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Head: Economic Research Department
South African Reserve Bank
P O Box 427
Pretoria 0001

Tel. +27 12 313 3911

The cost of complying with Basel III liquidity regulations for South African banks

Howard Diesel*, Mukelani Nkuna†, Tim Olds‡ and Daan Steenkamp§

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Abstract

Basel III regulatory reforms affect incentives for banks to choose between holding liquid assets or extending loans, and therefore potentially have monetary policy implications. Estimates of the costs of prudential regulations are important for accurate assessments of the transmission of these policies to the real economy via bank funding behaviour and credit extension, as well as for a cost-benefit analysis of such regulations. We construct an aggregate measure of high-quality liquid asset (HQLA) holdings by South African banks and discuss the shift in bank balance sheets to meet the liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) regulations. We also create measures of the implied cost of holding HQLA and maintaining LCR buffers for the South African banking sector using market and supervisory data. We then benchmark our estimates against the estimates of large banks themselves based on a once-off survey. We estimate that banks are holding HQLA at a positive carry relative to their cost of funds. This implies that the LCR requirements have created an opportunity cost in terms of forgone income from higher yielding loans or other investments, as opposed to a direct cost to banks. The NSFR regulations, on the other hand, served to increase banks' funding costs by increasing the duration of banks' funding liabilities and the relative cost of deposit funding. We suggest that these regulations have had monetary policy implications as they have raised bank funding costs and increased the sensitivity of bank balance sheets to sovereign creditworthiness and money market developments.

JEL classification: E58, G21

Keywords: HQLA, LCR, NSFR, Basel III regulations, regulatory compliance costs

*Modelware Systems. Email: howard@modelwaresystems.com.

†South African Reserve Bank, Pretoria, South Africa. Email: mukelani.nkuna@resbank.co.za.

‡Email: tolds07@gmail.com.

§Corresponding author. Codera Analytics and Research Fellow, Department of Economics, Stellenbosch University. Email: daan@codera.co.za.

1. Introduction[1]

Banks fund loans by obtaining funding from several sources, the most important being deposits obtained from households, businesses, corporates and other banks, as well as issuances of debt. Bank funding costs are crucial to the transmission of monetary policy. Changes in the South African Reserve Bank repurchase (repo) rate affect the bank lending rates paid by consumers and firms because of the impact of the policy rate on banks' cost of funding. The composition and cost of bank funding therefore have important implications for the provision of credit and consequently for economic output and inflation. Exogenous bank funding cost changes, such as those driven by regulatory requirements, can affect monetary policy pass-through to lending rates (Greenwood-Nimmo et al. 2022) and the economy (Hollander and Havemann 2021, De Jager et al. 2021).

Bank funding costs also have implications for financial stability. To the extent that banks pass on funding cost changes to lending rates, debt service costs and the number of non-performing loans could be affected. Credit losses will have a negative impact on bank profitability, which will affect the level of bank capital and may have implications for banks' solvency and financial stability. Another consideration is that high funding costs may incentivise riskier investment in order to generate higher returns.

Banks calculate internal 'funds transfer prices' (FTP) to apportion the costs of funding new loans to their different business units so that banks can set loan-lending rates that reflect their marginal funding cost and reward units that supply liquidity. Apart from the funding costs associated with raising new bank liabilities, banks' FTPs incorporate charges related to the implicit costs associated with meeting prudential regulations, which required banks to hold liquid assets.

To make banks more resilient to liquidity stress scenarios of the type observed during the Global Financial Crisis (GFC), the Basel Committee on Bank Supervision proposed liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) regulations. The former enhances resilience over a shorter period by requiring banks to hold liquidity buffers against potential short-term liquidity stress scenarios, while the latter enhances resilience over a longer period by addressing maturity 'mismatches' (that is, where short-term deposits are used to fund long-term loans). The LCR regulations aim to ensure that banks maintain sufficient levels of high-quality liquid assets (HQLA) such as government bonds to meet liquidity outflows during market-wide and idiosyncratic stress events. The NSFR regulations aim to mitigate funding risk over a one-year stress period by reducing over-reliance on short-term wholesale funding.

Even though these regulations have implied tighter liquidity and stricter funding requirements for banks, there have been few empirical assessments of the magnitude of the impacts of these

[1] We thank the Prudential Authority and large banks for supporting our survey and providing valuable feedback. We are grateful for assistance with the project from Cristel Bakker, Pierre Mananga, Tabea Mokotong, Wessel Mostert, Dries Smal and Myrtle Van Jaarsveld and comments from Vafa Anvari, Shaun De Jager, David Fowkes, Roy Havemann and Rowan Walter.

policies on bank funding costs and profitability. Most assessments of the impact of these regulations focus on the costs associated with phasing in the requirements (see European Banking Authority 2015 for a seminal example). In the case of stable funding requirements, such calculations are typically based on assumptions about the shortfall of stable funding in the lead-in to the requirements and the funding spreads that apply to funding components that will have to have rising shares of total bank funding. In the case of liquidity buffers, they are typically based on required additional buffers and the opportunity costs associated with holding a higher proportion of liquid assets. We construct historical estimates of the aggregate banking sector balance sheet and show that a less dramatic adjustment was required by the South African banking sector than in advanced economy jurisdictions (in part reflecting national discretion applied in the definitions used in the regulations). Specifically, we construct an aggregate measure of HQLA holdings by South African banks and discuss the shift in bank balance sheets to meet the LCR and NSFR requirements. We develop an updatable methodology for estimating the costs of Basel liquidity regulations using market and supervisory data, and we cross-check our estimates against actual estimates from banks based on a once-off survey that we conducted. As far as we are aware, there has not been any published research by other central banks aimed at quantifying and benchmarking such costs against estimates by banks themselves.[2] Unfortunately, supervisory data captured in the BA regulatory forms does not enable the duration of funding or the historical term structure of funding yields to be accurately measured to assess NSFR compliance costs. Although we document developments in NSFR compliance by the banking sector, we are only able to estimate LCR compliance costs as a result.

From a net interest income perspective, HQLA represent an opportunity cost for a bank as the return on liquid assets tends to be much lower than the returns on other bank assets (such as consumer loans) in most countries. The LCR regulations implicitly create an increasing demand for HQLA (for example, government or high-quality corporate bonds) and may affect how a bank optimises its portfolio of assets and liabilities to reduce funding and liquidity risks. Higher HQLA demand could incentivise issuance of debt to institutional investors or reduce their implicit interest rates, which might lower bank funding costs and boost economic growth. In some jurisdictions, the LCR regulations created a scarcity of HQLA by requiring that the central bank expand its balance sheet to meet increased demand for central bank reserves. But the LCR regulations may also inhibit lending growth directly if HQLA crowds out bank loans.[3] As will be shown, while HQLA holdings have increased dramatically in South Africa,

[2] Since large banks also attach risk weights to government bonds and other types of HQLA, other aspects of the Basel III reforms, such as the Capital Adequacy Ratio and Leverage Ratio requirements, also likely affect bank funding costs and therefore the transmission of monetary policy changes to lending rates and volumes. However, we do not consider the costs of maintaining risk-weighted assets or leverage ratio in this paper. Instead, we are interested in the cost to banks of carrying a liquidity cushion and changing their funding mix towards more stable sources.

[3] Thus far, there does not appear to be strong evidence that the LCR regulations reduced lending or economic growth. Banerjee and Mio (2018) do not find any impact of UK LCR regulations on bank balance sheets or credit extension. On the other hand, Curfman and Kandrac (2019) provide US evidence that the regulations caused banks to reduce credit supply, although the odds of bank failure have fallen concomitantly. De Jager

funding costs have in fact risen over recent years and an increasing proportion of credit has been channelled to the public sector.

Lastly, the liquidity regulations could affect collateral markets[4] and money markets. For example, the LCR regulations are likely to reduce activity in short-term unsecured markets as they serve to reduce short-term money demand by banks, while increasing the supply thereof, with the effects depending on whether the supply or demand effects dominate. Before implementation, the LCR was generally expected to lead to lower short-term unsecured money market volumes and a steeper short end of the unsecured yield curve owing to the risk-based capital charges applying to unsecured lending (see Bank for International Settlements 2015).[5] Since the NSFR regulations constrain the extent to which banks can fund via the money market while encouraging short-term lending, there may also be offsetting impacts on the demand and supply of money market funds.[6] As a result, the overall effects on money markets are ambiguous a priori as the volume and interest rate impacts depend on how banks shift the tenor of transactions and whether transactions are secured or unsecured (see Aaron et al. 2015 and Bank for International Settlements 2015 for discussion).

Variations in liquidity conditions affect inter-bank rates and bank funding costs and therefore monetary policy transmission. Under certain circumstances, the LCR and NSFR requirements could weaken monetary policy pass-through. The NSFR regulations, for example, could weaken monetary policy transmission and have procyclical impacts by constraining banks' ability to take advantage of lower short-term rates by shortening the duration of their funding during a cyclical downturn. The LCR requirement channels a greater proportion of available funding towards holdings of government securities. The LCR regulations could raise the cost of bank funding and support public sector credit extension, but they could also constrain private credit extension, which is a major channel of monetary policy pass-through to the real economy. This may be exacerbated in an environment where a deterioration in sovereign creditworthiness pushes up sovereign yields.

Duffie and Krishnamurthy (2016) argue that during a rising policy rate cycle, the LCR regulations

et al. (2021) suggest, using a model calibrated to South African data, that adverse economic growth shocks tend to reduce HQLA and that the LCR requirements would act to reduce credit extension if LCR and NSFR levels are not well above the statutory requirements.

[4] With regards to the LCR regulations, this applies to transactions beyond 30 days, or cash borrowing or lending transactions collateralised with non-Level 1 HQLA, or if banks can secure borrowing from the central bank using non-HQLA and haircuts for non-HQLA are lower than under the LCR regulations. In South Africa, the SARB only accepts sovereign or SARB securities as collateral in its monetary policy operations.

[5] In other banking systems, the LCR regulations created systematically higher demand for central bank reserves (see Rezende et al. 2016 or Bech and Keister 2017). SARB's monetary policy implementation approach involves the maintenance of a money market shortage and imposes minimum cash reserve holdings, forcing banks to hold government bonds (as well as Treasury bills and SARB debentures) as collateral to participate in repo auctions to refinance the shortage. This has similar implications to the LCR requirements since the shortage system imposes costs on banks. In this study, we treat the costs associated with cash reserve balances as part of the LCR in our analysis. In South Africa, the SARB intervenes to restrict the supply of reserves in the system and there is a penalty on the holding of surplus reserves, which should usually offset the use of such reserves for banks to meet their LCR requirements.

[6] The NSFR will not affect short-term central bank operations since short-term central bank reserves and deposits receive a 0 RSF (required stable funding) weight.

may cause banks to reduce their non-HQLA classified assets relative to HQLA assets by reducing the effective supply of safe assets, increasing the spread between their respective rates of return and reducing pass-through. Likewise, Bech and Keister (2017) provide a theoretical framework arguing that by increasing demand for central bank reserves (and therefore decreasing overnight spreads to term rates), the LCR regulations may affect monetary policy operations and effectiveness. Rezende et al. (2016) provide empirical evidence in support of these arguments using data for the Federal Reserve's term deposit facility, and Kedan and Veghazy (2021) find supportive evidence for euro-area economies. There is evidence that in other jurisdictions, the classification of securities as HQLA had a meaningful impact on security prices, creating an 'HQLA premium' (Fuhrer et al. 2017).[7] If there is a premium associated with HQLA as a result of the LCR regulations, then it could have implications for policy rate settings. Even though the LCR regulations are intended to limit the central bank's role in providing market liquidity, they could act as a capital constraint, reducing central bank borrowing and raising the interbank rate (Monnet and Vari 2019). Ahead of the introduction of the reforms, Santos and Elliott (2012) suggested that the combined impact of the LCR and NSFR regulations on lending rates would be between 0.11% and 0.21% in major economies (Japan, Europe and the United States), representing a similar cost to the capital regulations imposed under Basel III.[8] International assessments such as by Santos and Elliott (2012) and Hoerova et al. (2018) generally conclude that the overall economic costs of the reforms would be lower than the benefits of less frequent and costly financial crisis over the long term.

In a South African context, Nkuna et al. (2020) show that immediate monetary policy easing and refinancing operations during the onset of the COVID-19 crisis passed through effectively to the front-end of the South African yield curve. However, bank funding costs have not matched policy rate cuts since the COVID pandemic (Olds and Steenkamp 2021), implying tighter financial conditions over this period despite a lower policy rate.[9] Greenwood-Nimmo et al. (2022) find that even though monetary policy pass-through to lending rates has been effective since the GFC, the pass-through to deposit rates has been much lower, implying an offsetting impact on bank funding costs that limits the real economy pass-through of monetary easing. As argued in Greenwood-Nimmo et al. (2022), weak pass-through to bank credit extension since the COVID-19 crisis partly reflects the offsetting impact of increases in risk and liquidity premia embedded in South African market interest rates.

Our estimates show that banks are holding HQLA at a positive carry relative to their cost of funds, implying that the LCR requirements have only created an opportunity cost in terms

[7] Fuhrer et al. (2017) find that HQLA designation did depress average yields on such securities in Switzerland (but only by four basis points).

[8] They use assumed LCR and NSFR gaps and assumed increases in average funding costs from a higher proportion of long-term liabilities and reduced returns from a larger share of shorter-maturity assets on bank balance sheets. They estimate that the LCR impact on lending rates would be between one and 11 basis points and the NSFR between 10 and 16 basis points (with an overlap offsetting their combined net impact of between 0 and five basis points).

[9] This is also consistent with evidence from Corradin et al. (2020) for the euro area for the Basel III period and from Ihrig et al. (2019) for US banks.

of forgone income from higher yielding loans or other investments, as opposed to a direct cost to banks. Even though our analysis suggests that the compliance costs associated with the liquidity regulations are relatively modest, we argue that the Basel III regulations nonetheless have implications for monetary policy as they raised bank funding costs and increased the sensitivity of bank balance sheets to sovereign creditworthiness and money market developments.

