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The South African Reserve Bank's Systemic Risk Assessment and Macroprudential Policy Frameworks for Financial Stability

1. Introduction¹

Following the 2007-2008 global financial crisis (GFC), there was increased focus by policymakers on the need for macroprudential policy frameworks to protect and enhance financial stability. The South African Reserve Bank (SARB) and the National Treasury (NT), in pursuit of its financial stability mandate, launched a formal review of its financial sector regulatory framework. The process was ensued by the promulgation of the Financial Sector Regulation Act No. 9 of 2017 (FSR Act). The FSR Act assigned responsibility to the SARB to monitor the strengths and weaknesses of the financial system and any risks to financial stability as well as taking steps to mitigate those risks. This can be achieved through the application of a toolkit of macroprudential policy instruments.

Increasing financial resilience is critical to minimise the large costs often associated with crises in the form of recapitalisation of distressed banks and the negative feedback loop to the real economy and financial sectors, such as a disruption to

¹ The authors would like to thank Ms Esti Kemp, Dr Greg Farrell and Mr Eddie Musasiwa for contributions to the paper.

lending activity, a sharp rise in unemployment and a decline in economic growth (Adrian, He, Liang and Natalucci, 2019). This paper outlines the SARB's systemic risk assessment and macroprudential policy framework for financial stability monitoring in the South African financial system. It takes into consideration the market structure of the domestic financial system as well as international best practice.

2. Systemic risk

Systemic risk refers to the risk of disruptions to the provision of key financial services that is caused by an impairment of all components or parts of the financial system, and which can cause serious consequences for the real economy. These components are made up of financial intermediaries, financial markets and the infrastructural platform which consist of payment, settlement and trading systems. Systemic risk disruptions can be transmitted to the real economy through various channels.

- **Dimensions of systemic risk**

Borio (2003) identifies two key dimensions of systemic risk, namely; (i) a time (cyclical) dimension; and (ii) a cross-sectional (structural) dimension. The time dimension indicates the build-up of systemic risk during cyclical upswings when agents underestimate the risks they are taking, which refers to its procyclicality. Procyclicality arises when mutually reinforcing interactions between the financial and the real sectors of the economy have the effect of amplifying financial cycle fluctuations, thereby causing financial instability. In essence, there is a collective tendency of financial firms, companies and households to assume excessive risks in the upswing of financial and credit cycles and then to become overly risk-averse in the downswing.

Cyclical risks also have the ability to amplify the impact of adverse aggregate shocks owing to feedback mechanisms between excessive credit growth, asset price bubbles, excessive leverage and maturity mismatches. If bubbles formed in asset markets (such as real estate and equities) burst, it can often lead to a rapid selling of assets, severe price declines, a credit crunch, and ultimately financial crises with potential spillover effects into the real economy. Cyclical risks can also develop as financial

firms and investors increase risk-taking in response to loose financial conditions, leading to a build-up of macro-financial imbalances (Smaga, 2014).

The cross-sectional dimension reflects common exposures which can cause a specific shock to spread and become systemic at any given moment in time. Common exposures arise when institutions have direct exposure to the same or similar asset classes or they have indirect exposures via counterparty relationships. Adverse aggregate shocks could be amplified through spillovers, contagion, moral hazard, opacity and complexity of financial institutions, markets and products. Additionally, the degree of concentration in the financial system, where a large portion of the financial system's functions are conducted by a few closely interconnected institutions (which are exposed to the same kind of risks and dependent on the same sources of funding), could also add significantly to the level of systemic risk in the financial system.

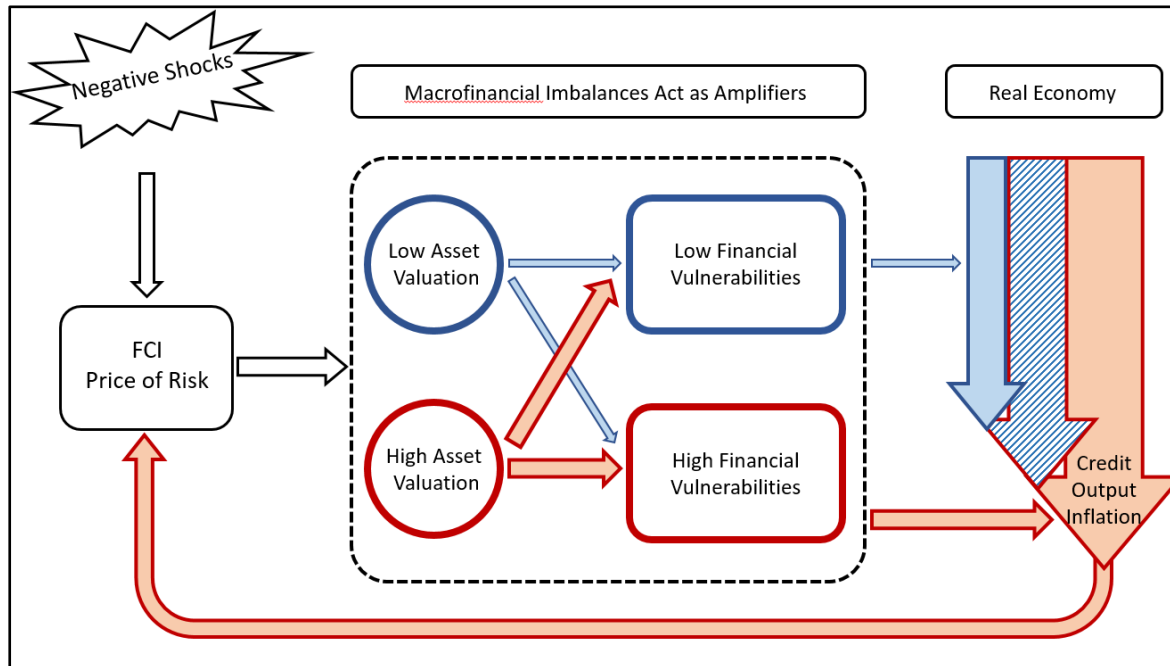
- **Transmission and amplification of shocks and risks to the real economy**

Systemic risks prevail as macro-financial imbalances rise due to increased risk-taking by lenders and borrowers. Elevated imbalances can amplify negative shocks that cause the price of risk to rise. Macro-financial imbalances develop endogenously during times of risk-taking while shocks are exogenous and difficult to predict. The imbalances act as amplifiers of shocks. High imbalances can amplify negative shocks and create an adverse feedback loops as prices fall and financial firms are forced to deleverage, leading to a sharp decline in economic growth (Adrian, et. al, (2019), Claessens and Kose (2017) and Muellbauer (2020)).

Adrian, et al 2019 notes that there are two amplification effects of negative shocks which can be transmitted to the real economy. The first mechanism involves high asset prices valuations while the second mechanism involves financial vulnerabilities. The effect of the former depends on whether asset are overvalued or undervalued with sharper price declines (if assets are overvalued). The latter states that the repricing of assets will be amplified if financial firms are highly leveraged and are forced to deleverage and sell assets in fire sales, which would lead to a further repricing. The net worth of borrowers falls and risk-management constraints of lenders become

binding, leading to declines in credit, economic growth, and inflation (Adrian, et. al, 2019) (Figure 1).

Figure 1: Transmission and amplification of shocks and risks to the real economy



Source: Adrian *et al.* (2019)

- **Example of market failure**

Systemic risk can arise from asymmetric and/or incomplete information, where one party to a transaction has inferior information about the conditions of a transaction compared to another party. This often results in the party with superior information taking on riskier projects at the expense of the other party. Marlor (1997:18) states that although institutions have satisfactory information about the business cycle to make rational decisions on the provision of loans, they may not have sufficient information on the behaviour of borrowers. A party might intentionally decide not to reveal all their information when entering into an agreement which is moral hazard/adverse selection. For example, in the case of insurance, companies or individuals could take part in risky activities knowing that they are insured, which constitutes asymmetric information as well as adverse selection and moral hazard. This can result in making depositors and bankers less vigilant and allow safer banks

to cross subsidize the more perilous ones. Tailoring financial institutions' insurance contributions to supervisors' could limit the impact of market failure, however, it should be the task of macroprudential policy (Sinclair and Farrell, 2018).

3. Examples of different approaches of systemic risk assessment frameworks in other jurisdictions

Systemic risk assessment frameworks have evolved over the decade in different jurisdictions and can be structured in various ways. We briefly note two approaches to monitoring and assessing financial stability risks in this section and include three other approaches in the Annexures.

Many institutions have found effective ways of monitoring systemic risks. The choice of monitoring and assessing risks depends on a number of factors such as the structure of the financial system. However, the main focus is assessing the build-up of vulnerabilities and how shocks could be amplified, thereby disrupting financial intermediation and impairing real economic activity. Conditional on the structure of the financial system, the institutions will tailor and enhance their monitoring frameworks according to their market structure and availability of the data.

3.1 The International Monetary Fund's Monitoring Framework for Global Financial Stability

(i) Monitoring framework and its financial stability indicators

The IMF's monitoring framework focuses on macro-financial linkages between the financial sector and the real economy. This conceptual framework is forward-looking in nature and emphasises the need for different indicators of vulnerabilities, particularly due to higher financial integration across countries. It consists of a systematic empirical approach to multilateral surveillance consisting of two parts: (i) regular monitoring of a broad set of indicators of macro-financial imbalances associated with negative externalities (for example, fire sales and contagion); and (ii) presenting a time series of downside risks to GDP growth, or growth at risk (GaR), alongside financial

conditions² indices and associated components. This involves GaR estimates for the short to medium term, which can be compared directly with their historical estimated values to judge the severity of risks. Table 1 provides a list of indicators identified by the IMF that can be used to monitor systemic risk.

