum. In 2021, APRA and the RBA announced that the CLF would be phased out and this occurred at the start of 2023.

Effects of the LCR/CLF arrangements

There were a number of issues arising from these arrangements. First, it can be asked whether the process of excluding certain assets (such as RMBS) from LCR eligibility, but then making them repo-eligibility for the CLF, is soundly based? Should a bank have a liquidity problem, then both HQLA and RMBS can be used to access cash. Perhaps the argument is that in a widespread liquidity crisis, if banks undertook fire sales of RMBS into the market, the downward impact on yields could aggravate the situation. However, one might expect that, as it has done in the past, the RBA would intervene to inject liquidity via purchase of such securities via repos. If the liquidity problem only applied to one bank, it could be expected that it would be able to liquidate holdings of RMBS or other assets without disrupting financial markets. So, it is difficult to reconcile APRA's insistence that RMBS and other assets should not be eligible directly for inclusion in LCR calculations, but that they are eligible indirectly via the CLF mechanism.

Second, the repo eligibility of certain securities for the CLF endows them with a liquidity characteristic which other assets do not have. This could be expected to reduce the yields they need to offer. However, at the same time, the requirement that banks hold such securities on balance sheet to match their CLF allocations, reduces the supply of such securities in the market (although self-securitisation may simply reflect a different way of holding loans which were not for sale in any event).

Required Net Stable Funding Ratio (NSFR)

Initially mooted in a December 2010 document (BCBS188) the NSFR was finalised in October 2014.

APRA undertook consultation on the introduction of the NSFR in 2016, and subsequently announced that implementation would occur on January 1, 2018. The precise nature of arrangements is outlined in Prudential Standard 210

The NSFR is calculated for a bank as the "Available amount of stable funding" / "Required amount of stable funding" or ASF/RSF. The denominator can be intuitively interpreted as the volume of longer term assets on the bank balance sheet. An intuitive interpretation of the numerator is the amount of longer term liabilities in the bank's funding mix. In practice, these aggregates are calculated by applying weights to their components.

The NSFR requirement is that ASF/RSF > 100%, intuitively that the bank is funding its longer term assets with longer term funding, and not relying on rolling over short term funding for financing those assets. While a single bank may be able to roll over short term funding to finance long term

assets in normal conditions, the concern is that relying on short term funding could lead to fire sales of longer term assets in a crisis when many banks are unable to roll over such financing.

The time horizon involved is one year and both ASF and RSF are calculated respectively as averages of "liabilities" and "assets/commitments" weighted by "stickiness" over 1 year horizon. The calibration of available stable funding is based on two assumptions: (a) funding tenor - longer term liabilities are more stable, (b) funding type and counterparty – short term funding from retail/business more stable than from wholesale markets. Table 7 provides information on ASF weights from APS120.

TABLE 7: APS 120 AVAILABLE STABLE FUNDING WEIGHTS

ASF weight	Examples	Notes
100	Regulatory capital (including Tier 2 with >1 year maturity) Term deposits/borrowings with > 1 year maturity	
95	"stable" (for LCR) retail/SME deposits of < 1 year maturity	Also intermediated deposits (eg super fund "cash option") for retail customers (subject to 12 months "tied" agreement)
90	"less stable" retail/SME deposits of < 1 year maturity	As above
50	Non-financial customer deposits with < 1 year maturity Operational deposits Other funding with 6-12 months maturity	Some super fund deposits
0	Other (including from financial institutions with < 6 months maturity)	

"Required funding" reflects assumptions about: (a) need for resilient credit creation (b) bank loan roll-over behaviour for customer relationships (c) asset tenor – some short term assets mature and not rolled over (d) high quality assets can be securitised or traded – don't need stable funding. Table 8 provides information on the weights.

TABLE 8: REQUIRED STABLE FUNDING WEIGHTS

RSF weight	Examples	Notes
0	Currency, Central Bank deposits (< 6 months maturity), trade date receivables expected to settle normally	
5	(other) HQLA1	
10	Loans (<6 months maturity) secured against HQLA1	
15	Unencumbered HQLA2A assets Loans to financial institutions with maturity < 6 months	
50	Loans to financial institutions with maturity 6-12	

	months Australian equities Loans (corporate, retail etc) with maturity < 1 year	
65	Residential mortgages (>12 months maturity)	If standardised risk weight < 35%
85	Assets posted as collateral for derivatives Loans with > 12 months maturity (and risk weight >35%)	
100	Encumbered assets (> 1 year) Fixed assets, non-performing loans, loans to financial institutions (> 1 year)	

Theoretical Underpinnings

Various papers such as Brunnermeir and Oehmke (JF, 2013) indicate potential for excessive maturity transformation. Papers such as Allen and Gale (JEEA, 2005), Shleifer and Vishny (JF, 1997) etc suggest potential for asset prices to depart from fundamental values such that fire sales can lead to losses and potential losses and risk of insolvency. Brunnermeir and Pederson (RFS, 2009) demonstrate how liquidity problems can lead to a vicious spiral as asset sales generate downward pressure on asset prices and margin/collateral requirements etc. Some empirical papers suggest greater failure rates of banks with poor funding structures (but adverse effects may not require failure – just distress or weakness leading to asset sales and spillovers onto markets).

NSFR Possible consequences and issues:

There has been relatively little empirical examination of the consequences of the NSFR. Possible effects include:

(a) Lower profits for banks due to less "riding the yield curve"

(b) Effects on interest rates paid/charged on deposits/loans for different maturities

(c) Lasting effects on shape of yield curve for different types of securities – less bank demand for longer term assets (other than government debt), more bank demand for long term liabilities

(d) Changes in funding mix reflecting weights applied in ASF

(e) Less willingness to make long term loans

(f) Increased role for shadow banking/capital markets funding

(g) Design of new deposit products – growth of longer term negotiable certificates of deposits which can be sold in secondary market

(h) Need for reconsideration of "break terms" for term deposits – previously, banks unable to charge penalty other than interest amount for early withdrawal.

(i) Can "mutual funds" be constructed which invest in LT bank deposits but offer investors ready access (eg with some notice of withdrawal) to their investments?

(j) "stickiness" of short term funding partly dependent on bank interest rate policies in times of liquidity stress, these may change and affect stickiness, such that "arbitrary" weights no longer appropriate.

(k) Some arbitrariness in distinguishing between nature of counterparties and stability of funding provided – eg re SMSFs and Institutional Super Funds in Australia, with potential for differential interest rate offers flowing on to profitability of those institutions.

(l) Should long term assets available for use as collateral for repos with Central Bank have lower RSF weights?

(m) What should be disclosure requirements of banks re NSFR?