2. Liquidity buffer and stable funding regulations in South Africa

The NSFR must equal or exceed 100% on an ongoing basis. It is calculated as the ratio of available stable funding (ASF) to required stable funding (RSF). These amounts are determined by factors that are based on the expected liquidity characteristics of different funding sources and bank exposures. A factor of 0 indicates unreliable funding (in the case of ASF) or no exposure requiring stable funding (in the case of RSF); a 100 factor indicating stable funding, that is, an exposure must be entirely funded by stable funding. ASF is meant to capture the share of bank liabilities that are expected to remain stable for over a year, while RSF is meant to capture the extent of stable funding that a bank must hold given the liquidity characteristics and residual maturities of its assets (including contingent liquidity risk from any off-balance sheet exposures). ASF calibration is based on the funding tenor (longer is assumed to be more stable), funding type and counterparty (short-term retail deposits are assumed to be more stable than short term wholesale funding) of bank liabilities. Likewise, RSF calibration is based on-asset tenor (short-dated assets require less stable funding), asset quality and liquidity (assuming that unencumbered HQLA can be readily sold or used as collateral and therefore require less stable funding).

$$NSFR = \frac{ASF}{RSF} \geq 100 \tag{1}$$

ASF is calculated as a weighting of different funding sources, while RSF is calculated using a weighting of a bank's assets and estimates of its off-balance sheet exposures with weighting that reflects the residual maturity or liquidity characteristics. Whereas the Basel III principles treat negotiable certificates of deposits (NCDs) as a less stable funding source in the calculation of the NSFR, NCDs represent a very important and relatively stable source of funding in South Africa.[10] As a result, national discretion was applied to increase the ASF factor applied to short-term retail and wholesale funding in the calculation of South African NSFR relative to the Basel III calibration (see Table 2 in the Appendix for full details of the supervisory factors applied in South Africa in the calculation of the NSFR).

The LCR requirements aim to ensure that banks maintain sufficient levels of HQLA to meet expected liquidity outflows during a period of market-wide and bank-specific stress. They

[10] In fact, over 50% of bank deposits comprise wholesale funding from non-banking financial institutions and the majority of deposits have a residual maturity below six months.

require that a bank's stock of unencumbered[11] HQLA exceeds its expected net liquidity outflow under a stressed scenario. The Basel III regulations specify such a scenario as the difference between the weighted sum of stressed cash outflows relative to the weighted sum of stressed cash inflows) over a 30-day period. HQLA comprise Level 1 assets (measured at undiscounted fair value, for example notes and coins, central bank reserves and government securities with a 0% risk weight, that is, they can be included without limit), and Level 2 assets (measured at discounted fair value, for example corporate securities).[12] Level 2 HQLA consists of two types: Level 2A (which includes government bonds with a 20% risk weight and corporate bonds that have a credit rating of at least AA-) and Level 2B (which includes residential mortgage-backed securities with a rating of at least AA, and corporate debt securities rated at least BBB-). While Level 1 HQLA qualifies in its entirety towards HQLA, Level 2A and Level 2B assets attract haircuts whose size depends on their liquidity characteristics. Net cash outflow (the denominator in equation 2) is calculated based on the tenor of a transaction, whether or not it is secured, the counterparty type, and the collateral quality. This calculation uses regulatory set run-off and inflow rates applied to different sources of cash outflows and inflows (capped in aggregate at 75% of total cash outflows).

$$LCR = \frac{HQLA}{[Cash\ outflows - Cash\ inflows]_{30\ days}} \geq 100\% \tag{2}$$

To initially assist banks with complying with the LCR requirements, the SARB allows a committed liquidity facility (CLF) limited to a maximum of 40% of the total HQLA requirements as a substitute for Level 2A assets).[13] The CLF was provided as there was limited availability of Level 1 HQLA and very low Level 2 assets that would otherwise have met the Basel III criteria. The CLF attracts a favourable RSF factor of 5% and acts to reduce the RSF requirement since securitised mortgage lending assets are treated favourably (see Table 4 in the Appendix for a full breakdown of the calculation of the LCR in South Africa). Another amendment made to the calculation of outflows was to allow foreign currency Level 1 HQLA to cover rand-denominated net cash outflows, as permitted under the Basel III principles for assessing eligibility for alternative liquidity measurement approaches. Table 1 summarises the phase-in arrangements of South Africa's liquidity requirements as part of the Basel III framework. The LCR became fully effective on 1 January 2019, having been phased in from 1 January 2015, with an annual 10% increase in the requirements. Banks had until 2018 to become fully compliant with the NSFR requirement.

[11] 'Unencumbered' implies being free of restrictions on banks' ability to liquidate, sell, transfer or pledge the asset if desired. Unencumbered HQLA are calculated as a weighting of specific categories of assets and assumed to be easily converted to cash without incurring losses.

[12] The SARB requires that banks hold 2.5% of their deposit base in SARB reserves (which earn a zero rate return).

[13] Banks must meet the Level 1 HQLA requirements to apply for the CLF and must lodge acceptable collateral with the SARB to make use of the facility, with fees scaled to rise with higher use to avoid CLF reliance. The CLF is currently being phased out as there has not been a general shortage of HQLA and will be replaced by a restricted-use committed liquidity facility (RCLF), which will be part of Level 2B assets. Over our sample, the CLF was provided at a cost of roughly 60 basis points.

Table 1: Phase-in arrangements for minimum liquidity requirements

Phases[1]	Basel III	2013	2014	2015	2016	2017	2018	2019	1 Apr 20
LCR	100%			60%	70%	80%	90%	100%	80%
NSFR	100%						100%	100%	100%

Note: All dates are as of 1 January unless otherwise stated.

3. Developments in stable funding and liquidity buffers

The Basel III framework's implementation has seen banks in most economies decrease their reliance on short-term wholesale debt and increase the proportion of retail and commercial deposits and long-term wholesale funding on the liability side of their balance sheets. On the asset side of balance sheets, banks in other economies have tended to increase their holdings of liquid assets and government bonds and decreased loans.

Figure 1 summarises the composition of banking sector assets and liabilities in South Africa. Bank assets range from highly liquid components such as cash or Treasury bills to less liquid components such as mortgage rates. Bank liabilities include stable sources of funding such as capital, long-term debt instruments or long-term retail deposits and less stable sources such as corporate deposits that are sensitive to bank rates. South African bank assets are dominated by mortgage and other loans as well as fixed income and government securities (at 67.8% and 26.1% of banking assets, respectively).

Bank funding is dominated by domestic deposits - about a quarter from retail and three-quarters from wholesale sources - with the regulated funds industry playing an important role. Retail deposits are sourced from the household sector, while wholesale deposits comprise those from the interbank market and non-bank financial institutions. Although banks increased the average tenor of wholesale debt issuances (Naidoo et al. 2020), Rapapali and Steenkamp (2020) estimate that the average original maturity of long-term wholesale funding fell since the implementation of Basel III regulations. This is because the most commonly used marginal funding source for banks is the issuance of NCDs, which often have maturities of 12 months or fewer.[14] South Africa's banking sector is unusual compared to many advanced economies in its high share of deposit-sourced funding from the regulated funds industry.[15] Long-term wholesale debt funding increased from 7% to 10% since the GFC. Basel III regulations also

[14] Unfortunately, the low granularity of official bank survey data prevents accurate ongoing assessment of the profile of wholesale funding in South Africa and the evolution of the weighted duration of funding. Available data show that bank funding is dominated by relatively short-term wholesale deposits (over 85% of such funding has a residual maturity of six months or less) and this share of total bank funding has not shifted meaningfully since the adoption of the LCR regulations (Olds and Steenkamp 2021).

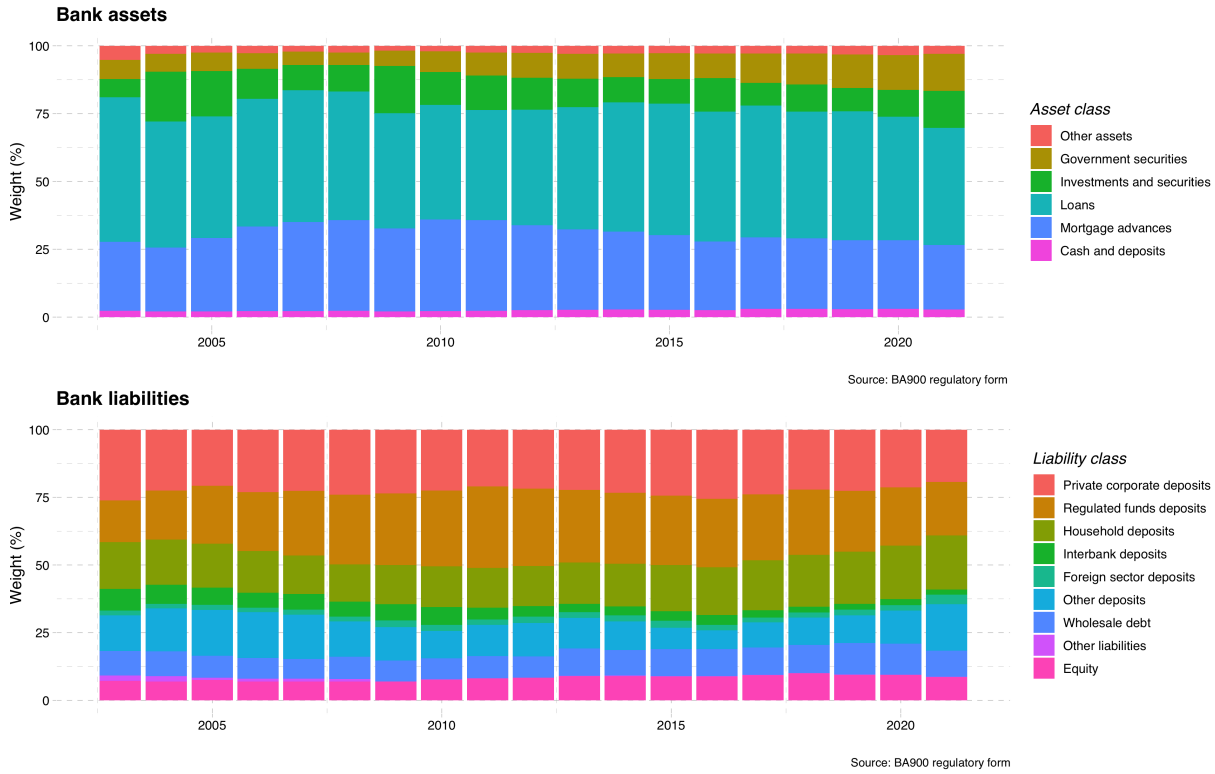
[15] In this paper, regulated funds deposits include private insurers and pension funds, money market and other unit trusts, and fund managers and medical schemes. Private corporate deposits include rand and foreign currency, private non-financial corporate deposits, and foreign currency funding of financial and non-financial corporates. Other deposits include public sector financial and non-financial corporates, money market unit trusts and fund managers, central bank and provincial and local government, other monetary institutions, and non-profit organisations. Note that some components of the BA900 form became available only in 2002, which explains the compositional change in Figure 1.

increased regulatory capital buffers for banks (to a minimum of 8% excluding Pillar 2 and other buffers in South Africa), which saw common equity increase from about 7% to about 9% of liabilities, further strengthening the liquidity position of banks.

Asset side changes have been dominated by an increase in government securities and a decline in mortgage loan share, while the liability-side composition has been relatively stable on aggregate. Government debt security assets increased from roughly 5% of banking sector assets before the GFC to about 14%. While the introduction of the Basel III regulations has not seen the composition of bank funding change to the extent observed in many advanced economies, bank funding costs are systematically higher than they were before the GFC, just as they are in advanced economy banking systems. In South Africa's case, this reflects, in large part, an increase in the relative cost of raising deposit funding, given the dominance of deposits as a source of bank funding (Olds and Steenkamp 2021). Decomposing bank assets by liquidity characteristics, it is clear that South African banks have dramatically increased their holding of liquid assets. In the lead-up to the introduction of the stable funding and LCR-related compliance, South African banks increased the share of liquid assets on the asset side of their balance sheet (from 12% to 18.5%). Bank sector holdings of government securities increased from R410 billion to R930 billion between January 2015 and February 2021, compared to the total banking sector balance sheet growth of 52% in the same period. HQLA holdings increased from 12 (January 2015) to 18.5% (February 2021) of assets, while loans and advances fell from 75% to 68% as a share of total assets over the same period. This suggests that there was some substitution of loans with liquid securities.[16]

[16] It is also possible that banks shortened the maturity of their loans to reduce maturity transformation and boost their NSFR, but data of the average contractual maturity of bank loans are not available.

Figure 1: Bank balance sheet composition



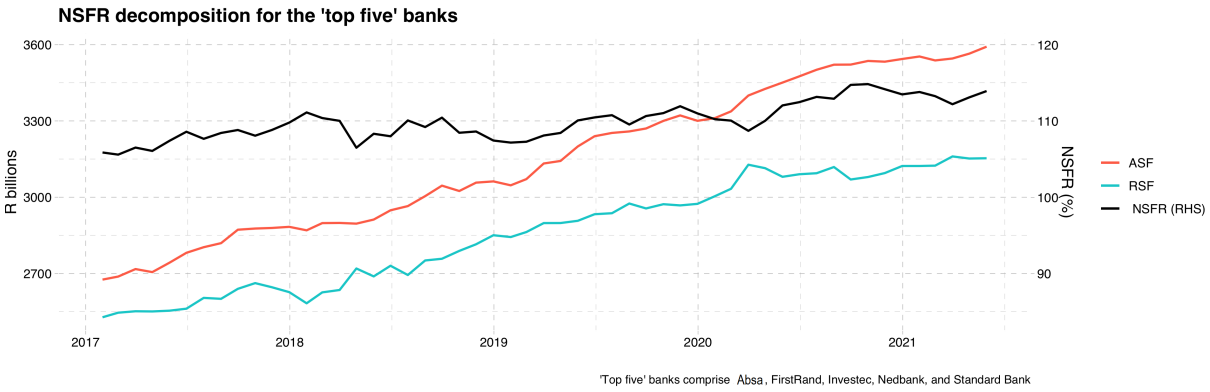
To improve its NSFR, a bank can increase their ASF (by changing the mix of their liabilities towards longer-maturity liabilities) or decrease their RSF (by shifting the composition of their assets towards short-maturity assets, zero-weighted government securities or short-maturity loans to financial institutions). In the case of the LCR, banks can improve their ratio by holding more cash or more liquid assets (implying higher opportunity costs), decreasing cash outflows by increasing the maturity of their liabilities or replacing unsecured funding with secured funding, decreasing the use of credit facilities (implying lower returns) or increasing their cash flows by decreasing the maturity of loans (implying lower returns). While the liquidity requirements potentially reduce liquidity risk, they tend to raise the funding cost (if stable funding replaces less stable funding) and reduce net interest income by raising the implicit cost of liquidity buffers (though higher HQLA holdings). To maintain profit margins, banks may respond to the increased compliance costs of these regulations by increasing lending spreads, which may reduce credit extension.