Table 1: IMF examples of indicators that can be monitored

Types of indicators to be monitored	
Short term funding	Libor-OIS spreads
Sovereign debt	Term premiums; risk spreads; volatility; market depth; trading volumes
Corporate debt	Risk premiums, underwriting standards; market depth; trading volumes
Equities	Equity risk premium; implied volatility; volatility risk premium; market depth; trading volumes
Foreign exchange	Cross-currency spreads; FX implied volatility; market depth; trading volumes
Real estate – residential	House price growth, house price-to-rent deviation, lending standards
Real estate - commercial	Commercial property price growth; commercial price-to-income deviation; lending standards
Banking sector; Depository Institutions	<p><i>Leverage:</i> Regulatory capital; Stress test capital; Market-based capital measures; Off-balance-sheet assets and derivatives</p> <p><i>Maturity and liquidity mismatch:</i> Short-term wholesale funds ratio; Liquid asset ratios; Regulatory liquidity; Asset-liability duration gap; Collateral eligible for the discount window</p> <p><i>External debt claims and currency mismatch:</i> US\$ funding needs; Cross-border funding; Reliance on cross-currency FX swaps</p> <p><i>Interconnectedness and complexity:</i> Interbank claims; Non-bank financial claims; Cross-border activities; Price-based systemic risk measures</p>
Nonbank Financial Firms and Market-Based Finance	<p><i>Leverage:</i> Regulatory capital; Leverage ratios; Off-balance-sheet: assets and derivatives; Securitizations (risk retention); Margin credit; Collateralized borrowing and haircuts</p> <p><i>Maturity and liquidity mismatch:</i> Short-term wholesale funds ratio; Carry trades; Open-end funds and exchange-traded funds (with less liquid assets)</p> <p><i>External debt claims and currency mismatch:</i> Open-end and other funds invested in foreign debt</p>

² A financial conditions index (FCI) comprises asset prices that are conditional on the state of the economy and are often an important leading indicator of GDP growth. Additionally, financial stability assessments should also capture the effects they have on the build-up of vulnerabilities and conditional downside risks to growth following periods of a low price of risk.

Types of indicators to be monitored

	<i>Interconnectedness and complexity:</i> Claims on banks; Claims on other non-bank institutions; Financial innovations that introduce complexity; Common business models (e.g. index funds)
Central Counterparties (CCPs)	<i>Leverage:</i> Capital; Default fund; Margins; Credit lines <i>Maturity and liquidity mismatch:</i> Liquidity lines <i>Interconnections and complexity:</i> Members provide services to CCPs; Members are connected to multiple CCPs
Private Nonfinancial Households	<i>Leverage:</i> Credit to GDP; Credit growth; Debt service; Lending standards <i>Maturity and liquidity mismatch:</i> Debt with adjustable rates <i>Interconnectedness and complexity:</i> Debt overhang; Home foreclosure externalities
Private Nonfinancial Business	<i>Leverage:</i> Credit to GDP; Credit growth; Interest coverage; Lending standards <i>Maturity and liquidity mismatch:</i> Short-term debt; Adjustable-rate debt; Liquid assets; Liquidity and depth of securities market <i>External debt claims and currency mismatch:</i> Debt issued in foreign currencies
Government Sector	<i>Leverage:</i> Government debt to GDP; Debt growth; Off-balance-sheet liabilities <i>Maturity and liquidity mismatch:</i> Debt maturity profile; Short-term debt; Liquidity and depth of market <i>External debt claims and currency mismatch:</i> External debt; US dollar versus local currency debt; Short-term debt to foreign exchange reserves; Capital flows

Source: IMF (2019)

Note: FX = foreign exchange; LIBOR = London interbank overnight rate; OIS = overnight indexed swap.

(ii) Growth at Risk approach to assessing financial stability

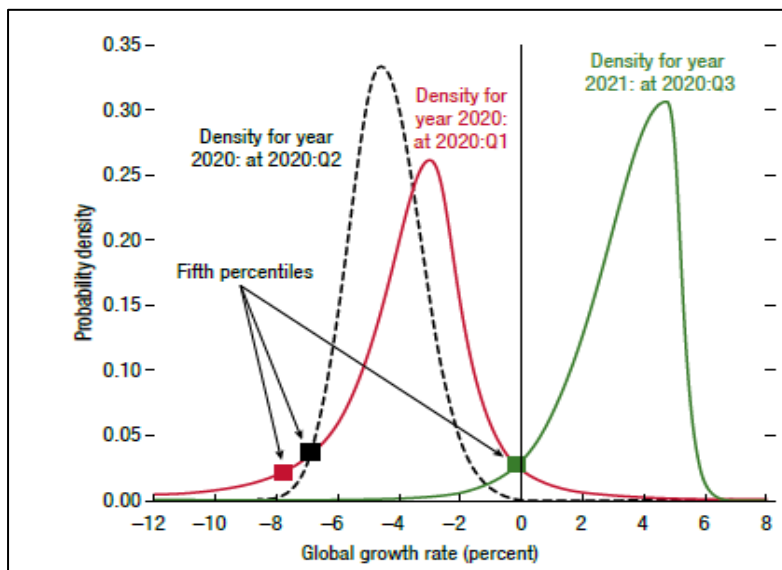
The IMF's GaR measure is a top-down approach and captures downside risks to GDP growth, by monitoring financial conditions (IMF, 2017). GaR links current financial conditions to the distribution of future growth outcomes. Prasad, Elekdag, Jeasakul, Lafarguette, Alter, Feng and Wang (2019) found that the GaR provides best results when quantifying macro-financial risks to growth. It assesses the relative importance of the macro-financial factors that impact the entire probability distribution of future GDP growth, and its ability to monitor how risks to economic activity may evolve over

time. The authors note that it provides desirable results for enhancing macro-financial surveillance.

According to the IMF (2017), the GaR is a useful approach to assess whether the tightening or easing of financial conditions is on net macro-critical and may therefore put financial stability and future growth at risk. It is defined as a low percentile of the conditional GDP growth distribution and the lower fifth percentile of the distribution is chosen in the model (Figure 2), although it is possible to use other percentiles. In essence, GaR implies that there is a 5% probability that forecast growth will be lower than that value in the event that a shock occurs. When the loosening of financial conditions is associated with increasingly stretched asset valuations and with rising leverage, the GaR measures the extent to which increased financial vulnerabilities could dampen growth in the future if adverse shocks occur. The financial conditions indicators that feed into the GaR model include a wide range of price-of-risk and leverage metrics for different countries, sectors and asset markets.

GaR is deemed effective in capturing growth distributions in their entirety, encompassing both downside and upside risks. Furthermore, GaR provides a framework for analysing key drivers of future GDP growth, including their relative importance, which vary across the growth distribution and the forecasting horizon. Lastly, it quantifies the impact of systemic risk on future GDP growth and therefore holds promise for guiding macroprudential policy (Prasad et. al 2019). Adrian, Boyarchenko and Giannone (2019) apply the same methodology in the US and find that the upside risks to GDP growth are low in most periods while downside risks increase as financial conditions become tighter. They argue that amplification mechanisms in the financial sector generate the observed growth vulnerability dynamics.

Figure 2: Global growth at risk



Source: IMF, *Global Financial Stability Report*, October 2020

3.2 US Federal Reserve Board

The US Federal Reserve Board (Fed) monitoring framework for financial stability makes a strong distinction between shocks and vulnerabilities in the financial system. Shocks are sudden changes to financial or economic conditions that are difficult to predict. Vulnerabilities, on the other hand, have the tendency to build up over time and are expected to cause spillovers under stressed financial conditions. Against this background, the Fed's monitoring framework mainly focuses on assessing vulnerabilities under four broad categories:

- (i) *Elevated valuation pressures*: Valuation pressures are a sign that asset prices are excessively high relative to economic fundamentals or historical trends. These developments are largely driven by a risk-on environment;
- (ii) *Excessive borrowing* by businesses and households: Excessive borrowing could leave businesses and households vulnerable to an economic downturn, if incomes decline or assets fall in value. In the event of such shocks, firms and households that are over-indebted are the most vulnerable.

- (iii) *Excessive leverage* within the financial sector: In the event of an adverse shock, firms would be under pressure to absorb losses and might be forced to scale back on lending, sell assets or even close down their businesses. These developments could result in reduced access to credit for firms and households.
- (iv) *Funding risks*: In periods of stressed financial conditions, investors could withdraw their funds rapidly from a particular institution or sector. Most firms raise funds from the public with an obligation to pay back these investment funds on short notice, and most of these funds can be invested in illiquid assets that are difficult to sell quickly or in assets that have a long maturity. In the event of a stress event or adverse conditions, this liquidity and maturity transformation can result in a quick withdrawal of funds by investors. Facing a potential run, firms may need to engage in "fire sale" activities that could further result in substantial losses, with some firms even becoming insolvent.

The Fed's monitoring framework also assesses domestic and international developments to identify short-term risks and focuses on potential shocks affecting financial stability in the US financial system, given the four broad areas of vulnerabilities. Table 2 provides a list of the indicators that are monitored by the Fed.