Whereas individual bank HQLA data is publicly available in some major economies like the US, in South Africa such data is confidential so we do not plot any of the bank-level data used in this study. Figure 2 plots the two components of NSFR holdings for large South African banks over time.[17] Figure 3 presents a decomposition of the NSFR for large banks over time. Unfortunately data availability prevents assessment of whether the banking sector had a NSFR shortfall during the phase-in, although as mentioned earlier, the national discretion applied in the calculation of the NSFR in South Africa dramatically reduced the required adjustment to the

[17] For the NSFR decompositions, we focus on the large banks, given the difficulties to aggregate bank-level data owing to differences in the layout of available supervisory data for our sample.

introduction of the NSFR regulations compared with other jurisdictions.[18] However, Figure 2 demonstrates that the large banks all complied with NSFR more than 12 months before the introduction of the requirement. Since then, the improvement in the NSFR reflected the strong growth in ASF rather than a reduction in RSF. The increase in ASF reflected a particularly strong increase in less stable deposit[19] growth and funding from other legal entities.[20] The composition of RSF has been fairly stable, except for an increase in all other assets category. There appears to have been little change in the relative share of short-term loans in loan portfolios for banks; this is consistent with what has been observed in other jurisdictions. This is to be expected, as liability-side adjustment to meet NSFR requirements is more cost effective than adjusting the composition of loan portfolios (see European Banking Authority 2018).

Figure 2: NSFR compliance



[18] For example, all large South African banks would have been substantially below the 'core funding' requirements applied in other countries had it not been for the national discretion applied in the definitions used in the regulations.

[19] These include deposits not covered by deposit insurance or guarantees, or foreign deposits that are more volatile than domestic currency deposits.

[20] This is the sum of operational deposits, non-operational deposits and funding raised in South Africa and denominated in domestic currency, excluding banks, deposits specified by the Authority and non-operational deposits and funding not included in the other items.

Figure 3: NSFR breakdown

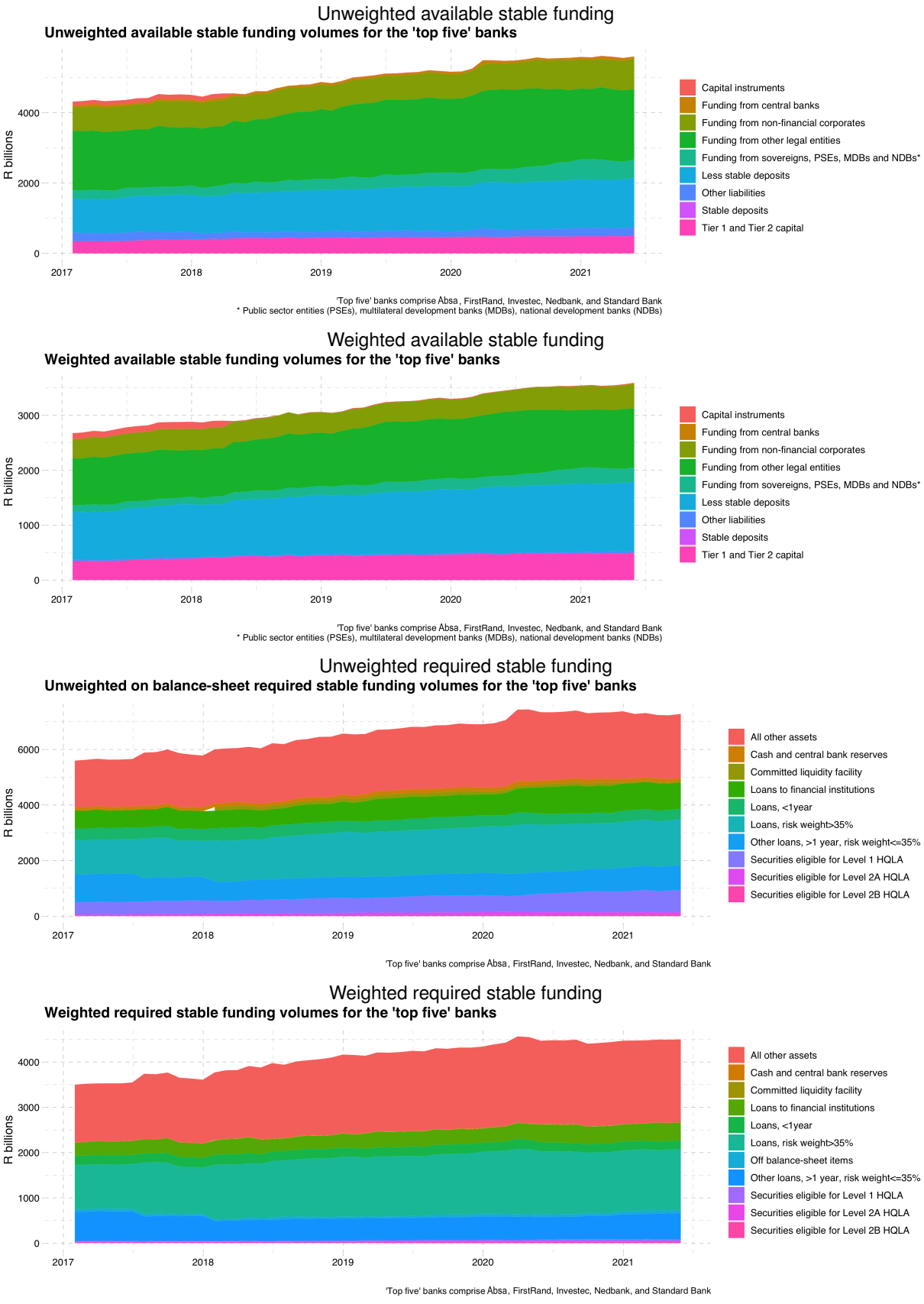


Figure 4 plots the evolution of aggregate LCR compliance over time. The LCR ratio increased from about 50% in mid-2014 to over 150% in late 2019 (73% in January 2015 to 141% in May 2021 excluding the CLF). Ahead of the introduction of the LCR, the supply of HQLA in South Africa fell short of the quantum that would be regarded as sufficient for domestic commercial banks to comply with the requirements. As a result, the demand for HQLA far outstripped supply and the SARB had to intervene initially by offering the CLF to enable domestic banks to comply with the LCR requirements. All else being equal, the demand would have been expected to put downward pressure on the yields of qualifying HQLA in the domestic market. However, the yields of Level 1 assets (mainly constituted of government bonds and Treasury bills) remained somewhat elevated and this was attributed largely to the increase in the sovereign credit risk coupled with sovereign credit ratings downgrades. South Africa's fiscal challenges from slower economic growth and solvency issues within state-owned entities have seen the supply of government bonds and Treasury bills grow steadily. As a result of this additional supply, the SARB started phasing out CLF as it was evident that there were no longer HQLA supply constraints. The additional supply put extra pressure on the government bond yield curve, particularly the back end of the curve, which rose significantly higher than the shorter end, making the South African government bond curve the steepest in peer emerging market economies. In the Treasury-bill curve, the three-month point was most affected and was trading higher than the domestic banks' three-month NCD yields, which was an anomaly as the sovereign credit quality supersedes domestic issuers.

One can clearly see that major banks acquired HQLA ahead of the full-compliance deadline. The LCR improvement reflected increased HQLA holdings rather than enhanced net cash outflow optimisation. HQLA increased by 142% between January 2015 and May 2021, while net cash outflows only rose by 26%. Figures 5 and 6 summarise the composition of LCR buffers for the banking system as a whole over time. The observed growth in HQLA reflected increased bank holdings of government securities (127% higher bank holdings since January 2015) as well as a large increase in CLF (contributing about 13% to the rise in the LCR and observable as the bump in panel three of Figure 6 shows). Wholesale unsecured non-operational funding forms the largest portion of cash outflows, while the largest inflows are fully performing unsecured loans.[21] South Africa is unusual compared to advanced economies, where Level 2 HQLA tend to have a much larger share in total HQLA in the banking sector. HQLA make up a large share of total bank assets, rising from around 10% to almost 17% currently (Figure 7). This is consistent with the findings of Banerjee and Mio (2018) for UK banks, which show an increase in the share of HQLA and non-financial deposits in their assets. However, in South Africa there is less evidence of a decline in intra-financial loans and short-term wholesale funding in bank liabilities to become compliant with the Basel III regulations.

[21] Confidential HQLA compliance data for individual South African banks, however, shows that there are significant differences in the composition of HQLA across banks, reflecting differences in business models, internal liquidity needs, or expected risk-return trade-offs.

Figure 4: LCR compliance

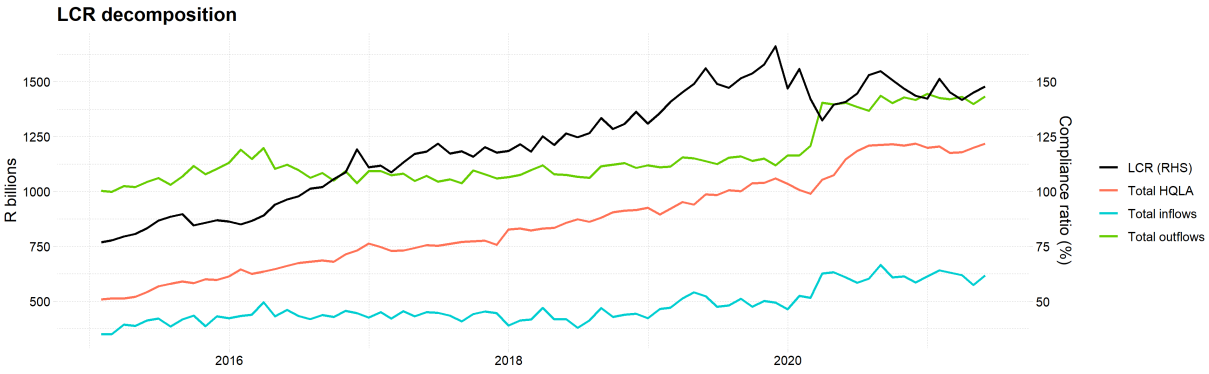


Figure 5: LCR breakdown

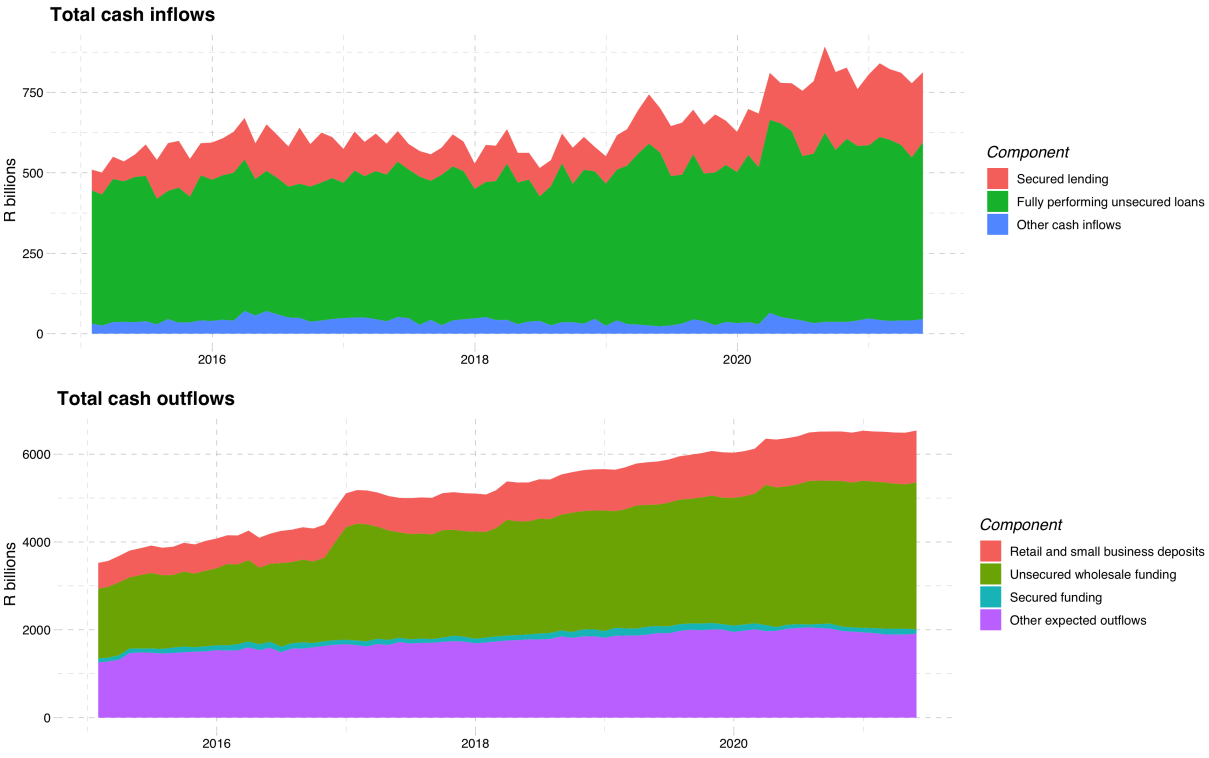


Figure 6: Components of HQLA

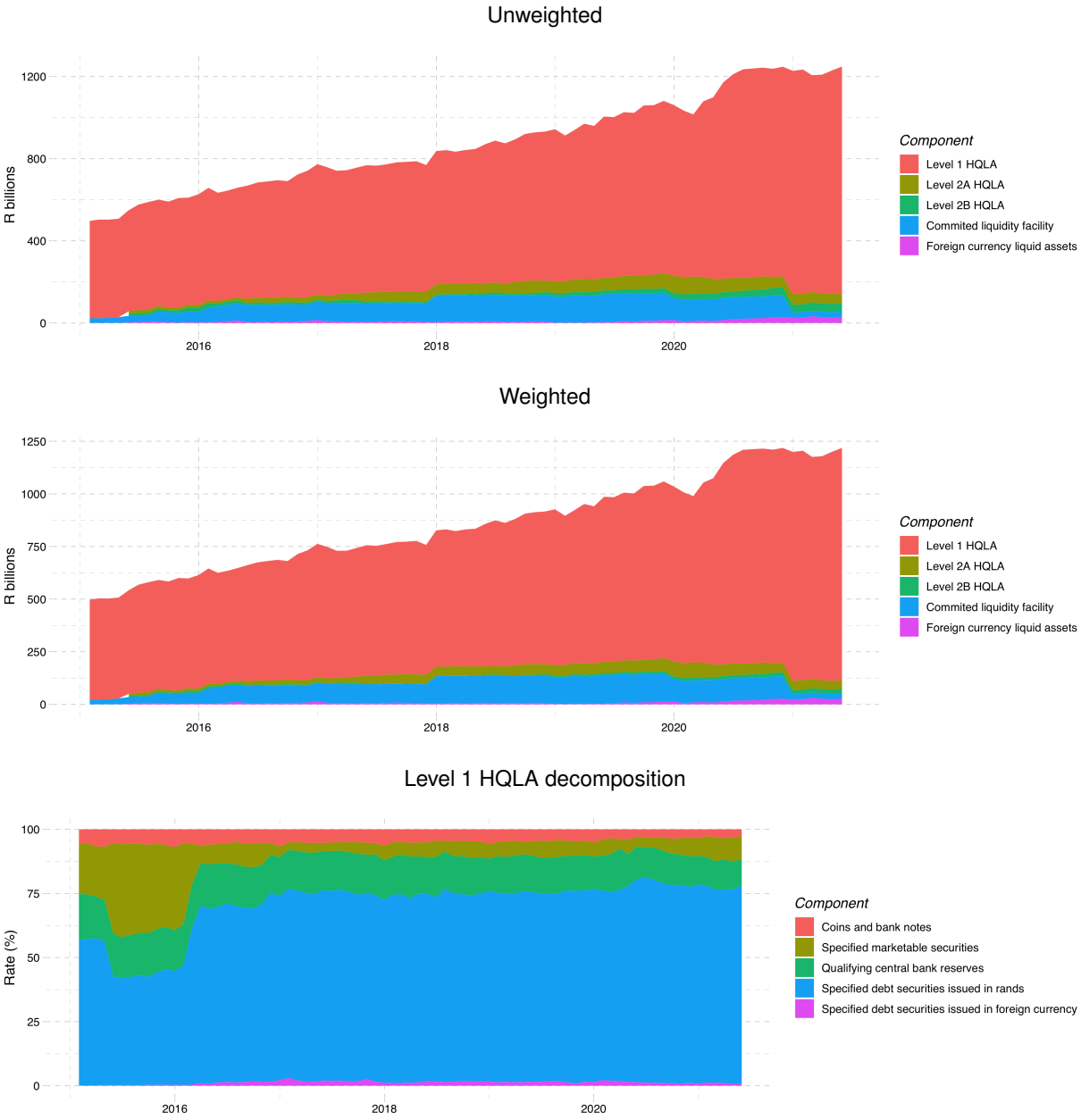
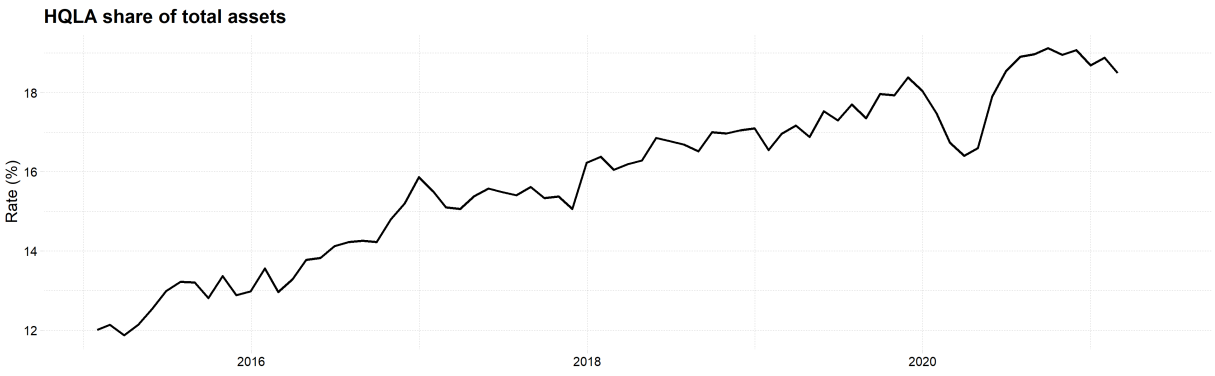


Figure 7: Liquid assets to total assets



During the COVID-19 crisis, which began in March 2020, there was an increased demand for short-term call deposits from higher perceived financial market risks, resulting in an increase in short-term cash outflows in the LCR. This saw the LCR ratio fall to around 125%. South Africa's sovereign credit ratings downgrade at the end of March 2020 forced banks to increase their HQLA, as there was a fall in the value of HQLA from mark-to-market adjustments to bond prices, reflecting increases in the yields of the underlying instruments. In response, the SARB temporarily reduced the required level specified for banks' compliance with the LCR regulations (to 80% from 100%)[22] and announced a bond purchase programme which helped to calm financial markets (Havemann et al. 2022). Banks' holdings of HQLA consequently did not decline meaningfully, nor were there meaningful changes to the composition of HQLA.

Holding additional liquidity buffers may imply a cost to banks as these liquid assets typically attract a low yield compared to loan rates in most countries. It is therefore interesting that banks' NSFR and LCR ratios substantially exceed minimum statutory levels. As will be shown, overcompliance may reflect attractive returns on such assets. Overcompliance is also a common international phenomenon and can be interpreted as evidence of the regulations binding at levels above the minimum thresholds (see Bonner and Eijffinger 2016). This, in turn, could be evidence of market discipline (see Nier and Baumann 2006) or concern over reputational damage from being perceived as at risk of non-compliance (see Berger et al. 2008 in the case of capital ratios). Overcompliance suggests that these requirements are not binding, or at least are binding at levels well above their statutory minima. There may, for example, be a need for operational headroom to absorb unexpected volatility in HQLA and net cash outflows, or banks may be trying to take advantage of the high relative yields of government securities. Excess NSFR also likely reflects the dominance of retail and stable deposit funding in bank liabilities in South Africa.

4. Methodology for estimating liquidity buffer carry

In most countries, liquidity buffers are 'expensive' for a bank as their returns are generally lower than that of their loan books. While HQLA holdings provide a positive rating factor for the liquidity and funding regulations, they represent a persistent drag on earnings since there are generally costs associated with sourcing HQLA and costs of capital associated with these holdings on bank balance sheets. Banks therefore tend to try to economise on the extent of the liquidity cushions they hold to limit the impacts that they have on bank profitability. We estimate the per unit cost of complying with the LCR requirement using the carry-on HQLA in addition to the opportunity cost of holding HQLA. We use National Treasury vanilla bonds and Treasury bills issuance data, as well as commercial banks' holding of cash reserves and notes and coins to estimate an average yield on the industry HQLA. We also compare to an alternative approach where we assume that banks' holdings of HQLA are only constituted of Treasury bills and the yield thereof is used as an indicative yield on banks' holdings of HQLA.

[22] Regulatory capital requirements were also relaxed, with Pillar 2A reduced from 1% to 0%, and criteria outlined for utilising the 2.5% (of risk-weighted assets) capital conservation buffer.

We calculate HQLA carry C_{HQLA} as:

$$C_{HQLA} = R_{HQLA} - CoF_{HQLA} \tag{3}$$

where R_{HQLA} is the return on the HQLA portfolio and CoF_{HQLA} is the average cost of funds (which we proxy using the weighted cost of funds [WACF] measure of Olds and Steenkamp 2021).

4.1 Estimating the return on HQLA

4.1.1 Volume-weighted issuance yields

We calculate R_{HQLA} as the volume weighted yield of the total industry HQLA holdings as reported in BA returns, taking into account the following assumptions:[23]

1. The industry holdings of HQLA are adjusted for non-observable factors. In this regard, the debt instruments issued in foreign currency as well as Level 2 HQLA volumes are removed as their respective yields are not observable. Our measure thus assumes that the total industry holdings of HQLA are only constituted of cash (notes and coins and central bank reserves), Treasury bills (T-bills) and bonds.[24]

2. The volume of T-bills is assumed to be part of the debt instruments issued in domestic currency by the government and central bank; the value thereof is estimated at 85% of the total outstanding T-bills in the market.[25] It is further assumed that commercial banks acquire their T-bill holdings weekly at weekly T-bill auction-clearing yields: therefore their holdings' running yield is a volume-weighted yield of all outstanding T-bills.

3. The volume of bonds held is estimated by subtracting the volume of T-bills as calculated above from the total volume of debt instruments issued in domestic currency by the government and the central bank. By implication, the bond volume will be inclusive of debentures[26] and inflation-linked bonds (ILBs).[27] Similar to T-bills, it is assumed that the commercial banks acquire their bonds at weekly bond auctions and that their yield

[23] In the Appendix we provide some evidence supporting the plausibility of these assumptions. Figure 15 shows that the weights used in our estimation approach are similar to those obtained from the alternative approach discussed earlier, while Figure 16 demonstrates that the use of WACF to calculate the HQLA carry spread produces a similar but smoother estimate of the cost of funding. The same results are seen when a more conservative measure is used where it is assumed that bank HQLA holdings are only constituted of T-bills.

[24] This adjustment has a limited impact on the calculation. As can be seen from Figure 6, Level 1 HQLA represents about 90% of total HQLA in 2021, while Level 2A represents slighly over 3%, Level 2B less than 2%, and the CLF and foreign currency liquid assets slightly over 2% each.

[25] Estimated using the historical commercial bank share of total outstanding T-bills lodged in the SARB's SAMOS system.

[26] This is not a concern as the issuance thereof has been very sporadic and the outstanding volumes were at times negligible.

[27] This assumes that the vanilla bond yields are the same as ILB yields, that is, there is no arbitrage between ILBs and vanilla bonds in such a way that when converting the ILBs yields to their nominal equivalent they will be similar to the outstanding vanilla bond yields.

is a volume-weighted yield of all outstanding bonds.[28] Our bond series starts in 2011 and it was further assumed at the start of the series that the outstanding bonds were yielding the market yields prevailing at the start of the series and thereafter the yields were adjusted on a volume-weighted basis using the clearing yields of the marginal weekly issuances.

4. The cash holdings of banks are calculated by adding the notes and coins and central bank reserves holdings as reported. A yield of 0% is applied on the cash holding as commercial banks are not remunerated for their cash reserve holdings with the SARB.

5. In relation to T-bills and bonds, we further assume that the commercial banks follow an amortised cost classification and measurement model as provided for under the International Financial Reporting Standards (IFRS) 9 accounting standards. We further assume that the bonds are fair value hedged using interest rate swaps which result in an effective hedge and therefore that the fair value adjustments to the carrying value are done monthly which is offset by the return on the swap (thus zero impact to the income statement). Thus accrued interest on the bonds will be calculated using the yield at which the bond was recognised in the balance sheet.[29] While the package of the bond and a swap could be looked at as three-month Jibar plus a bond swap spread, we recognise the bond yield as a carrying yield instead of a rate linked to Jibar given the accounting treatment (that is, interest income during the life of the bond will continue to be calculated using the yield at which the bond was acquired). The implication of this is that bond carry yields will remain static at a volume-weighted moving average of

[28] We note that commercial banks do acquire their bonds in the secondary market at yields that are likely to be different from auction-clearing yields and further that a portion of their holdings could have been acquired via reverse repos. However, such acquisitions are not incorporated in our analysis owing to lack of visibility of such operations. The implication is that the yields of the bonds acquired in the secondary market are likely to be different to the auction-clearing yields, although such a difference is regarded as insignificant as bond auctions are conducted weekly and usually clear near pre-auction market yields. The carrying yields for bonds acquired through reverse repos would be equivalent to short-term money market yields which are closer to three-month Jibar, the level thereof being largely dependent on the tenor of the reverse repo, as well as the market demand for the underlying bond. That is, reverse repo carrying yields will tend to be significantly lower than bond-auction-clearing yields.

[29] For example, if a commercial bank acquires a R100 million five-year government bond at par (with a coupon of 10%) this would result in an increase of R100 million in the Investment Securities line of their balance sheet, whereas the Derivatives Financial Assets and Liabilities would not change since the swap fair value will be zero at the beginning. However, at each month-end other than the coupon payment date, Interest Receivable of R100 million times 10 times 1 over 12 would be recognised in the balance sheet and the same value in the Income Statement as Interest Income. At coupon payment date, on the other hand, the coupon received will increase Cash and Cash equivalents while Interest Payable will decline to zero. The bonds' carrying value would need to be adjusted for fair value movement attributable to changes in bond yields, while the opposite adjustment would happen in the Financial Derivatives Assets/Liabilities, that is, the changes in yields will have zero impact in the balance sheet. This implies that bonds purchased are perfectly interest rate delta hedged. Therefore, the only impact to the size of the balance sheet at month-end will be the accrual booked under Interest Receivable. We do recognise that in reality, basis risk exists between the government yield curve and the interest rate swap curve. As a result, movements in government bonds' yield curve would not be accompanied by the same movement in the swap curve, that is, there could be factors that result in the government bond yields rising by a higher magnitude compared to the movement in the swap yields. This would imply that a hedge might not be 100% effective. Future refinements of the methodology could consider the implications of hedging HQLA using swaps.

auction-clearing yields and will not adjust as three-month Jibar changes and also implies that the swap net cash flows will be zero during the life of the bond.[30]

Data on auction volume and clearing yields are based on the SARB's records of vanilla bonds and T-bill auction results.

4.2 HQLA carry

The estimation of meeting Basel III liquidity regulations is complicated by the complexity associated with optimising HQLA portfolios. Banks can enhance the return on HQLA by increasing the proportion of long-duration government bonds in HQLA (which tend to have a higher return owing to the generally upwards sloping sovereign yield curve), and optimise the opportunity cost of HQLA funding by sourcing funding for HQLA portfolios using the most favourable point on their funding curve. The latter will depend on market conditions, the interest rate cycle, a bank's funding mix, and its expectations around the ability to roll over its funding as desired. Banks also have different business models that may require different funding and liquidity management approaches, and prioritise funding stability, liquidity management and return enhancement differently.

Aggregate government security holdings by banks have gradually increased, reflecting the increase in their relative yield (Figure 9). Not only are the yields on South African bonds high by international standards, but they have not followed the policy rate and T-bill rates lower following the COVID-19 pandemic (Figure 9). Longer-duration HQLA have provided much higher carry benefit, and T-bill rates have generally been above both the policy rate and bank funding costs, while cash and reserve holdings go unremunerated. Consequently, the HQLA carry widened, reducing the opportunity cost that the domestic banks were incurring in complying with the LCR standards, especially as funding rates declined on the back of policy rate cuts following the COVID-19 pandemic. The increase in carry cost since mid-2018 therefore reflects the deterioration in sovereign creditworthiness and associated widening of spreads on government bonds, and increases in banks' holdings of such securities. Figure 9 highlights the possibility that the LCR regulations may create incentives for banks to redirect lending to government at the expense of lending to the real economy.