Table 2: Fed examples of indicators that can be monitored

Types of indicators to be monitored	
Asset valuation: Size of asset markets (outstanding institutional leveraged loans, growth (y/y), average annual growth since 1997)	Residential real estate; Equities; Commercial real estate; Treasury securities; Investment-grade corporate bonds; Farmland; High-yield and unrated corporate bonds; Leveraged loans; Price growth (real): Commercial real estate and residential real estate
Borrowing by businesses and households (outstanding institutional leveraged loans, growth (y/y),	Total private nonfinancial credit; Total business credit; Corporate business credit; Bonds and commercial paper; Bank lending; leveraged loans; Non-corporate business credit; Commercial real estate; Total household credit; Mortgages;

average annual growth since 1997)	Consumer credit; Student loans; Auto loans; Credit cards; Nominal GDP
Leverage in the financial sector (total assets, growth (y/y), average annual growth since 1997)	Banks and credit unions; Mutual funds; Insurance companies; Property and casualty; Hedge funds; Broker-dealers; Securitization; Agency; Non-agency
Funding risks (Total assets outstanding; growth (y/y), average annual growth since 1997)	Total runnable money-like liabilities; uninsured deposits; Repurchase agreements; Domestic money market funds; Commercial paper; Securities lending; Bond mutual funds

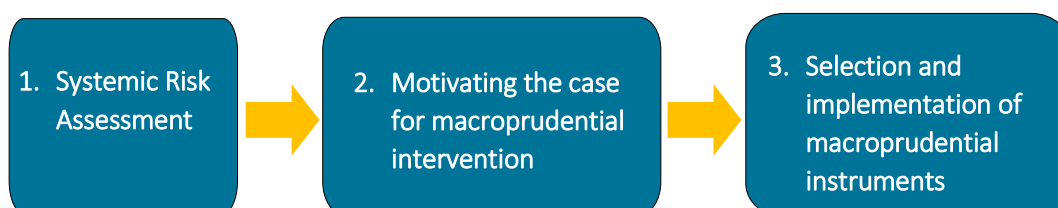
Source: Fed (2019)

The SARB also considers the monitoring frameworks of other key jurisdictions such as the Bank of England, De Nederlandsche Bank and Bundesbank, among others. Indicators of the above-mentioned jurisdictions are included in Annexures 1, 2 and 3, respectively.

4. The SARB’s three-step process of systemic risk assessment and macroprudential policy

The SARB’s framework for monitoring financial stability consists of three steps that culminate in the process of activating macroprudential instruments, namely (i) a systemic risk assessment; (ii) motivating a case for macroprudential intervention and; (iii) selecting and implementing the macroprudential instruments steps (Figure 3).

Figure 3: SARB’s frameworks of systemic risk assessment and macroprudential policy



Source: SARB

The *first step* towards systemic risk assessment is to design a monitoring framework. The SARB's monitoring framework is broadly based on the International Monetary Fund (IMF) and the United States Federal Reserve Board (Fed) frameworks. The framework was designed using international best practice and is evolving to better capture the specific structure of the South African economy and financial system. The SARB's assessment of risk covers global and regional developments, asset markets, systemically important financial institutions (SIFIs), non-bank financial intermediaries (previously referred to as shadow banks) and the non-financial sector (non-financial corporates, households and government). Analysis is done on an aggregate and sectoral level.

Other key measures of systemic risk that act as early warning signals include, among others, the heat map, the financial cycle, the financial conditions index (FCI), growth at risk (GaR) and the systemic risk contribution of individual financial firms (known as SRISK) and the credit-to-GDP gap. The risk assessment matrix (RAM), presented to the Financial Stability Committee (FSC) each quarter and published in the *Financial Stability Review (FSR)*, are compiled by using these measures of systemic risk.

The *second step* in the framework is for the FSC and other stakeholders to interrogate whether there is a case for macroprudential intervention. There would need to be consideration on whether systemic risk across the financial system would deepen if left unattended to. The GFC demonstrated that traditional microprudential policy³ on its own is not sufficient to guarantee the stability of the financial system.

The case for macroprudential intervention also takes into consideration:

- the potential cost relative to the expected benefits of the intervention;
- that inactivity may also have costs;
- the possible trade-off between missing the build-up of risk and implementing measures that are not needed;
- interactions with other policies such as monetary, fiscal, among others

³ Microprudential policy focuses on the health of individual financial institutions, while macroprudential policy addresses risks to the financial system as a whole (IMF, 2013)

- the appropriate timing of an intervention. A badly timed activation/deactivation could have a poor signaling effect to markets and unintended consequences of amplified procyclicality.

The *third step* in the framework is to select and implement macroprudential instruments that are intended to target the sources of systemic risk. Macroprudential instruments or policy tools that target the sources of systemic risk and are generally classified into three categories; namely (i) capital-based instruments; (ii) asset-side instruments; and (iii) liquidity-based instruments.

When designing macroprudential policy framework, it is important to take into consideration that macroprudential policy instruments are not only be targeted at the banking sector but can also be focused on systemic vulnerabilities arising from non-bank SIFIs, NBFIs, asset markets and the non-financial corporate sector, among others. Macroprudential policy instruments of the SARB are discussed in more detail in Section (5.2).

5. The SARB's Systemic Risk Assessment and Macroprudential Policy Framework

5.1 SARB's Systemic Risk Assessment Framework

The SARB's systemic risk assessment framework is broadly based on the IMF and the Fed programmes, but also builds into its framework key indicators used by other jurisdictions, with the main focus on systemic vulnerabilities that propagate adverse shocks (Adrian *et al*, 2015; Bernanke, 2013). The framework consists of the compilation of and monitoring of time-varying and cross-sectional risks that allow a focus on build-up of risks, which could manifest into vulnerabilities when adverse shocks impact the financial system. Risk assessments are done on global and exogenous developments, asset markets, SIFI's, NBFIs and the non-financial sector.

The SARB's systemic risk framework seeks to address the following key questions:

- Is potentially excessive risk building up in financial institutions?
- Are asset prices growing too fast or is there is disconnect with economic fundamentals that could cause an abrupt repricing?
- What are the potential shocks that could trigger vulnerabilities and cause feedback loops?
- Which parts of the financial and non-financial sectors would be affected initially?
- What second-round effects and interaction effects between the real economy and the financial system, or between financial sector participants might be set in play?
- What are the amplification channels through cross-border spillovers?
- How would the combined effects of the various transmission channels affect South African financial system stability?
- What is the probability of a systemic crisis?

5.1.1 Components of the SARB’s systemic risk assessment framework: Broad areas monitored

The next section provides a brief overview of the systemic risk monitoring exercise in each of the broad areas (Table 6). The set of indicators used by the SARB is likely to vary over time, as circumstances dictate and new risks emerge. An analysis of these indicators is published in the bi-annual *Financial Stability Review* publication of the SARB.

Table 3: SARB’s key systemic risk indicators

Monitoring area	Example of entities or activities	Examples of indicators ⁴
Global developments	monetary and fiscal policy in advanced economies and emerging markets, political environment and geopolitical environment	Fed funds rate Global debt to GDP ratios Emerging market debt ratios Capital flows to emerging markets
Asset markets	Equity prices and volatility, interest rates fluctuation, domestics and foreign, credit markets, commodities, exchange rates	Equity premium, corporate bond spreads, price-to-earnings ratio, real share price indices (global and domestic), the VIX, bond spreads and sovereign CDS spread
Banking sector (SIFI)	Banks	Concentration of exposures, common exposure analyses, ratio of equities-to-assets, assets to GDP, the liquidity coverage ratio, the loan-to-deposit ratio, capital adequacy ratio, profitability ratios
Non-bank financial intermediation (NBFI)	Insurance, pension funds, investment funds, money-market funds, broker dealers, finance companies,	Distribution of assets among financial intermediaries, Size of the NBFI, Interconnectedness among financial intermediaries, non-bank credit-to-GDP

⁴ Note: this is not an exhaustive list of indicators.

Monitoring area	Example of entities or activities	Examples of indicators ⁴
	trust companies, structure finance vehicle etc.	gap, other financial institutions' (OFI) assets-to-GDP gap and NBFIs assets-to-GDP gap. (Banks and non-banks), CISs portfolio analyses.
Insurance sector	Insurance companies	Penetration ratio (individual lapse ratio) and assets to GDP, composition of the insurance sector; insurance density; reinsurance retention rate; combined ratio – non life insurers; and insurer concentration, gross written premiums (life and non-life insures); SCR cover ratio
Non-financial sector	Households	Debt-to-GDP ratio, the debt service ratio, debt-to-disposable income and credit growth
	Non-financial corporate sector	Debt-to-GDP (local and foreign), debt to net operating profit, credit growth and the interest coverage ratio (ICR)
	Government sector	Government guarantees in addition to the ultimate holders. Government debt-to-GDP ratio, loan debt of national government, government debt holdings by financial institutions; local and foreign reserve holdings.
Other measures of systemic risk⁵	Financial Cycle (FC)	FC: credit aggregates, house prices and equity prices (JSE)
	Financial Conditions Index (FCI)	FCI: 30 indicators from credit, foreign exchange, real estate, foreign, funding and equity markets

⁵ 'Other measures of systemic risk' will be discussed in more detail in (vii) below.

Monitoring area	Example of entities or activities	Examples of indicators ⁴
	Heatmap	Heatmap – uses all majority of the indicators in the different sectors mentioned above.
	S-RISK	GDP-at-risk- FCI, GDP growth
	GDP-at-risk	Credit-to-GDP gap – Credit aggregates for non-financial sector and GDP figures

Source: SARB, 2021

(i) Global developments

South Africa has become increasingly integrated in the global financial system. Additionally, countries are also becoming more interconnected as financial intermediaries operate across national borders and financial markets as well as transactions become more intertwined. Areas of monitoring include global financial stability developments (advanced and emerging markets); monetary and fiscal policy changes; economic growth, political developments; global financial conditions; among others.

(ii) Assets markets

The SARB's systemic risk framework monitors developments for a range of assets, including public and private fixed-income instruments, equities, real estate, commodities, and structured credit products. Foreign and domestic markets are included, as well as global linkages that may be important. The objective is to identify unusual patterns in valuations, such as historically high or low ratios of price-to-earnings in equity markets, using a variety of models and methods. The monitoring exercise also considers factors such as the leverage and degree of maturity mismatch, liquidity, and the sensitivity of the asset's value to changes in broad financial conditions.