In other banking systems, the requirement to hold higher levels of liquid assets has required more bank funding to be applied to relatively low-yielding assets. As a result, we estimate

[30] The realised profit and loss of the swap will likely start as negative (assuming an upward slopping swap curve) as the fixed rate payer will pay a higher rate compared to the three-month floating rate received, but over the duration of the swap cash flows are expected to be neutral, in line with the initial pricing (that is, an upward sloping curve assumes future three-month rates / forwards rates will be higher than current three-month rates, otherwise there would be arbitrage opportunities). We acknowledge that this assumption is potentially a source of inaccuracy in our methodology since banks typically compare yield and return using a spread over Jibar. Using the bond swap package carrying yield (that is, Jibar plus bond swap spread) instead, for example, would take into account the cash flows of the swap. This methodology was not explored as it would ideally require estimation of swap yields corresponding with each marginal bond issuance, but this should be considered in future improvements of the methodology. By way of example, Figure 17 plots the Jibar reference rate against our funding cost and carry cost estimates.

that HQLA carry was positive in the lead-in to the LCR requirements and then marginally negative until mid-2017. Our estimates increase from a positive carry of about 50 basis points pre-COVID-19 to 200 basis points (Figure 10). A positive carry indicates that the return on HQLA has been higher than the average cost. A positive carry suggests that the LCR requirements have only created an opportunity cost in terms of forgone income from higher-yielding loans or other investments, as opposed to a direct cost to banks from additional holdings of HQLA. This is unusual by international standards: in the case of the euro area, for example, Hoerova et al. (2018) estimate that the difference (cost in their case) averaged around 74 basis points (calculated as the spread between deposits rates and government bond yields).

Figure 8: Weights of components of HQLA

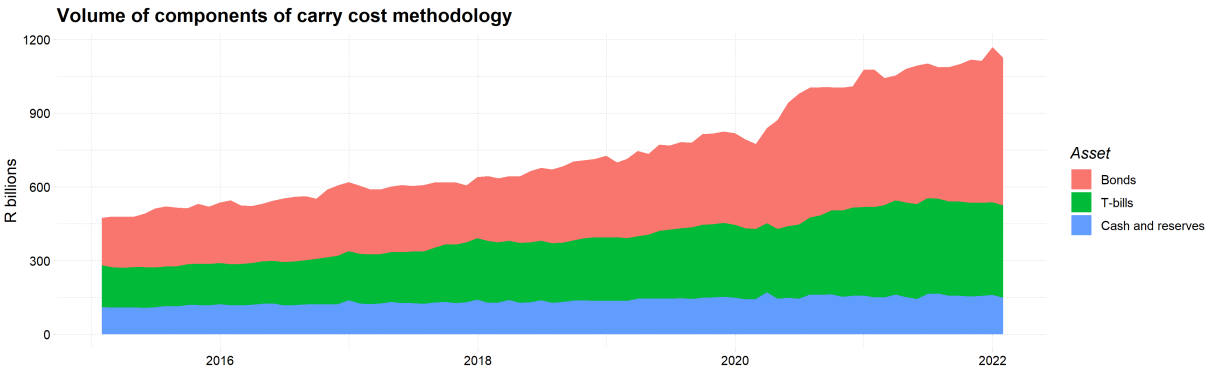


Figure 9: Cost of components of HQLA

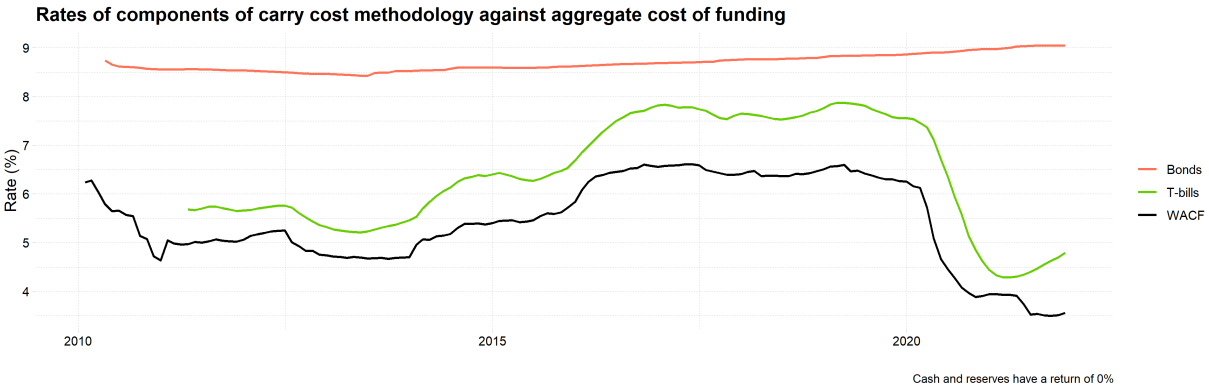
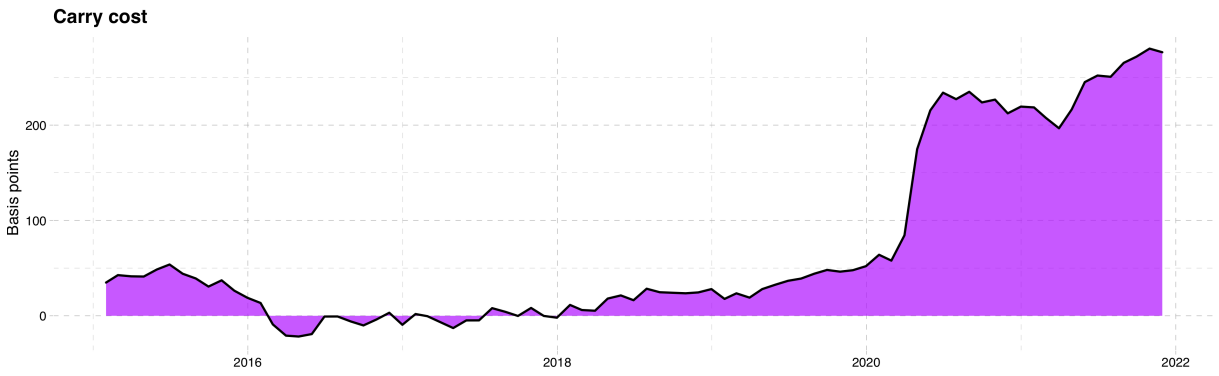


Figure 10: SARB HQLA carry estimate



4.3 LCR compliance costs

Many banks responded to the Basel III regulations by augmenting their risk-based FTP pricing with regulatory compliance incentives (see Appendix A for more detail). Calculating the cost of meeting liquidity buffer or stable funding requirements allows banks to allocate these costs to specific parts of their balance sheet. In the case of the LCR, for example, a bank may incentivise the origination of assets with LCR benefits or allocate costs to liability-generating activities that reduce LCR. Estimating the compliance costs of the LCR and NSFR is complicated by the need to control for the composition of the HQLA and liabilities used to fund those assets. Although further research is needed to assess the extent to which risk-return considerations of HQLA holdings and return preferences of banks affected bank responses to regulations, we can nonetheless measure the cost implications of the regulations.

We estimate the cost of complying with the LCR as the opportunity cost the banks incurred by allocating funding to HQLA instead of other interest-bearing assets, that is, the difference between HQLA carry and the net interest margin for the banking sector (Figure 11). Figure 12 plots our estimate of the rand cost of HQLA using our opportunity cost metric. We estimate the opportunity cost at over 200 basis points or about R10 billion in 2015, rising to around R25 billion in 2020. By way of context, this is against total bank equity of around half a trillion rand. Our estimates imply a cumulative opportunity cost of over R100 billion for the past five-years, although this does not adjust for the earlier liquid assets requirements which banks were required to comply with before the introduction of the liquidity standards.[31]

[31] On a risk-adjusted basis, a measure like net interest income after capital cost (NIACC) - that is, adjusting the net interest margin for the cost of capital - would be a more comparable measure, given that the capital costs of HQLA would be relatively lower than the capital costs of the loans and advances. Future refinements of our methodology could use the difference between NIACC and bond carry to better represent the carry costs from the perspective of a commercial bank shareholder. Net interest margins are also inclusive of the interest income from HQLA holdings and thus likely understated.

Figure 11: HQLA carry relative to net interest margins

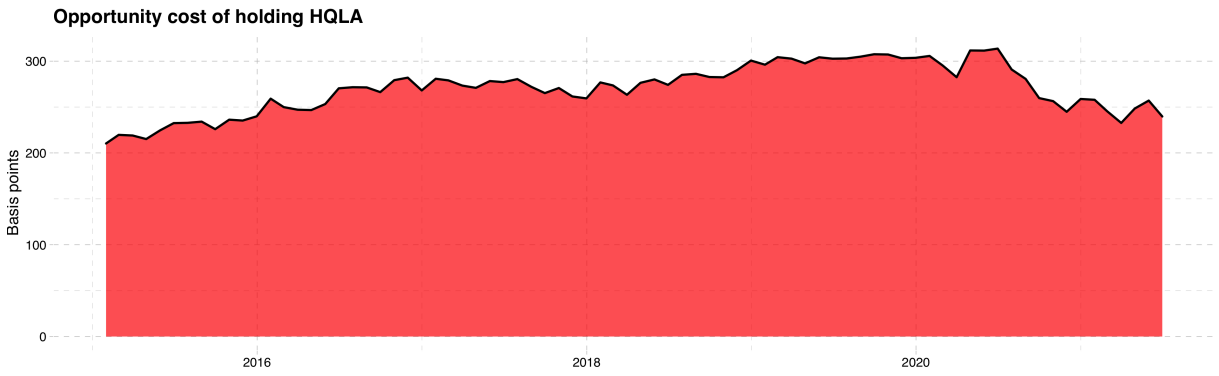
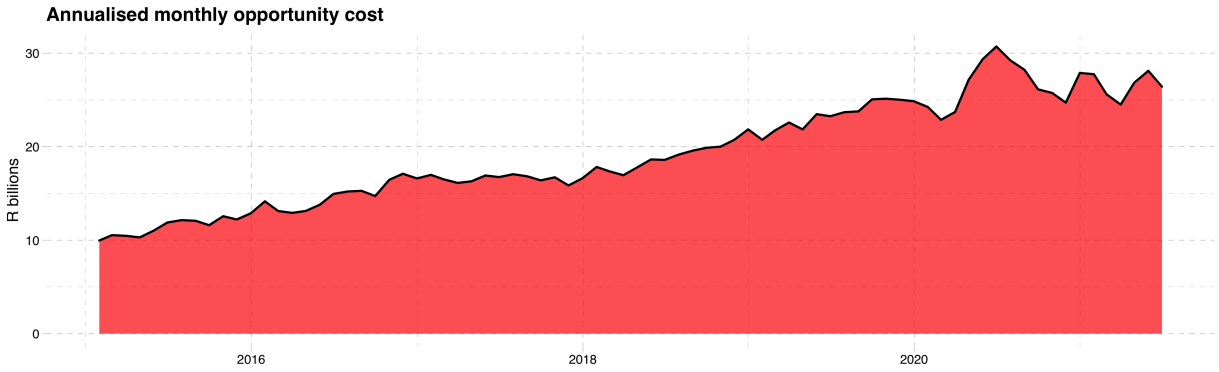


Figure 12: HQLA cost estimate (rands)



Our analysis does not specifically test whether liquidity regulations shifted banks' funding curves higher.[32] The increase in bank funding costs measured by Olds and Steenkamp (2021) is largely associated with an increase in the duration of banks' funding liabilities and the relative cost of deposit funding. Since market conditions and bank business models also affect liquidity buffers and funding composition, our estimates should not be interpreted as direct measures of the impact of the LCR and NSFR regulations on marginal bank funding costs. However, our estimates suggest that for Basel III compliance reasons banks allocated funding to HQLA instead of other assets, resulting in an opportunity cost as other assets would have generated better returns compared to HQLA. There could also be times when HQLA provided attractive risk-adjusted returns relative to loans, which would have incentivised the banks to allocate to this asset class for reasons not related to Basel III compliance. Under both scenarios, we believe the significant allocation to HQLA could have crowded out funding of other forms of assets.

[32] It may also be that the retail deposit curve steepened owing to increased competition for LCR- and NSFR-favoured deposits, although there is no regulatory data available to assess this.

5. Estimates of actual cost of bank compliance with liquidity buffers

Next we benchmark our estimates of the carrying costs of HQLA and regulatory buffers against an aggregation of estimates provided by the five largest banks in South Africa.[33] We conducted a once-off survey of their own historical estimates of the implied costs of holding HQLA and maintaining LCR buffers, and aggregate the results from the survey to maintain the confidentiality of the individual bank results.[34]

There are many challenges to creating comparable measures of the implied costs of funding and liquidity regulations using bank-level estimates. Despite the standardisation of the definitions for the components of HQLA and stable funding, there is little standardisation in the approaches banks use to report on LCR and NSFR compliance costs and a lack of granular data from regulatory surveys to measure these concepts with a high degree of accuracy. This complicates the creation of consistent comparisons over time and across banks. Different banks use very different assets and liability categorisations, for example, making it difficult to weigh up components of regulatory compliance costs consistently across banks. As discussed earlier, the composition of HQLA holdings and the funding of banks' HQLA portfolios also differ meaningfully, implying substantial differences in the level and profile of the returns and costs associated with HQLA across banks over time. Nonetheless, our survey allows us to benchmark our aggregate measure against those of South African banks themselves. To aggregate bank-level HQLA carrying cost estimates, we weigh each bank's annual estimates using individual bank contributions to total top five bank HQLA. We also present summary measures of funds transfer pricing curves and the liquidity premia embedded in them by averaging individual bank responses based on their respective shares of the relevant asset and liability categories for the banks that submitted each concept. Most banks do not explicitly measure the costs of complying with the LCR or NSFR requirements, focusing instead on the net cost of liquid asset holdings. There are also meaningful differences between bank-provided estimates, reflecting methodological differences and different balance sheet compositions.[35]

Our survey results suggest that banks' own estimates of HQLA carrying costs have fallen slightly since the introduction of the LCR and have represented a net cost, that is, a negative carry (Figures 13 and 14). Our measure shows that banks held HQLA at a positive carry to their funding costs whereas banks' own estimates show that they were holding HQLA at a negative carry. As mentioned earlier, this partly reflects our assumption that bonds are bought at fixed rates that will not reprice, whereas banks typically compare yield and return of HQLA using a spread over Jibar. Since longer-dated maturity HQLA has recently provided

[33] We excluded smallers bank given the meaningful differences in their business models and different approaches to estimate regulatory compliance costs and funds transfer pricing.

[34] The five largest banks dominate total banking system liabilities and total loans and advances, with their share exceeding 92% for liabilities and 91% for total loans in 2020 and being fairly stable over the last decade. As at February 2021, 34 banks (all locally incorporated and subject to liquidity standards) reported data in the BA900 survey.