Shocks arising in the real economy can be propagated through financial markets, thereby amplifying business cycles. Shocks could also arise from financial markets, which, in turn, can lead to severe macroeconomic fluctuations. When asset prices increase to historic high levels, risks could emerge when prices abruptly revert to normal levels and potentially cause financial instability (Adrian, Covitz and Liang, 2015).

(iii) Systemically important financial institutions (SIFI's)

SIFIs are firms whose distress or failure could disrupt the functioning of the broader financial system and inflict harm on the real economy. Disruptions could potentially cause issues such as the expectation of government support insolvent institutions and failure to internalise private-sector coordination. The SARB monitors standard indicators, and also has access to confidential supervisory information and requires comprehensive recovery plans. The standard measures for systemic vulnerabilities include indicators that reflect interconnectedness of the sector, balance sheet (sector-wide value of assets to equity), credit risk indicators, profitability and capital adequacy liquidity, regulatory capital and leverage ratios, asset liquidity, and wholesale short-term funding.

The SARB is the process for developing a methodology to determine which insurers are systemically important within the South African context. The International Association of Insurance Supervisors (IAIS) indicators were utilised to assist in the evaluation of systemic risk are in line with the BCBS G-SIB methodology. The approach utilizes the categories similar to those used to determine G-SIBs, but the sub-indicators of each category have been aligned to better fit the insurance business in South Africa. The indicators that are used for the methodology is the size, interconnectedness, substitutability and complexity. These indicators have sub-indicators that will be also assessed.

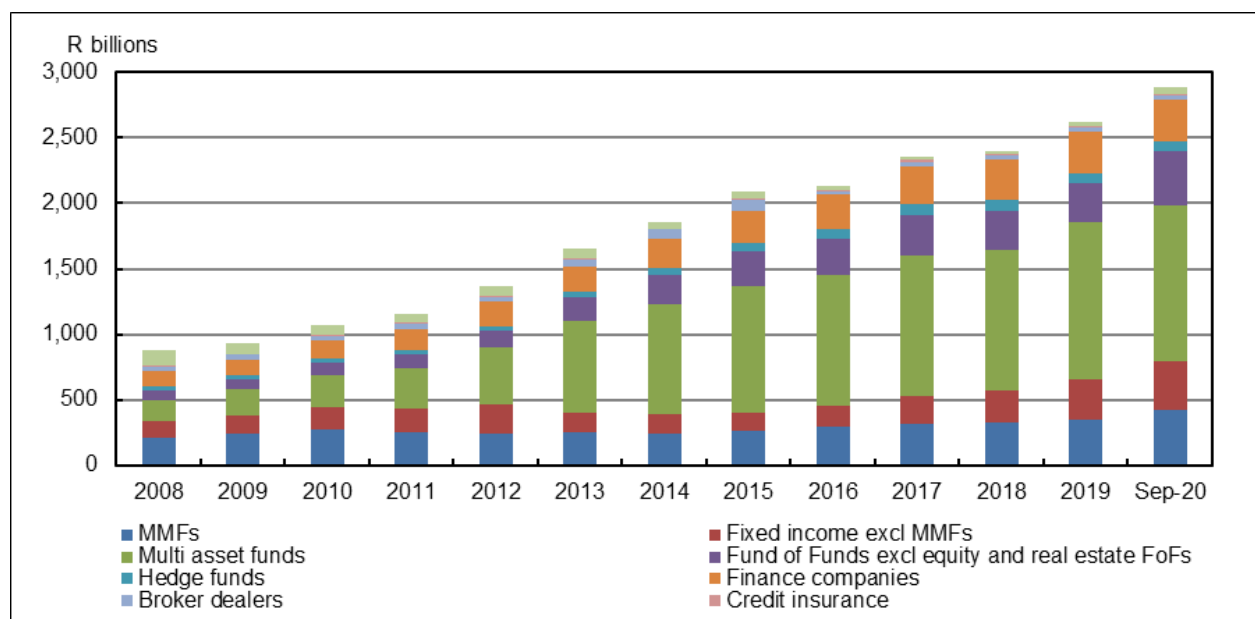
(iv) Non-bank financial intermediation (NBFI)

In 2018, the FSB adopted the term the ‘non-bank financial intermediation’ to replace the previously used term ‘shadow banking’. According to the FSB (2019), non-bank financing is a valuable source of financing for many corporates and households⁶. It facilitates competition among financing providers and is supportive of economic activity. Although additional sources of financing is a huge benefit to the economy, non-bank financing may become a source of systemic risk. This can be both directly and through its interconnectedness with other parts of the financial system, especially if it involves activities that are typically performed by banks, such as maturity/liquidity transformation and the creation of leverage. The ongoing FSB monitoring exercise continues to improve and the SARB will take lessons from time to time.

The size of NBFI sector in South Africa is increasing at a faster rate than the banking sector, and the sector has become an increasingly important area of monitoring (Figure 4). There are several ways to monitor the NBFI as it varies across jurisdictions and evolves over time. The FSB (2011) proposes stylised steps for monitoring, drawing on different types of information and analytical methods from both the macro (system wide) and micro (entity/activity based) perspectives. National flow of funds and sector balance sheet data are particularly important. Since 2018, more data has been collected by the SARB from various areas, such as repurchase (repo) assets and liabilities, total liabilities and interconnectedness.

⁶ The shift to non-bank financing has also become quite prominent in South Africa over the past five years.

Figure 4: NBFi activities in South Africa



Source: SARB, 2020

The three steps identified as important in the monitoring exercise are as follows (SARB, 2016):

- Scanning and mapping of the overall NBFi;
- Identification of the aspects of the NBFi sector that poses systemic risk or regulatory arbitrage concerns; and
- Detailed assessment of systemic risk and/or regulatory arbitrage concerns.

The SARB is increasing its focus on the assessment of risks and vulnerabilities in the NBFi sector and will endeavour to align its work with that of the current priorities of the Group of Twenty (G20) and the FSB⁷, particularly in light of the frictions in the sector caused by the COVID-19 crisis.

(v) Non-financial sector

Excessive growth in credit and leverage in the private non-financial sector is a key indicator of systemic risk, as the non-financial sector are the largest clients to financial

⁷ See FSB work priorities on: <https://www.fsb.org/wp-content/uploads/P250221.pdf>

institutions. Highly indebted households and non-financial corporates are more vulnerable to negative shocks to incomes or asset values. Measures of vulnerabilities in the nonfinancial sector include aggregate indicators of excessive leverage and debt service burdens. (e.g. debt growth and debt-to-GDP ratios). Indicators of credit conditions, such as underwriting standards, are also important, as are credit-to-GDP ratios and gaps, which were found to provide reliable signals ahead of systemic banking crises (Drehmann, Borio and Tsatsaronis, 2011)⁸. Balance sheet and income statements data can provide valuable information about the vulnerabilities in the sectors. Such indicators include interest coverage ratios and their stressed counterparts, as well as disaggregated data for households.

(vi) Government finances

Government finances are important for financial stability. A government's responsibility is to create a stable environment and infrastructure of legal rules and practice and timely, accurate information, supported by regulatory and supervisory arrangements that help ensure constructive incentives for financial market participants. Success will promote growth and stabilise the economy on a higher growth path. However, sovereign debt can also cause crises and is viewed as a crucial component of a country's macroeconomic and financial policy framework.

The recent heightened attention on sovereign risk from policymakers and financial markets stems from the fact that public debt management considerably influences the soundness and solvency of the overall public sector balance sheet (Litsios and Pilbeam, 2017, Niemann and Pichler, 2020). Therefore, debt management is also perceived as an important factor underpinning the credibility and reputation of a sovereign. Debt management also impacts the stability of debt capital markets and the financial institutions that hold public debt (Das, Papaioannou and Trebesch, 2012). Overall levels and trends in government debt should be monitored, in addition to government guarantees (to parastatals and perhaps even to banks), and the ultimate

⁸ The Basel Committee on Banking Supervision (BCBS) has suggested in its guidance to national authorities (BCBS, 2010) that the credit-to-GDP gap be used as a guide for deploying Basel III countercyclical capital buffers.

holders of government debt (direct interconnectedness); local and foreign reserve holdings.

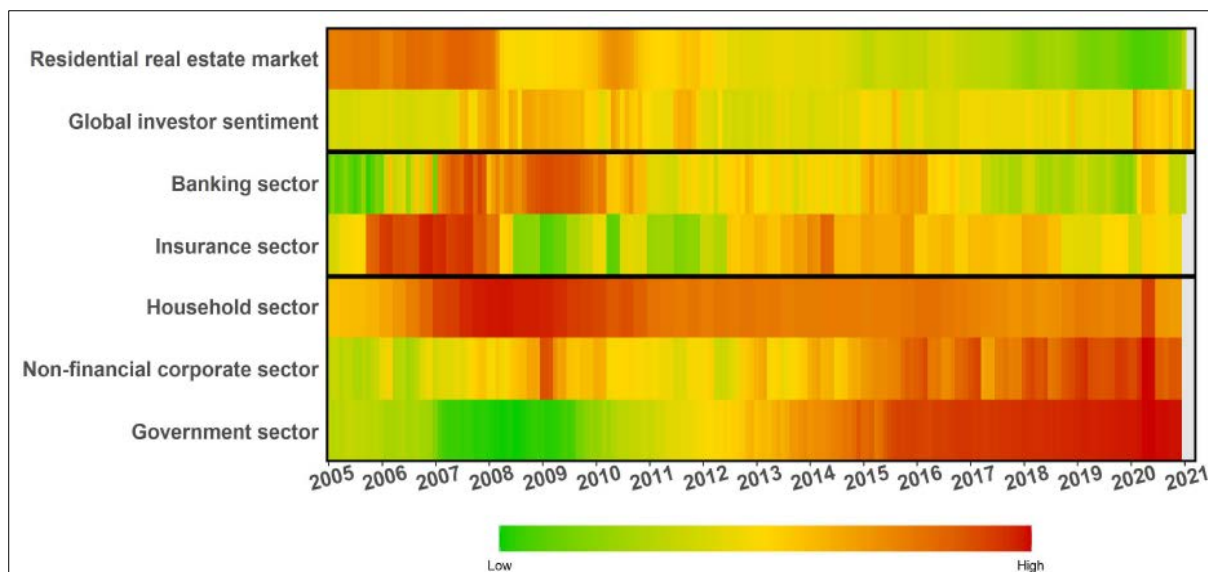
(vii) Other measures of systemic risk

Additional key indicators/measures are included in the SARB's monitoring framework, which provides a broad indication of the change in risks to financial stability, and are therefore useful monitoring tools for policymakers. These include the following:

- Heat map

The heatmap provides a visual presentation of the development of possible financial stability risks and the build-up of vulnerabilities in the financial system by tracking the development of various macroprudential and macroeconomic indicators over time. It represents data in the form of a map or diagram where data values are represented by colours. The heatmap is compact and provides an easy to grasp visualisation of a large amount of data, making it easier to identify patterns and trends and to communicate risk assessments to a broad audience.

Figure 5: SARB's financial stability heat map



Source: SARB, 2021

- The financial cycle

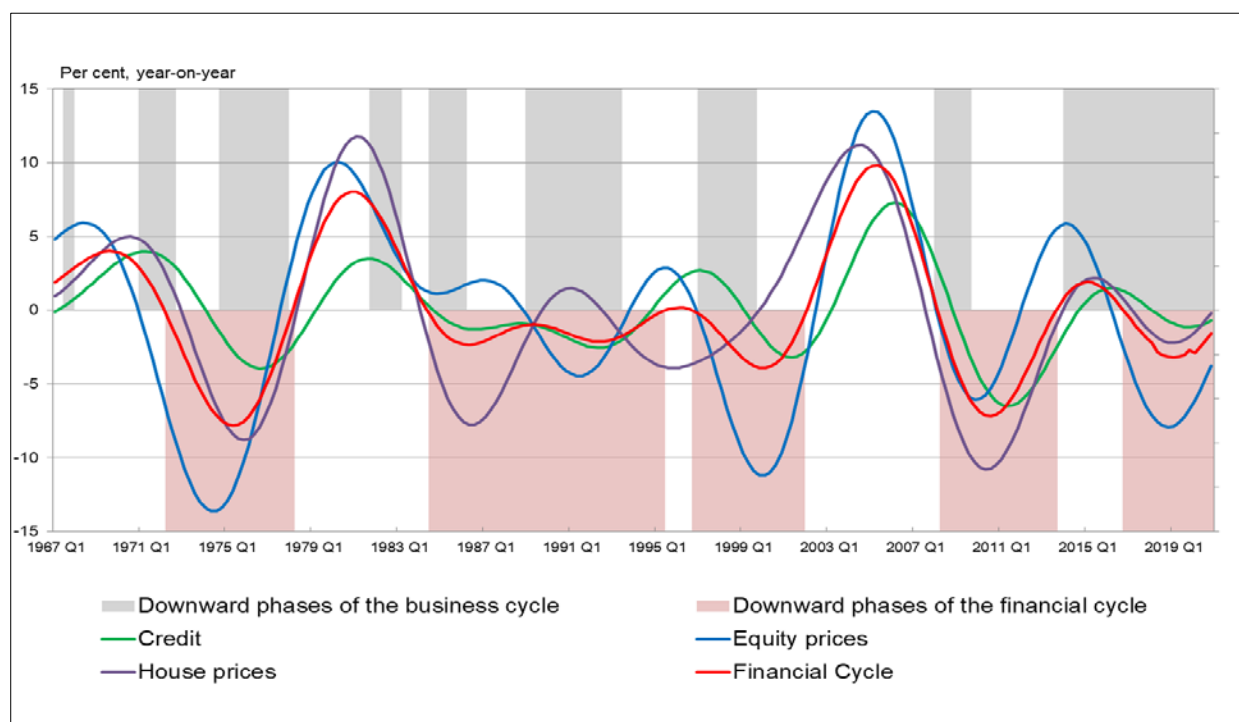
The financial cycle provides a broad indication of the change in risks to financial stability and as such, provides a useful monitoring tool for policymakers. The financial cycle denotes self-reinforcing interactions between perceptions of value and risk, attitudes towards risk and financing constraints, which translate into booms followed by busts (Borio, 2014).

Financial cycles are generally measured by the co-movement of a broad set of financial variables (BIS, 2015). Financial cycles are identified using credit, house prices and equity prices. Credit aggregates (which can be used as a proxy for leverage), together with property prices (a measure of collateral available) are jointly important for the financial cycle because of mutually reinforcing feedback effects. Strong growth in credit extension, specifically mortgage credit, often results in higher property prices. In turn, higher house prices boost collateral values and the amount of credit the private sector can obtain. Such interactions have been associated with the most serious bouts of financial instability.

The SARB measures the financial cycle in South Africa using three different methodologies, namely (i) applying a traditional turning point analysis to detect peaks and troughs in the individual component variables that make up the financial cycle; (ii) applying a frequency domain approach that uses band-pass filters to isolate the cycles that correspond to medium-term frequency intervals; and (iii) using a multivariate model-based approach to extract cycles using unobserved components time series models. A comparison of the results of the three approaches is done to compare the estimates of the financial cycle with those of the business cycle to determine whether the cycles are distinct from one another (Farrell & Kemp, 2017).

In Figure 6, Christiano-Fitzgerald band-pass filters (that aim to allow frequencies of 32-120 quarters and attenuate all other frequencies) have been applied to constant price data to extract the medium-term cycles in credit, equity prices and house prices. These are then averaged to obtain an estimate of the financial cycle (the thick red line).

Figure 6: The financial cycle of the SARB



Source: SARB

- Financial Conditions Index

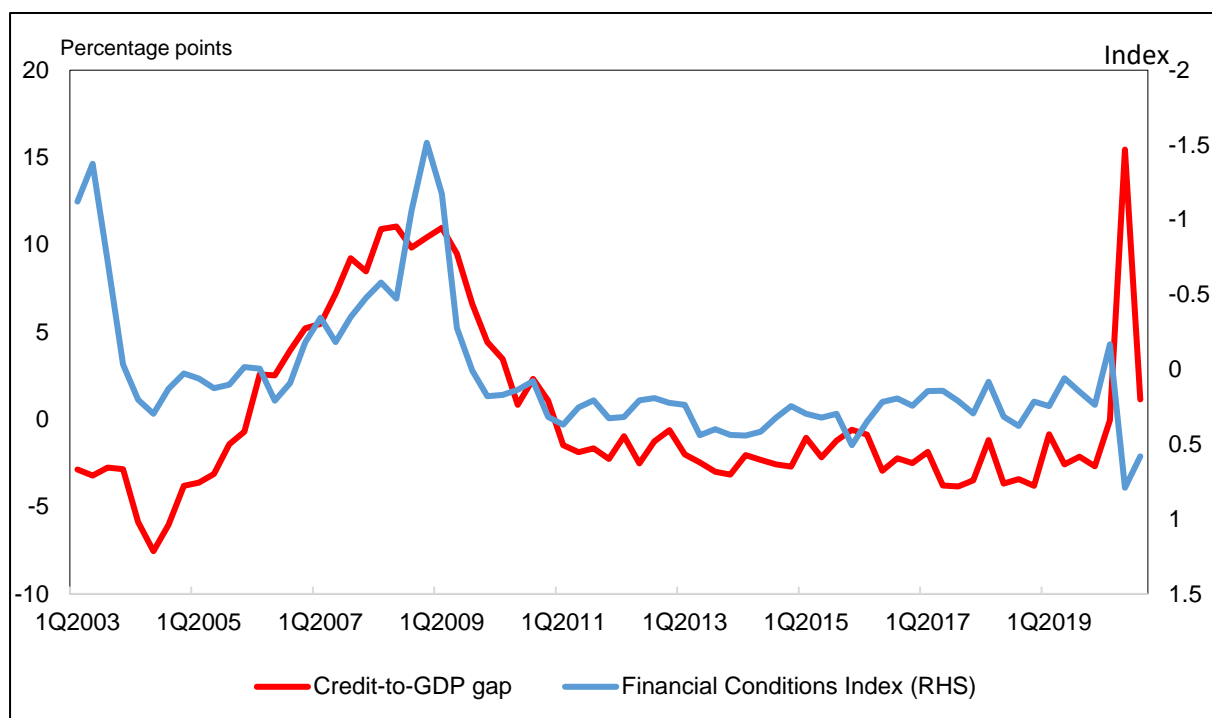
A financial conditions index (FCI) is a composite index that informs policymakers about the build-up of stress in the financial system and the driving forces behind it. Ndou, Gumata and Klein (2012) found that the estimated FCIs had powerful predictive information for the near-term GDP growth (up to four quarters) and therefore a further deterioration may imply that economic activity is likely to slow in the period ahead.

Following the work of Ndou et al (2012) and Kabundi and Mbelu (2017), the SARB has continued to develop its FCI, following the methodology of Koop and Korobilis (2014), whereby the FCI is calculated in two steps. The first step uses standard principal component analysis (PCA) analysis to obtain an initial estimate of the FCI. This estimate is then passed into a Kalman filter and smoother, which calculates time-varying loading factors, and time-varying VAR parameters. In the second step, these time-varying parameters are used in a Kalman filter and smoother to extract the FCI. These steps estimate the weights used to average the constituent financial variables of the FCI into an index, and the relationship between the FCI and the

macroeconomy (real GDP growth and inflation). As a result, this approach allows for time-varying weights, and a time-varying relationship with the macroeconomy, which is simultaneously purged from the FCI.