[35] Different banks estimate the cost of holding liquid assets differently. Some apply specific annual spreads to their liquid asset holdings, which are sometimes split between statutory minimum holdings and surplus buffers.

positive carry relative to their costs of funding, the difference also suggests that banks' risk limits may be preventing them from terming out more of their government bond holdings. For example, some banks may have previously accepted the cost of utilising CLF instead of investing directly in HQLA. There are two main factors that explain the difference between the estimate from in this study and those reported by banks in the survey we conducted. For our estimations, we assume that banks hold HQLA at amortised cost and do not hedge interest rate risk with swaps, whereas if the banks hedged, a large portion of their negative carry would be attributable to the interest rate swap, given that by its construct, an interest rate swap instrument allows a hedger to pay a higher longer-dated fixed swap rate in exchange for a shorter-dated floating rate (usually three-month Jibar) as protection for a possible increase in interest rates in the future. Banks assume that costs are static and generally do not update their assumptions regularly, resulting in a mismatch between their estimates and realised costs, particularly with the yield curve steepening from 2015 onwards, owing to a deterioration in sovereign credit risk. The significant steepening in the sovereign yield curve resulted in the bond swap basis widening at a faster pace than banks' funding spreads. However, it was not evident from the estimates reported by the banks that their HQLA cost of carry measures were recalibrated accordingly, as we would have expected that on a hedged basis, the banks should have realised a positive carry on their marginal HQLA holdings as they continued to build up their HQLA portfolios. It is also possible that banks' estimates assume that government securities are risk-free (and express their appetite through board limits on which parts of the government curve to invest in). However, we base our estimates on current market pricing that adjusted during periods of market concern around our sovereign creditworthiness. The static costs could also be for operational reasons, such as for process efficiency or the need to minimise volatility in asset pricing.

Figure 13: Survey-based HQLA carry cost estimate

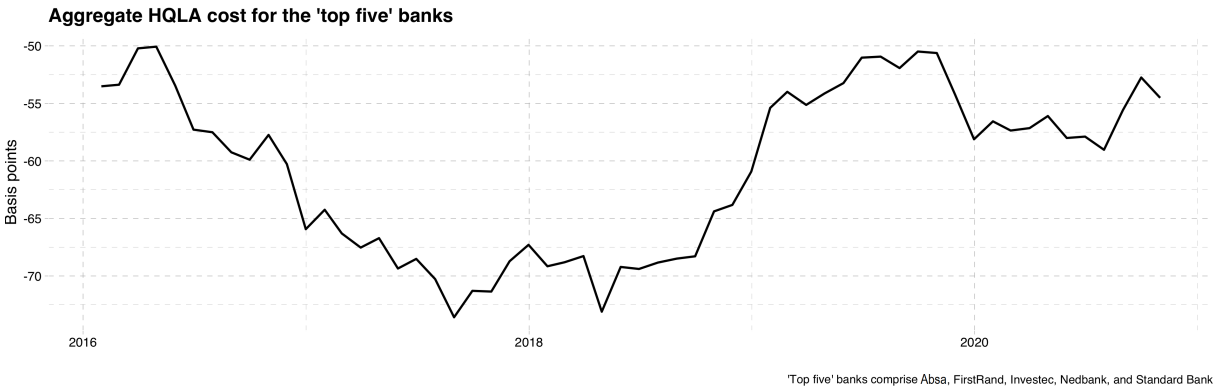
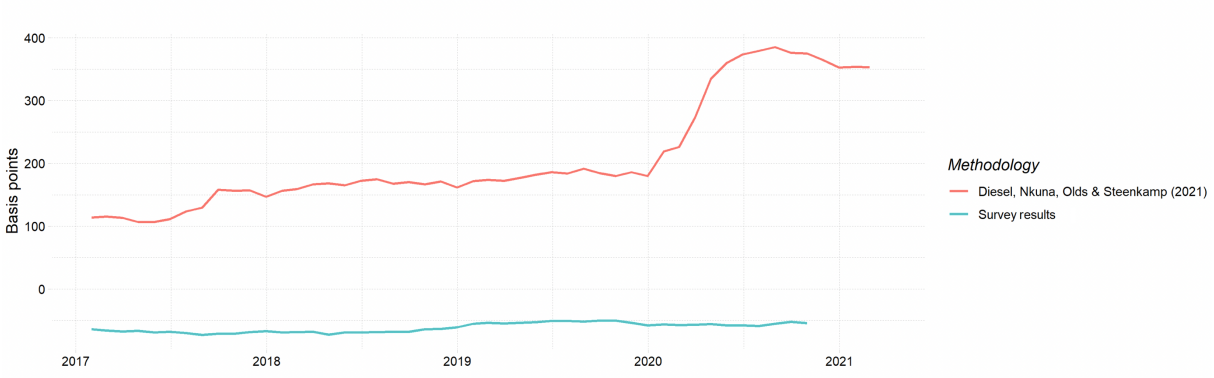


Figure 14: Comparison of HQLA carry cost measures



6. Conclusion

Basel III regulations require banks to hold liquidity buffers at the expense of higher-return assets (such as loans) and a higher proportion of relatively expensive stable funding. We developed a methodology for estimating the costs of meeting these regulations on an ongoing basis and benchmarked our estimates against those of banks themselves. We showed that banks typically account for HQLA holdings as a net cost, and that banks' own estimates of these costs have fallen over recent years. Our estimates suggest that banks are holding HQLA at a positive carry relative to their cost of funds, implying that the LCR requirements have only created an opportunity cost in terms of forgone income from higher-yielding loans or other investments, as opposed to a direct cost to banks. Our estimates suggest that since mid-2019, commercial banks have not suffered negative carry from holding HQLA for LCR purposes as has been the case in advanced economies, except an opportunity cost associated with holding a relatively lower-yielding HQLA portfolio against (potentially) higher-yielding loan portfolio. Since market conditions and bank business models also affect liquidity buffers and funding composition, our estimates should not be interpreted as direct measures of the impact of the LCR and NSFR regulations on marginal bank funding costs.

However, these regulations have monetary policy implications as they have contributed to higher bank funding spreads and increased sensitivity of bank balance sheets to sovereign creditworthiness and money market developments. Liability-side bank funding costs have been higher owing to the increase in the relative costs of deposit funding following the introduction of the NSFR regulations (Olds and Steenkamp 2021). On the asset-side of bank balance sheets, our estimates suggest that the regulations reinforced the crowding-out effects of the relative steepness of the South African sovereign yield curve on private credit over recent years. Higher sovereign bond holdings by banks have also implied greater sovereign exposure. Deterioration in the market's perception of the creditworthiness of the South African sovereign can affect the value of banks' liquid asset holdings. This would negatively affect the ability of such assets to serve as collateral and as sources of liquidity for banks during a crisis, which would exacerbate the impact on economic growth (De Jager et al. 2021). This implies that there may be procyclical effects of high sovereign exposure from LCR requirements. A higher

concentration of sovereign assets on bank balance sheets during times of concern around sovereign debt sustainability may weaken banks' creditworthiness (see South African Reserve Bank 2021).

This paper has not assessed the possible benefits of these regulations. Larger liquidity cushions and more stable funding likely improves the resilience of the banking system to liquidity shocks, which may also reduce banking sector credit risk and have an offsetting impact on interest rates.[36] Estimates of the costs of prudential regulations are therefore important as they are prerequisites for accurately assessing the transmission of these policies to the real economy via bank funding behaviour and credit extension, as well as for comparing the costs of these regulations against their benefits, which include increasing the resilience of individual banks and the banking sector more generally.

This research also informs thinking about how certain reforms might alter the way in which prudential policy affects credit and enables assessment of the impact of regulatory changes on bank funding costs and credit extension. This will allow the SARB to understand the impact of the recent relaxation of regular settings on bank behaviour, funding costs and lending, which in turn would enable assessments of the macroeconomic costs and financial stability benefits of these regulatory framework changes. Although we discussed the impact of market conditions on the costs of bank funding, it is difficult to isolate the impact of the Basel III regulatory changes on bank funding costs. An important avenue for future research is to refine the frameworks developed in this paper to enable more granular decompositions of the contributions of funding mix and policy settings to compliance costs. There are also possible interactions between leverage and liquidity regulations that will amplify money market shocks by forcing banks to de-lever (by reducing lending, for example) or increase holdings of unproductive liquid assets (such as central bank reserves). Future policy research should investigate the role of the central bank balance sheet in mitigating money market shocks.

Our analysis also highlights that a lack of data prevents the monitoring of key banking sector risks. For example, it is difficult to measure marginal funding costs or marginal rate setting for the South African banking sector. In the case of liquidity, a lack of comparable data across banks prevents analysis of the liquidity requirements for banking operations or detailed concentration of funding analysis. For example, since the LCR increases exposure to HQLA, it could increase concentration risk, while the NSFR could amplify funding concentration risks, and the SARB cannot assess these at product or customer level. These data gaps also make it difficult to assess the optimal levels of HQLA for South African banks and optimal composition of liquid assets and stable funding or how Basel III regulations interacted with SARB liquidity provision during the COVID-19 crisis.[37] Enhancing disclosure requirements to improve comparability would enable better assessment of the costs and benefits of the liquidity regulations.

[36] We recommend that future work formally assesses whether the liquidity regulations have reduced bank default risk following the approach by Hoerova et al. (2018).

[37] This would involve assessing whether South Africa's risk-return trade-off could explain our HQLA composition by estimating whether banks' observed HQLA portfolios are consistent with the efficient frontier for South Africa.

Easily updated estimates of marginal funding costing rates are also a prerequisite for ongoing analysis of the implications for monetary policy of money market developments and bank sector policies such as whether the LCR regulations have crowded out bank lending.

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Appendices

Figure 15: Alternative bond weight calculations using BA300 and National Treasury (NT) data

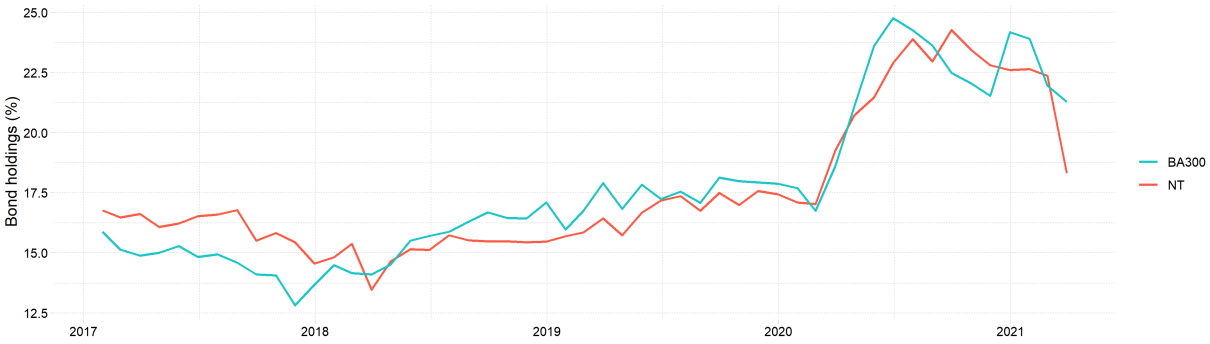


Figure 16: Alternative funding cost calculations

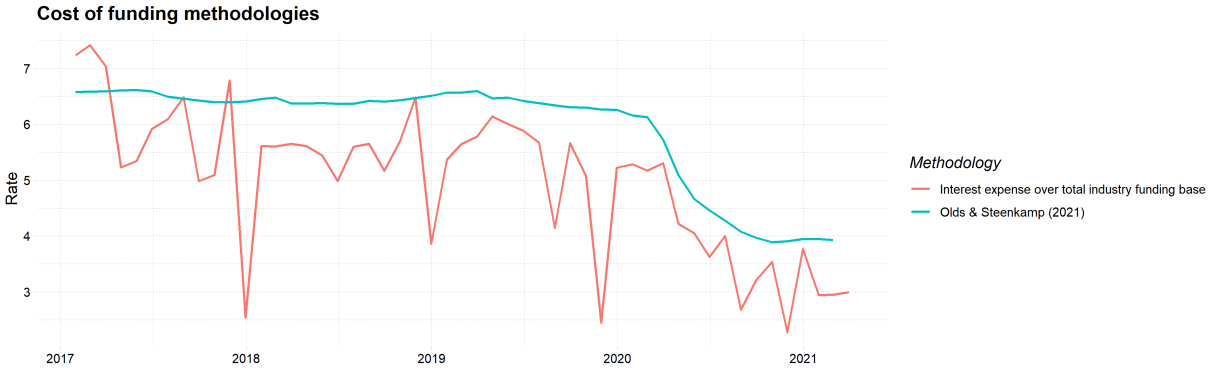


Figure 17: Jibar vs HQLA carry vs WACF

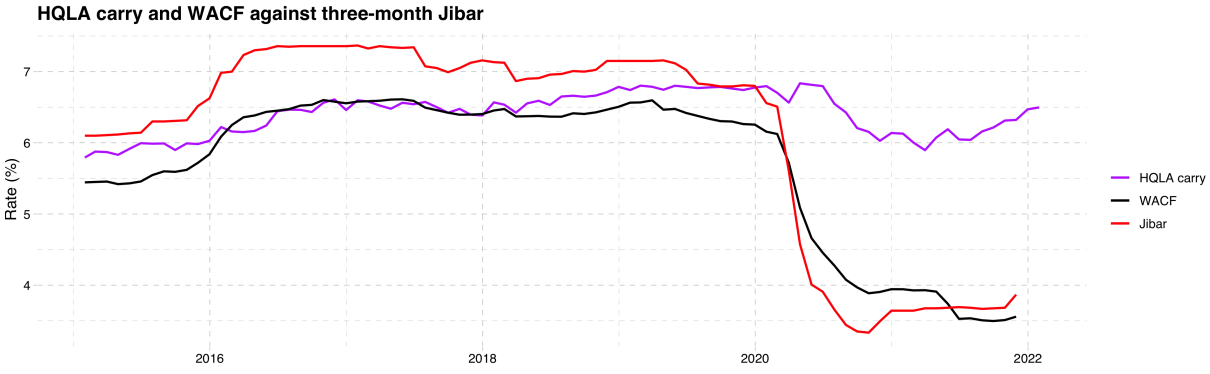


Table 2: NSFR factors in South Africa

Net stable funding ratio (NSFR)		**Specified factor**		
Available stable funding (ASF)	**Line no.**	$<$ 6 months	$\geq$ 6 months to $<$ 1 year	$\geq$ 1 year
Tier 1 and Tier 2 capital	1			100%
Capital instruments	2			100%
Stable deposits	3	95%	95%	100%
Less stable deposits	4	90%	90%	100%
Funding from non-financial corporates	5			
Operational deposits	6	50%	50%	100%
Non-operational deposits and funding	7	50%	50%	100%
Funding from central banks (total of items 9 and 10)	8			
Operational deposits	9	50%	50%	100%
Non-operational deposits and funding	10	0%	50%	100%
Funding from sovereigns/PSEs/MDBs/NDBs (total of items 12 and 13)	11			
Operational deposits	12	50%	50%	100%
Non-operational deposits and funding	13	50%	50%	100%
Funding from other legal entities (total of items 15 to 17)	14			
Operational deposits	15	50%	50%	100%
Non-operational deposits and funding raised in South Africa and denominated in ZAR, excluding banks	16	35%	50%	100%
Non-operational deposits and funding not included in line 16	17	0%	50%	100%
Deposits from members of the same cooperative network of banks	18	0%	0%	100%
NSFR-derivative liabilities (items 19 less 20)	19			0%
NSFR-derivative liabilities (gross of variation margin posted)	20			
Total variation margin posted	21			
Interdependent liabilities	22	As specified by the Registrar		
All other liabilities and equity categories not included above	23	0%	50%	100%
Total ASF (total of items 1 to 5, 8, 11, 14, 18, 19, 22, 23)	24			