The current FCI (Figure 7) is calculated using 38 monthly financial variables, covering six markets (credit, foreign exchange, real estate, foreign, funding and equity) from February 2000 until present. The advantage of this approach is that it uses different weights associated with different divisions within a financial market, such that it is relatively easy to identify a sector that is under stress.

Figure 7: Financial Conditions Index for South Africa



Source: SARB

- SRISK

SRISK is a forward-looking, market-based measure of systemic risk that estimates the capital shortfall of the entire financial system conditional on a systemic event (Brownlees and Engle, 2017). According to Chatterjee and Sing (2021) SRISK takes into account a bank's market capitalisation, its prudential capital ratio, and the level of

debt given by its total liabilities. It proxies the amount needed to bailout the financial sector in the event of a sufficiently extreme, system-wide, negative shock. This measure assumes that the entire financial system is constrained, or in distress, such that any single financial institution whose (market value of) equity falls sufficiently relative to its liabilities; (i) would be unable to raise additional capital; (ii) would not be acquired by another market player; or (iii) would be unable to conduct an orderly resolution. SRISK is also reported in a number of ways, being used as either a potential microprudential indicator, or a macroprudential early warning signal for systemic risk.

Brownlees and Engle (2017) use predictive regressions to show that aggregate SRISK provides early warning signals of distress for indicators of real activity. The sum of SRISK across all firms is used as a measure of overall systemic risk in the financial system. It can be thought of as the total amount of capital that the government would have to provide to bail out the financial system in case of a crisis. A crisis is quantitatively defined as a fall in the broad market index of more than 40% in a 6-month period.

A study by Chatterjee and Sing (2021) measures SRISK in the South African context. They utilise various market-based measures of systemic risk to understand how they can inform the vulnerability assessment of South African banks⁹ from the perspective of both markets and regulators. A comparison of three measures is made through changes in CoVaR (the impact on the financial system conditional on an institution being in distress), Marginal Expected Shortfall (MES), and SRISK in the context of six South African banks. The SRISK measure incorporates information about balance sheet structures.

- Growth at Risk

The growth-at-risk (GaR) framework links current macro-financial conditions to the distribution of future growth. Its main strength is its ability to assess the entire distribution of future GDP growth vis-à-vis a point estimate, quantify macro-financial

⁹ These banks constitute 92% of the total assets in the South African banking system.

risks in terms of growth, and monitor the evolution of risks to economic activity over time. GaR is similar to the ‘value-at-risk’ terminology used predominantly in financial risk management. It is defined as the fifth percentile of the distribution of future growth, conditional on current economic and financial conditions. This means that given the distribution of growth in any given period, GaR represents the value below which only 5% of the probable outcomes fall. This approach, initially proposed by Adrian, Grinberg, Liang and Malik, 2018 essentially allows policymakers to take a view on how escalating (or declining) financial vulnerabilities impact the possible distribution of future growth. Therefore a deteriorating FCI only predicts an increase in the probability of poor economic outcome (Sing, 2019). GaR allows policymakers to estimate how financial conditions can be translated into financial imbalances (Sing, 2019).

To apply the GaR methodology to South Africa (Figure 8), financial conditions are measured by the SARB’s FCI and growth in economic activity is measured by the seasonally-adjusted and annualised quarterly growth rate of real GDP. The GaR estimates (as at the end of the second quarter of 2019) are shown in Figure 8(a). GaR in the near term (one year ahead) estimated to be marginally negative, while medium-term (three years ahead) GaR is around 1%. Meanwhile, Figure 8(b) depicts how GaR has changed over the past three quarters. By monitoring the evolution of these measures, the SARB is able to estimate how ‘tail risks’ to economic growth evolve over time and take steps to guard against excessive build-ups in financial vulnerabilities as and when they appear.

Figure 8(a): Growth at Risk for South Africa

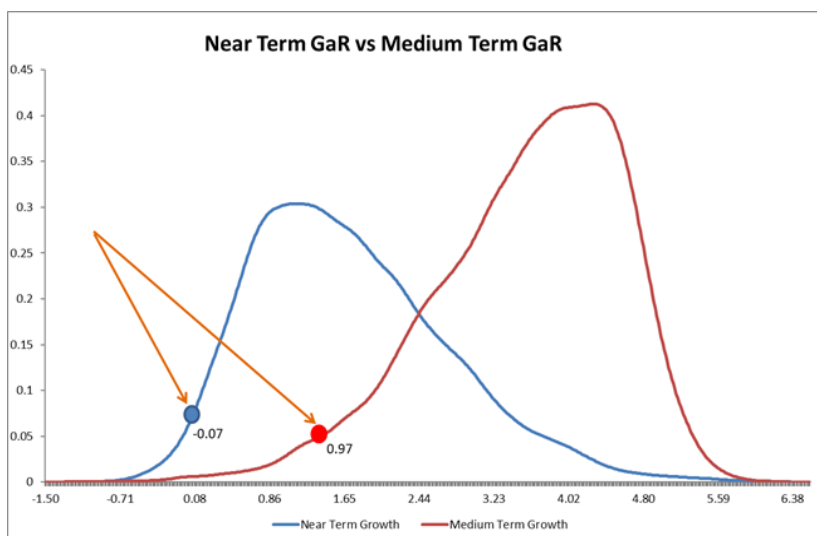
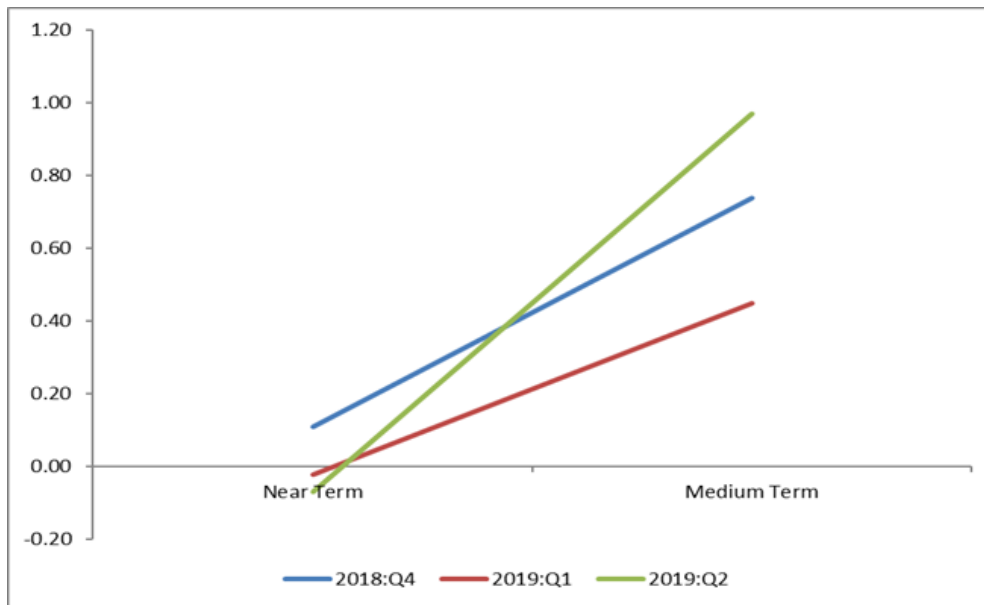


Figure 8(b): Growth at Risk for South Africa



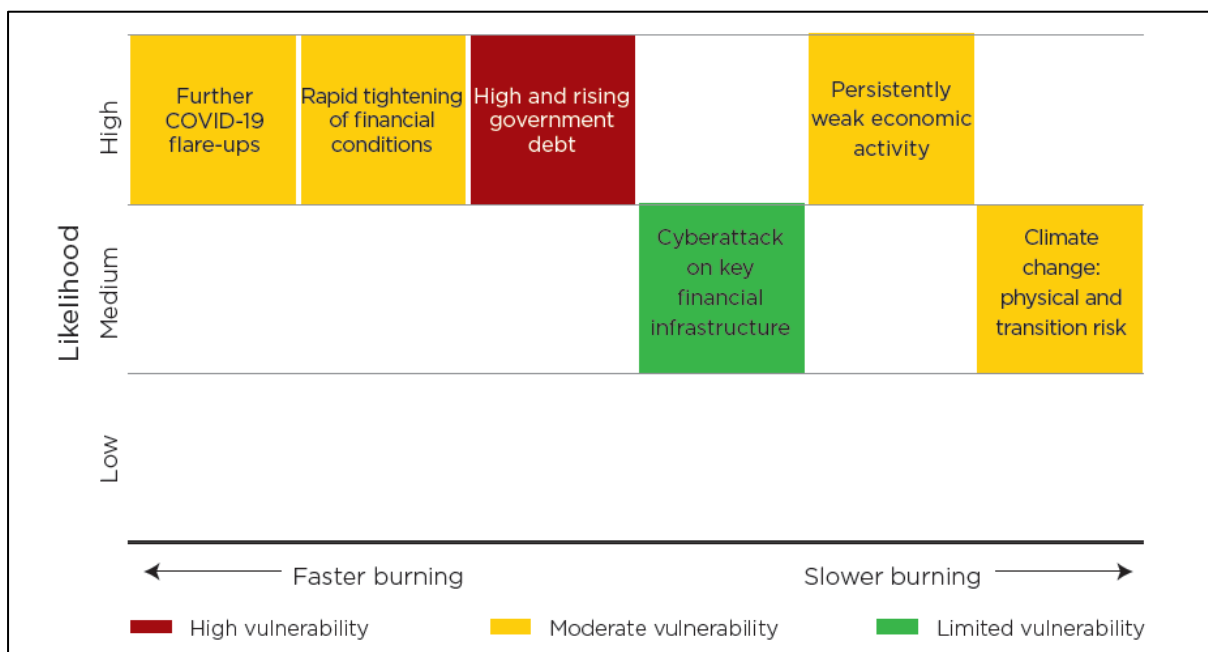
Source: SARB, *Financial Stability Review, 2nd Edition 2019*

The SARB will endeavor to continuously enhancing its measures for vulnerability assessments and systemic risk monitoring by also looking at current research being done by academics. One such measure is the South African Stress Index (SAFSI) that uses predictive performance for economic conditions using a mixed frequency vector autoregression (Kisten (2020)). The index uses monthly frequency data that allows for the real-time assessment of stress levels within the entire financial system, which can be easily updated to account for new observations as they become available. The aggregation of the methodology ensures parsimony since each indicator is assessed in terms of its systemic importance and ranked according to its information content. Such approaches can be used to complement current approaches in analysing the usefulness of policy interventions. The decomposition of the SAFSI into contributions from each market segment allows regulatory authorities to track the buildup of stress from individual sectors at any given point in time. The advantage of this measure is that it provides information about the sources of financial stress which could prove useful in guiding policymakers in their decisions.