Required stable funding (RSF)		**Specified factor**		
		$<$ 6 months	$\geq$ 6 months to $<$ 1 year	$\geq$ 1 year
Coins and banknotes	25	0%		
Total central bank placements (total of items 27 and 28)	26			
Required central bank reserves	27	5%		
Other placements with the central bank	28	0%	0%	0%
Securities with offsetting reverse repurchase transaction	29	0%	0%	0%
Deposits at cooperative network of banks	30	0%	0%	100%
Loans to financial institutions (total of items 32, 35 and 38)	31			
Loans to financial institutions secured by Level 1 collateral (total of items 33 and 34)	32			
Unencumbered	33	10%	50%	100%
Remaining period of encumberance	34	10%	50%	100%
All other secured loans to financial institutions (total of 36 and 37)	35			
Unencumbered	36	15%	50%	100%
Remaining period of encumberance	37	15%	50%	100%
Unsecured loans to financial institutions (total of 39 and 40)	38			
Unencumbered	39	15%	50%	100%
Remaining period of encumberance	40	15%	50%	100%
Securities eligible as Level 1 HQLA (total of items 42 and 43)	41			
Unencumbered	42	5%	5%	5%
Remaining period of encumberance	43	5%	50%	100%
Securities eligible for Level 2A HQLA (total of items 45 and 46)	44			
Unencumbered	45	15%	15%	15%
Remaining period of encumberance	46	15%	50%	100%
Securities eligible for Level 2B HQLA (total of items 48 and 49)	47			
Unencumbered	48	50%	50%	50%
Remaining period of encumberance	49	50%	50%	100%
Committed liquidity facility from the SARB	50			5%
Deposits held at financial institutions for operational purposes	51	50%	50%	100%
Loans to non-financial corporate clients (residual maturity $\geq$ 1 year)	52	50%	50%	
Loans to sovereigns, central banks, PSEs, MDBs and NDBs with a residual maturity of less than one year	53	50%	50%	
Residential mortgages ($<$ 35% risk weight)	54	50%	50%	65%
Other loans, excl. loans to financial institutions (residual maturity $\geq$ 1 year and $<$ 35% risk weight, total of items 55 and 56)	55			
Unencumbered	56			65%
Remaining period of encumberance	57	65%	65%	100%
Performing loans (except loans to financial institutions and loans reported in above categories, risk weights $>$ 35%)	58	50%	50%	85%
Non-HQLA exchange traded equities and physical traded commodities, including gold (total items 59 and 60)	59			
Unencumbered	60			85%
Remaining period of encumberance	61	85%	85%	100%
Non-HQLA securities not in default	62	50%	50%	85%
Other short-term unsecured instruments and transactions (residual maturity $\geq$ 1 year)	63	50%	50%	
All asset encumbered not included above	64	50%	50%	100%
NSFR-derivative assets (items 65 less 66)	65			100%
NSFR-derivative assets (gross of variation margin received)	66			
Cash variation margin received	67			
RSF associated with derivative liabilities	68			10%
Total initial margin posted	69			85%
Items deducted from regulatory capital	70			100%
Interdependent assets	71	As specified by the Registrar		
Trade date receivables	72	0%		
All other assets not included in above categories	73			100%
Total on balance-sheet RSF (total of items 25, 26, 29 to 31, 41, 44, 47, 50 to 55, 58, 59, 62 to 64, 65, 68 to 73)	74			
RSF - off balance-sheet items				
Irrevocable or conditionally revocable liquidity facilities	75			
Irrevocable or conditionally revocable credit facilities	76			
Unconditionally revocable liquidity facilities	77			
Unconditionally revocable credit facilities	78			
Trade finance-related obligations (including guarantees and letters of credit)	79			
Guarantees and letters of credit unrelated to trade finance obligations	80			
Non-contractual obligations (total of items 82 to 85)	81			
Debt buy-back requests (incl related conduits)	82			
Structured products	83			
Managed funds	84			
Other non-contractual obligations	85			
Total Off balance sheet RSF (total of items 75 to 81)	86			
Calculating the NSFR				
Total ASF (item 24)	87			
Total RSF (total of items 74 and 86)	88			
NSFR (item 87 divided by 88 multiplied with 100)	89			

Table □: LCR factors in South Africa

Component	BA300 Line	Specified factor
Total qualifying HQLA (total of items 99 and 114 to 117)	98	
Total Level 1 HQLA (total of items 100 to 104)	99	
Coins and banknotes	100	100%
Specified marketable securities from sovereigns, central banks, public sector entities, and multilateral development banks	101	100%
Qualifying central bank reserves	102	100%
Specified debt securities issued in rand by the central government of South Africa or the SARB	103	100%
Specified debt securities issued in foreign currency by the central government of South Africa or the SARB	104	100%
Total Level 2 HQLA (total of items 106 and 110)	105	
Total Level 2A HQLA (total of items 107 to 109)	106	
Specified marketable securities from sovereign, central bank, multilateral development banks and public sector entities	107	85%
Specified corporate bonds	108	85%
Other qualifying items (please specify)	109	85%
Total Level 2B HQLA (total of items 111 to 113)	110	
Specified residential mortgage-backed securities	111	75%
Specified corporate debt securities	112	50%
Specified common equity shares	113	50%
Total qualifying Level 2 high-quality liquid assets	114	
Committed central bank facility	115	Specified
Foreign currency liquid assets	116	Specified
Additional Level 2 HQLA	117	Specified
Retail deposits (total of items 119 and 124)	118	
Demand deposits and qualifying term deposits with residual maturity or notice period within 30 days (total of items 120 to 123)	119	
Specified stable deposits that meet the specified additional criteria	120	3%
Stable deposits that do not meet the specified additional criteria	121	5%
Less stable deposits	122	10%
Other	123	Specified
Term deposits with residual maturity greater than 30 days subject to withdrawal with a significant penalty, or no legal right to withdraw	124	Specified
Unsecured wholesale funding (total of items 126 to 134)	125	
Stable demand and term funding from small business	126	5%
Less stable demand and term funding from small business	127	10%
Specified term deposits with residual maturity greater than 30 days	128	Specified
Specified persons with specified operational relationship	129	25%
Portion of specified corporate deposits with specified operational relationship covered by deposit insurance	130	5%
Specified funding from cooperative banks in an institutional network	131	25%
Specified non-financial corporates, sovereigns, central banks and others (no operational relationship)	132	40%
Specified non-financial corporates, sovereigns, central banks and others (no operational relationship), entire amount fully deposit insured	133	20%
Other legal entities	134	100%
Secured funding (total of items 136 to 141)	135	
Secured funding backed by Level 1 HQLA or the SARB	136	0%
Secured funding backed by Level 2A HQLA	137	15%
Secured funding from specified counterparties backed by non-Level 1 or non-Level 2A	138	25%
Secured funding backed by residential mortgage-backed securities qualifying as Level 2B	139	25%
Secured funding backed by qualifying Level 2B other than Level 2B already specified	140	50%
Other secured funding	141	100%
Other expected outflows (total of items 143 to 152, 160, and 165 to 169)	142	
Net payable amount related to specified derivative transactions	143	100%
Outflows related to specified transactions such as collateral calls for specified downgrade	144	100%
Valuation changes on posted collateral securing derivative transactions that is comprised of non-level 1 HQLA	145	20%
Excess collateral held related to derivative transactions that could contractually be called at any time	146	100%
Liquidity needs related to collateral contractually due on derivative transactions	147	100%
Increased liquidity needs related to derivative transactions that allow collateral substitution to non-HQLA	148	100%
Market valuation changes on derivative transactions (largest absolute net 30-day collateral flows realised, preceding 24 months)	149	100%
Specified funding from asset-backed securities or other structured financing instruments	150	100%
Maturing funding from asset-backed commercial paper and required liquidity from assets that may be returned	151	100%
Committed undrawn credit or liquidity facilities (total of items 153 to 159)	152	
Retail or small business	153	5%
Credit facilities to non-financial corporates, sovereigns or central banks, public sector entities and multilateral development banks	154	10%
Liquidity facilities to non-financial corporates, sovereigns or central banks, public sector entities and multilateral development banks	155	30%
Credit or liquidity facilities extended to any other bank subject to prudential supervision	156	40%
Credit facilities extended to any financial institution other than banks subject to prudential supervision	157	40%
Liquidity facilities extended to any financial institution other than banks subject to prudential supervision	158	100%
Other legal entities	159	100%
Uncommitted undrawn credit or liquidity facilities (total of items 161 to 164)	160	
Retail or small business	161	Specified
Credit facilities to non-financial corporates, sovereigns and central banks, public sector entities and multilateral development banks	162	Specified
Liquidity facilities to non-financial corporates, sovereigns and central banks, public sector entities and multilateral development banks	163	Specified
Other legal entities	164	Specified
Trade finance instruments	165	Specified
Internally matched client assets against other clients' short positions	166	Specified
Specified contractual lending obligations	167	100%
Other specified outflows, such as dividend payments (please specify)	168	100%

Other	169	Specified
Total outflows (total of items 118, 125, 135 and 142)	170	
Maturing secured lending transactions secured by: (total of items 172 to 176)	171	
- Level 1 HQLA as collateral	172	0%
- Level 2A HQLA as collateral	173	15%
- eligible residential mortgage-backed securities qualifying as Level 2B HQLA as collateral	174	25%
- assets other than eligible residential mortgage-backed securities, qualifying as Level 2B HQLA as collateral	175	50%
- assets other than Level 1 or Level 2 HQLA as collateral	176	100%
Margin lending transactions secured by assets other than qualifying Level 2 or Level 2 HQLA as collateral	177	50%
Credit or liquidity facilities provided to the reporting bank	178	0%
Specified net inflows (total of items 180 to 182)	179	
- from retail and small business	180	50%
- from wholesale non-financial institutions	181	50%
- from financial institutions and central banks	182	100%
Specified deposits held at financial institutions for operational purposes	183	0%
Specified deposits held at a centralised institution in a cooperative banking network	184	0%
Net receivable amount from derivative instruments	185	100%
Other contractual cash inflows	186	Specified
Total inflows (total of items 171, 177 to 179, and 183 to 186)	187	
Total outflows (item 170, column 3)	188	
Total inflows (item 187, column 3)	189	
Total net cash outflows (item 188 minus min[item 189, 75% of item 188])	190	
Liquidity coverage ratio (item 98 divided by item 190, multiplied by 100)	191	

Appendix A: Estimates of bank FTP

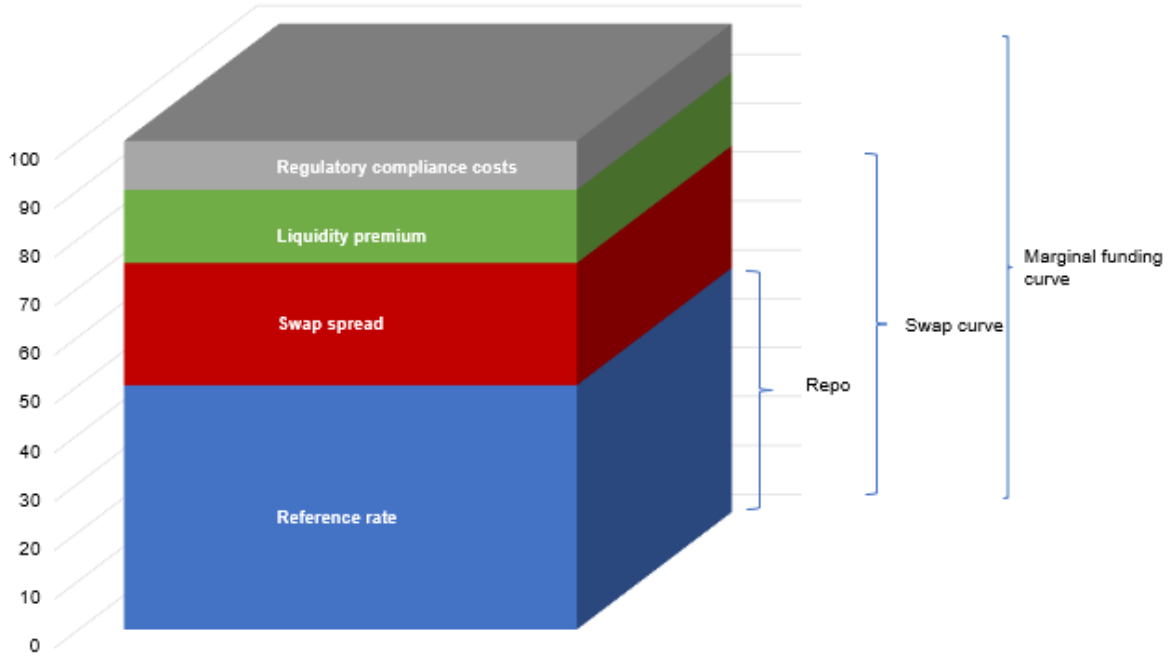
Bank funding costs affect bank loan and deposit rates, and therefore also lending volumes. But it is not only changes in the liability-side costs of raising funding that affect marginal funding costs of banks. The implicit costs of holding liquid assets also affect marginal bank funding costs via their impact on transfer pricing. Any assessment of the impacts of changes in prudential regulations on bank lending behaviour therefore also requires assessments of how these requirements affect the marginal funding costs of banks.

Figure 18 shows the components of FTP at a typical bank. It is made up of a reference rate (such as the overnight or repo rate), a swap spread (which incorporates the basis risk associated with interest rates when asset returns and liability costs are based on instruments of similar tenor but different reset frequencies), a liquidity spread (reflecting the premium over the swap curve to secure term funding for a specific maturity which compensates for credit risk and the opportunity cost of depositor funds) and regulatory compliance costs (such as the carrying costs associated with meeting HQLA requirement or South Africa's unremunerated reserve requirement, or meeting regulatory capital requirements).[38] Reference rates and swap curves (that is, rates over different tenors) can be observed in the market. Regulatory capital costs tend to be recouped by adding charges to the assets that banks produce separately to their FTP calculations.[39] Bank lending rates tend to be priced by adding premia that reflect credit risk, operating costs and a commercial margin to FTP rates, while deposit rates tend to be based on a markdown to FTP rates (see Cadamagnani et al. 2015 for discussion).

[38] FTP curve construction could also explicitly incorporate credit spreads, bond issuance costs or interest or exchange rate hedging costs, which are assumed to be part of liquidity premia in the representation in Figure 18.

[39] Some banks may also appropriate the premia associated with NSFR or LCR compliance to specific business units or separately estimate liquidity premia for different currencies.

Figure 18: Illustrative FTP decomposition

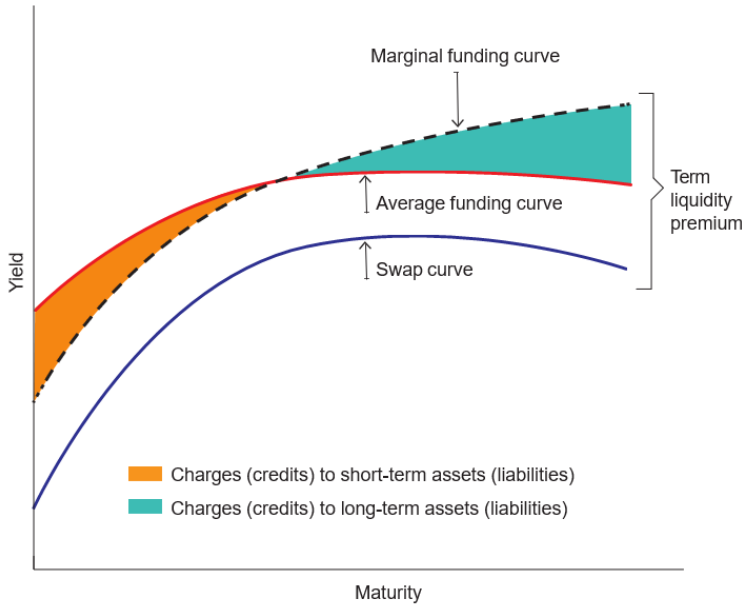


Different banks calculate their FTP rates (and their components) differently. International best practice is to estimate maturity-matched marginal funding costs for bank assets and liabilities, where business units receive (get charged) a transfer price that incorporates the maturity of the assets invested in (liabilities raised) (Grant 2011). The intention is to enable centralised management of interest rate and liquidity risk, allocation of liquidity value into the pricing of assets and liabilities, and attribution of the contributions of different business units to the interest margins of the bank as a whole. The approach incentivises deposit gathering and profitable asset-origination by providing credits from units that require funding to those that source it. Under this approach, a bank estimates a marginal cost of funds curve to estimate the opportunity cost of funding an additional unit of assets. This typically includes a maturity-specific liquidity premium over a base swap (or other reference) curve.

The specific point on the FTP curve used to pay for liabilities or charge to assets depends on a bank's approach to modelling the interest rate and liquidity risk associated with the expected maturity profiles of its assets and liabilities. Some banks explicitly estimate many different marginal funding cost curves to increase pricing accuracy. Figure 19 illustrates how the swap (base) curve for a specific asset (liability) tenor, estimated average funding cost curve and marginal funding cost curve can be used to determine term liquidity premia. As discussed earlier, the base rate can be calculated using an estimated swap curve that describes the estimated duration of different balance sheet items. The term liquidity premium characterises the charges to asset-generating business units and the credits accruing to liability-generating business units. Average cost (asset) and average benefit (liability) curves can be estimated using historical rates and prices by pooling across the assets and liabilities of the bank. The marginal cost of funds curve captures actual borrowing costs and can be estimated in a

variety of ways. The simplest approach is adding an estimated term premium (and add-ons as described above) to a chosen reference rate (often a swap curve to represent the term structure of interbank rates).[40] The term premium includes credit and liquidity risk associated with funding of a given maturity.

Figure 19: Illustration of maturity-matched marginal funding costs



Source: Grant (2011)

The Basel III principles emphasise the importance of liquidity mismatch management. As such, liquidity premia play an important role in bank FTP by aligning the charge for asset-originating business units and rewards for units that supply liquidity. Some banks align liquidity premia and charges by client and product type to encourage diversification of funding by source and tenor, and include FTP into client pricing. For example, the NSFR regulations create incentives for banks to enhance rewards for 'sticky' retail and operational deposits, and provide liquidity credits for high-credit, quality liabilities that are NSFR boosting. This is done while reducing premia for wholesale non-operational deposits that have low NSFR value, and paying up for long-maturity assets that tie up liquidity and represent a drag on NSFR.

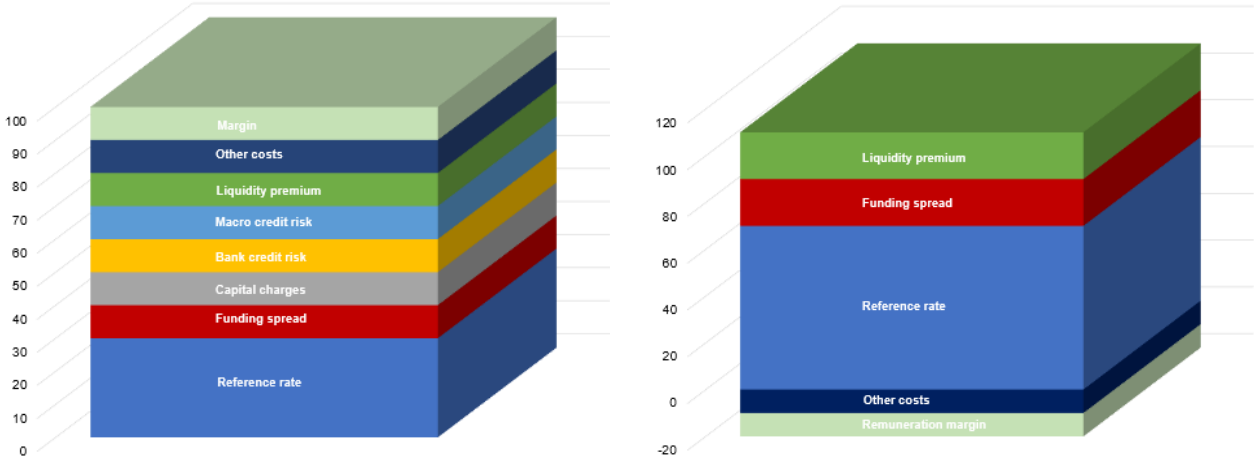
To understand why the cost of funding requirements and meeting liquidity buffer regulations has increased, one must consider changes in the funding mix for banks, including the composition of liquid asset holdings, and the cost impacts of regulatory changes from changes in market conditions. To illustrate how FTP rates have changed over time, we create summary measures of South African bank asset and liability FTP rates and liquidity premia by weighting together maturity- and product-level rates and premia across the portfolios of the banks surveyed.[41] We construct proxies of FTP rates (excluding liquidity premia) as well as proxies for aggregate

[40] Another commonly used approach is to estimate secured or unsecured wholesale funding curves.

[41] Where volumes data were not available, we use simple averages across components at bank-level before aggregating based on combined share in bank assets or liabilities. While this aggregation approach has obvious limitations, we are constrained by the survey responses and must preserve bank-level confidentiality.

asset and liability liquidity premia. Our estimates are illustrative only, as there are conceptual differences in the methodologies used by banks and some banks changed their methodologies over time. FTP rates and liquidity spreads are calculated in nominal interest rate terms but expressed as spreads over a reference rate (three-month Jibar).[42] Even though this analysis does not explicitly allow us to isolate the contribution of the NSFR and LCR regulations on FTP rates, these comparisons allow us to better understand how market conditions, together with the regulations, affected the determination of bank deposit and lending rate settings. As discussed in Greenwood-Nimmo et al. (2022) and illustrated in Figure 20, bank lending and deposit rate decisions are based not only on FTP rates, but also on other costs and margins, which tend to vary across products and over time.[43]

Figure 20: Illustrative decomposition of bank lending and deposit rate setting



Lending rates Deposit rates

The estimates suggest that funding costs (liabilities, Figure 21) have not followed the policy rate cycle: they rose over the last couple of years and matched policy rate easing over the course of the COVID-19 crisis. In the case of assets, base FTP rates are slightly higher on average than the liability measure, with a very similar profile over the sample (Figure 22). The liquidity risk premia embedded in FTP rates (which in this representation will include regulatory compliance costs) are also structurally higher than before the implementation of the liquidity regulations, consistent with what has been observed for long-term wholesale premia. This likely reflects a combination of higher term premia and credit risk (see Olds and Steenkamp 2021 for discussion). The liability FTP rate is higher than our weighted average liability funding cost proxy with similar profile overall. While our liability-side funding cost did not match the policy

We exclude banks that did not provide FTP rates where liquidity spreads could not be separated from FTP rates.

[42] Different banks use different base rates for different product FTP rates, such as the prime rate for mortgage products or Jibar for corporate rates, or they apply client-specific spreads to FTP, such as preferential rates for large customers. Liquidity premia are also constructed differently by different banks, with some using behavioural life considerations for different products and others using simple spread assumptions applied to term FTP rates.

[43] Few banks estimate capital charges explicitly, but estimation of the impact of capital charges, operating cost and margin changes on lending and deposit rates is an important avenue for future research.

rate decline over the COVID-19 period, this is true for the liability FTP proxy. As discussed earlier, these estimates are likely to be imprecisely calculated as the FTP methodologies of banks differ and have changed meaningfully over time. That said, these nevertheless help to enrich our understanding of the business drivers for liquidity risk management practices and the factors that affect loan and deposit pricing. Such data could be used in further research to quantitatively assess their contributions to developments in credit extension.

Figure 21: Estimated FTP decomposition (liabilities)

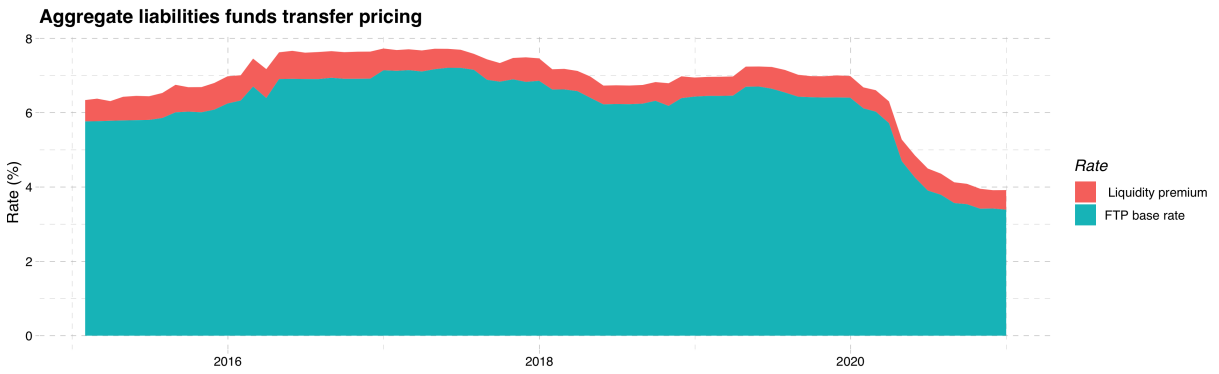


Figure 22: Estimated FTP decomposition (assets)

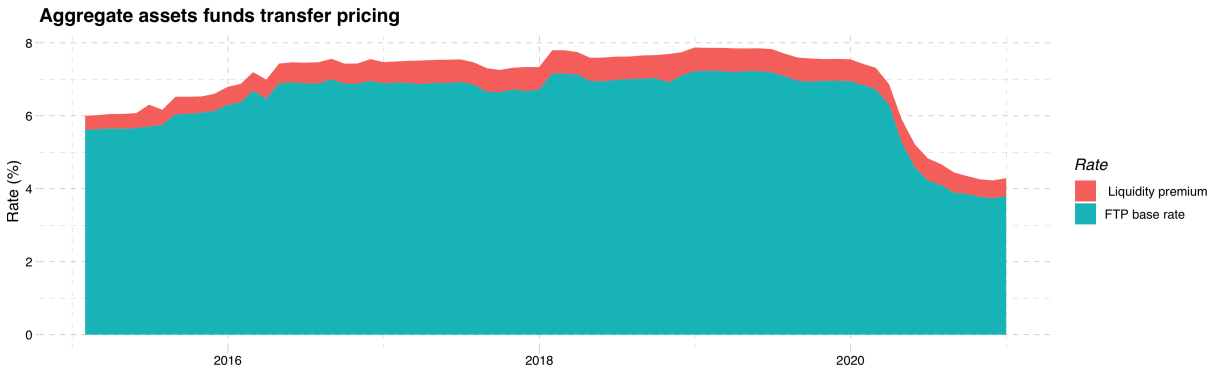
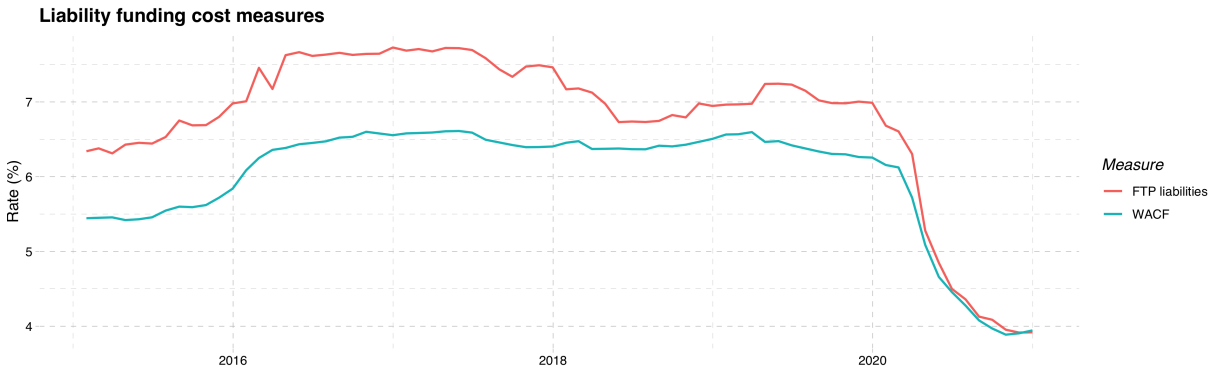


Figure 23: FTP (liabilities) vs WACF



Our survey revealed that the range of data formats and presentations for similar economic concepts was extensive across the large banks in South Africa. Each submission from different

reporting entities and SARB departments required data to be transformed to common data formats and structures requiring extensive data wrangling and cleaning effort. We recommend disclosure enhancement and the creation of a data taxonomy for bank liquidity data to improve comparability. In Figure 24 we provide an illustration of a standardised conceptual model for aggregating and comparing data across data concepts and institutions. A harmonised conceptual model with an appropriate multi-faceted taxonomy for observations would facilitate regular reporting and improve policy decision-making. We also recommend that more detailed breakdowns of liquidity buffers by asset type and maturity decompositions of assets and liabilities be made available to enable better assessment of the costs and benefits of liquidity regulation.

Figure 24: A data taxonomy for consistent definitions