5.1.2 SARB's Risk Assessment Matrix (RAM)

The SARB's RAM was recently adjusted in alignment with international best practice (Figure 9). The colours associated with each risk indicate the vulnerability of the financial system to the risk, after accounting for any significant mitigating factors. Previously, the colours indicated the change in the intensity of the risk. This shift better reflects the SARB's focus, which is primarily on the impact on the financial system if a risk materialises, rather than the risk itself. Potential threats are rated according to the likelihood of their occurrence as well as their expected impact on the domestic financial system. Vulnerabilities identified are classified between a range of 'fast burning', or 'slow burning'. The RAM is presented to the FSC at each (quarterly) FSC meeting and is also published in the bi-annual *Financial Stability Review*.

Figure 9: The SARB's Risk assessment matrix of the SARB



Source: SARB (2021)

The process to arrive at the RAM is indicated in Figure 10.

Figure 10: Process to arrive a risk assessment matrix

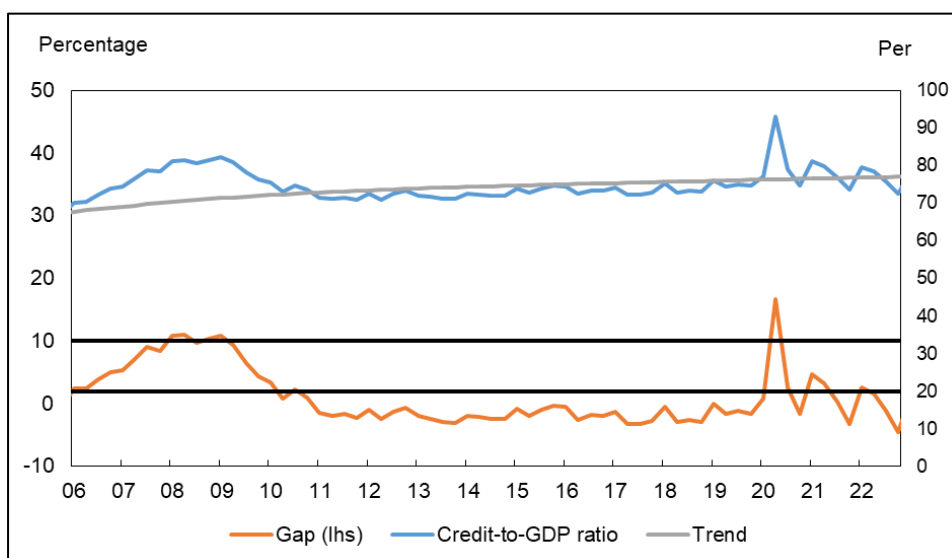


Source: SARB

5.1.3 Credit-GDP gap

The credit-to-GDP gap is designed to take into account the macro-financial environment in which banks operate, and is the main indicator that informs the activation of the CCyB. Banks are required to implement the CCyB when the credit-to-GDP gap is above its long-term average (after taking into account all relevant information) and the FSC decides to activate the buffer. The credit-to-GDP gap has remained mostly negative since 2011 and although it breached the Basel guide for CCyB activation in the second quarter of 2020, the rapid upward trend in the gap has been driven by a substantial decline in economic activity instead of high credit growth (Figure 11).

Figure 11: Credit-to-GDP gap



Source: SARB, 2021

5.2 The SARB's framework for macroprudential policy instruments

Macroprudential policy is primarily concerned with the use of macroprudential instruments to mitigate systemic risk. Macroprudential policy has two broad objectives aimed at mitigating this risk; namely (i) to strengthen the resilience of the financial system against systemic shocks (by building buffers into the financial system that absorb the impact of these shocks); and (ii) to restrain the build-up of vulnerabilities that amplify these shocks (these vulnerabilities increase the likelihood or the extent of a financial crisis).

The SARB is guided by the Bank for International Settlements (2012), with three main criteria to select macroprudential instruments: the instruments must be *effective, efficient, and transparent* in their implementation. Firstly, for effective implementation of macroprudential instruments, the SARB focuses on instruments for which there is a well-understood transmission mechanism. Since the implementation of the instruments is relatively new for the SARB, it would draw on its understanding of the transmission mechanism from experiences of other countries.

Secondly, efficiency of the instruments will be assessed by their unintended and adverse effects. The impact of the instruments on the flow of credit and economic activity are important in this regard. The ex-post assessment of effects exclusively attributable to the implementation of the instrument is likely to be extremely difficult, given that financial instability concerns are not recurring events like inflation.

Thus, the list of instruments adopted by the SARB will evolve with experience. Thirdly, the decision-making process and actions of the SARB should be seen to be transparent. In selecting the tools, the SARB would focus on instruments whose application is the most appropriate given the assessment. Simplicity and predictability of the actions would enhance the process of administering macroprudential policies.

The instruments should be relevant (that is, have a high degree of certainty regarding their usefulness to mitigate systemic risks), and their impact should be assessable. Each instrument should be related to intermediate policy target(s) of macroprudential

policy to enable one to assess whether the instrument is having its desired impact in reducing either time-varying or cross-sectional risks.

Macroprudential instruments are classified in the following three types and are applied to banks only:

- (i) Capital-based tools (countercyclical capital buffers, sectoral capital requirements and dynamic provisions);
- (ii) Asset-side tools (loan-to-value (LTV) and Loan-to-income (DTI) ratio caps); and
- (iii) Liquidity-based tools (countercyclical liquidity requirements).

Table 4 provides a list of the SARB’s macroprudential instruments and potential indicators linked to these instruments. A more detailed description of the features of these macroprudential instruments can be found on the SARB’s website¹⁰.

Table 4: SARB’s macroprudential policy instruments and potential indicators

Capital-based instruments	
Policy instrument	Potential indicators
Countercyclical capital buffers	Measures of the aggregate credit cycle for example credit-to-GDP Gap
Sectoral capital requirements	Measures of sectoral concentrations Distribution of borrowing within and across sectors Real estate prices (commercial and residential, old and newly developed properties) Price-to-rent ratios
Dynamic provisions	Bank-specific credit growth and specific provisions (current and historical average)
Asset-side instruments	
Policy instrument	Potential indicators
Maximum leverage ratios	Total assets to bank equity

¹⁰ FARRELL, G. 2016. South African Reserve Bank. A new macroprudential policy framework for South Africa. November 2016. viewed on <https://www.resbank.co.za/en/home/publications/publication-detail-pages/media-releases/2016/7547>

Loan-to-value (LTV)s and Debt-to-income (DTI)s	<ul style="list-style-type: none"> Real estate prices (commercial and residential, old and newly developed properties) Price-to-rent ratios Mortgage credit growth Underwriting standards Indicators related to household vulnerabilities Indicators of cash-out refinancing
Liquidity-based instruments	
Policy instrument	Potential indicators
Countercyclical liquidity requirements: LCR and NSFR	<ul style="list-style-type: none"> Liquid assets to total assets or short-term liabilities Loans and other long-term assets to long-term funding Loan-to-deposit ratios Lending spreads
Margins and haircuts in markets	<ul style="list-style-type: none"> Margins and haircuts Bid-ask spreads Liquidity premia Shadow banking leverage and valuation

Source: SARB, 2016

An important consideration in the framework is to assess the effectiveness of macroprudential instruments (once deployed). In particular, the structural nature of a country's financial system, the stage of financial development and the degree of openness are key factors that could affect policy interventions through possible leakage effects.

The effectiveness of a macroprudential policy tool should be judged on whether it has achieved the intended objective of its implementation, that is, to reduce the occurrence and magnitude of a financial crisis. A possible method of assessing the effectiveness of macroprudential instruments is to evaluate their impact on identified immediate targets. It can be expected that the effects of macroprudential policies would vary depending on the phase of the financial cycle. It is important to recognise that macroprudential policies are mainly intended to help reduce booms. To the extent that they are operative in busts, they are meant to limit declines in credit and asset prices and safeguard longer-term financial stability and economic performance. In assessing

the effectiveness of macroprudential policies, it is of key importance to understand the co-ordination of policy objectives. Monetary policy needs to take into account issues affecting financial stability.

5.3 Co-ordination between macroprudential policy and monetary policy

Financial stability issues are sometimes difficult to capture, making it difficult to determine when macroprudential tools need to be loosened or tightened. As a result, the flaws in the application of macroprudential instruments make it possible for monetary policy to respond to financial conditions in addition to the output gap and deviations of inflation from target (Claessens & Valencia, 2013).

With the SARB's mandate to maintain financial stability and price stability, policy co-ordination is prudent. There are various ways that the monetary policy and financial stability can respond to shocks in a synchronised manner.

A recent study by the SARB (Jager, Ehlers, Mojapelo & Pienaar (2020)) seeks to understand the link between monetary and macroprudential policy tools by using in the SARB's Core Macro-econometric Model. This model is used to provide a consistent basis to quantify and analyse the interaction of macroeconomic variables in the monetary policy transmission mechanism and macroprudential policy initiatives. The paper uses scenarios-based tests, that consider a combined monetary and macroprudential policy approach, for example in an instance where house prices are rising and there is evidence of the emergence of asset price bubbles.

The results from this combined scenario suggest a higher success rate if both monetary and macroprudential policies are geared towards a common goal, i.e. constraining the credit bubble and clamping down on unsustainably high house prices to minimise the potential risks to price stability in the macro-economy. The findings conclude that monetary policy responses through interest rates could potentially impact on financial stability, by either mitigating or intensifying the intended impact of the macroprudential instrument tool. This places a strong emphasis on the need for co-ordinated responses between the MPC and FSC when implementing optimal policy

measures. This is particularly important when there is cross-membership between MPC and FSC members, as is the case in the SARB.

Svensson (2017) also notes that coordination of and the interaction between policies are crucial elements of crisis management rather than a period of crisis prevention. On a global level, the work been done on the co-ordination and interaction between macroprudential policy and other policies (monetary, fiscal etc) is in its infancy stage and this area of a research is a key priority for the SARB in the near term.

7. Summary and Conclusion

This paper provides an overview of the SARB's frameworks to assess systemic risk assessment and macroprudential policy instruments. The SARB's framework for monitoring financial stability consists of a three-step process that ultimately culminates in the activation of macroprudential instruments to mitigate systemic risk identified earlier in the process. The systemic risk assessment framework is broadly based on the IMF and Fed's financial stability monitoring frameworks, and considers indicators and measures from global best practices from key jurisdictions and international organisations such as the Bank of England, Bundesbank, DNB, IAIS, among others.

The SARB's toolkit of macroprudential policy instruments is still in a development phase, similar to many other jurisdictions. Macroprudential policy calls for a need for a better understanding of transmission mechanisms and the co-ordination of the policy objectives of monetary policy and macroprudential policy. Once systemic risk is identified, newly introduced instruments and measures would need to be tried out in different circumstances and their performance evaluated against expectations. No common paradigms exist, as yet, and further fundamental and applied research is needed to better understand these relationships as financial risks evolve and circumstances change.

In conclusion, the SARB will continue to regularly review and update its systemic risk assessment and macroprudential policy frameworks in line with international best practice and as risks emerge and financial conditions change. The SARB in the

process of prioritising its work on the macroprudential toolkit of instruments, while also investigating the application of a risk-based approach to address common sources of systemic risk that could arise from other sectors such as NBFIs, asset markets and the non-financial corporate sector, among others. This area of work is being done alongside any other tools that the FSC of the SARB may consider important to address imminent idiosyncratic risks.

Annexure 1: Bank of England's financial stability monitoring framework

The Bank of England's (BoE) approach to systemic risk monitoring is to identify material threats to financial stability and focus on a small number of key vulnerabilities in the financial system using a core set of indicators. The BoE uses a systematic and analytical approach to assessing these vulnerabilities, which includes a broad-based attempt to evaluate the materiality in terms of probability and impact and an assessment of actions that could be taken to mitigate, reduce or remove systemic risks. The indicators are intended to be simple, high level, and understandable, and are categorised in terms of bank balance sheet stretch, borrower stretch, and terms and conditions in financial markets. The core sets of indicators serve two purposes at the BoE: Firstly, internally the indicators provide a starting point for analysis and consistency in that these indicators are monitored over time. Secondly, externally, the indicators provide for transparency, accountability, and predictability in the BoE's communication (signalling channel).

Table 1A shows the key sectors/indicators reported in the BoE's Financial Stability.

Table 1A: List of indicators used by the BOE to monitor risks and vulnerabilities

<u>Leverage</u>		<u>Asset Prices</u>	
Key Sector	Individual series		
Household Credit Growth	HH Secured Credit growth	Conditions and terms in the market	Real rate
	HH Unsecured Credit Growth		Term Premia
PNFC Credit Growth	CRE Credit Growth		Equity
	PNFC Credit Growth (excl. CRE)	Price to Earnings	
Debt to Income	Household Debt to Income	Bonds	Equity Risk Premium
	PNFC Debt to Profit		Investment Grade Spreads
Debt Service Indicators	Household Income Gearing		Residential Property
	PNFC Income Gearing	House Price to Income	
	National Balance Sheet	Current Account	CRE Property
Net Foreign Assets		DDM Risk Premium	
Gross External Debt		CRE Price Growth	
Gross Capital Inflows		CRE prime yields	
		Terms of credit	DDM Risk Premium
			Household
		LTV	
		CRE	LTI
			CRE LTV
			CRE mortgage spreads

Source: Bank of England, various Financial Stability Reports

The BoE’s list of indicators has proved helpful in identifying emerging risks to financial stability in the past for the following:

- the countercyclical capital buffer (CCB);
- sectoral capital requirements; and
- housing tools

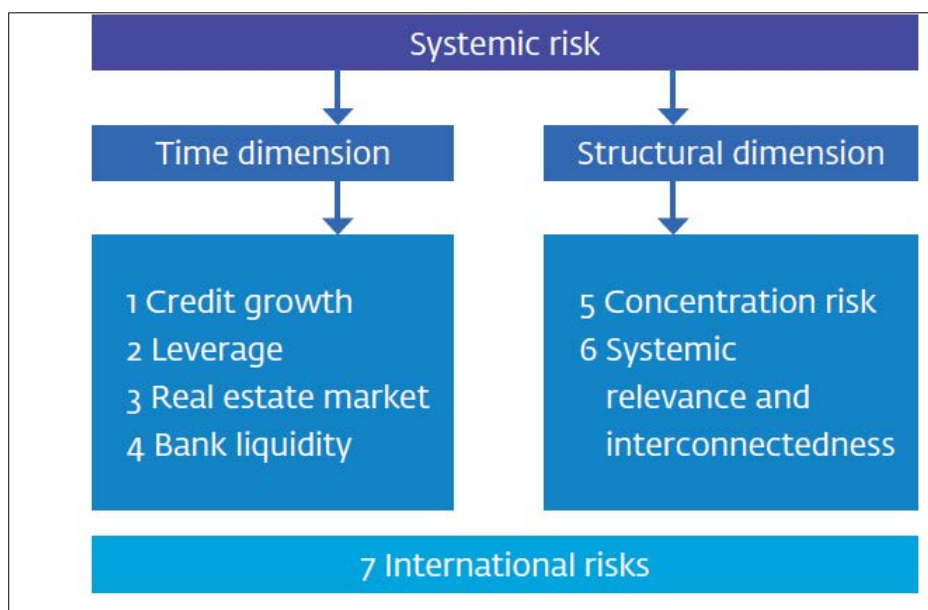
In addition to the monitoring exercise, the BoE has extra measures to capture the evolution of risks to financial stability over the financial cycle in the UK. Aikman, Bridges, Burgess, Galletly, Levina, O'Neill and Varadi (2018), use a framework to forecast early warning indicators of banking crises by identifying 29 indicators of financial stability risk. The indicators are normalised and aggregated to produce three composite measures, capturing; (i) leverage in the private nonfinancial sector, including the level and growth of household and corporate debt, the UK’s external

debt; (ii) asset valuations in residential and commercial property markets as well as government and corporate bond and equity markets and; (iii) credit terms facing household and corporate borrowers. The results show how these indicators influence downside risks to economic growth and different horizons. The authors note that an ideal indicator would signal building vulnerabilities with potential threats to financial stability at least two to three years in advance. This measure of financial cycle could be a simple communication tool for both macroprudential policymakers and the wider public.

Annexure 2: De Nederlandsche Bank’s financial stability monitoring framework

The De Nederlandsche Bank (DNB) monitors a broad set of indicators that covers both the structural as well as the time dimensions of systemic risk (Figure 1A). According to DNB, vulnerabilities are not independent of each other and may actually reinforce each other.

Figure 1A: DNB’s dimensions of systemic risk and focus areas



Source: DNB, *Financial Stability Task*, 2016

DNB views the credit gap as a reliable indicator of excessive credit growth and the build-up of asset bubbles. As a result, specific attention is paid to developments in the real estate markets; lending standards for mortgages, among others. The DNB also monitors risks at an international level through foreign exposures and interconnectedness of financial institutions. The analysis is aimed at identifying systemic risks and using this as a basis for adopting macroprudential tools or any other measures that can enhance the resilience of the financial system.

Annexure 3: Bundesbank’s financial stability monitoring framework

Although the German financial system is bank-dominated, the importance of the NBFi sector has grown over the past decade. Growth in the NBFi sector has been mainly driven by the growth in assets of other financial intermediaries¹¹ (OFIs), particularly investment funds.

In monitoring NBFi financial stability risks and vulnerabilities, the Bundesbank follows the monitoring approach of the Financial Stability Board’s (FSB) NBFi Policy Framework by classifying NBFi activities based on five economic functions (EF), namely (i) collective investment vehicles; (ii) lending dependent on short-term funding; (iii) market intermediation dependent on short-term funding; (iv) facilitation of credit intermediation; and (v) securitization-based credit intermediation. Table 2A provides an overview of the entities classified by the Bundesbank into the five EFs in the FSB annual monitoring exercise and the data sources used to monitor each entity.

Table 2A: Bundesbank NBFi monitoring framework

Economic Functions	Entities	Data sources
Collective investment vehicles with features that make them susceptible to runs	Money market funds, fixed income funds, mixed funds, hedge funds, real estate and other funds	Investment funds statistics of the Bundesbank, granular balance sheet information on investment funds located in Germany (monthly frequency), combined with the Securities Holding Statistics (SHS) and the Centralised Securities Database (CSDB) and private vendor data (Morningstar).
Lending dependent on short-term funding	Financial corporations engaged in lending, financial leasing companies, and factoring companies	Supervisory data of the Bundesbank, balance sheet information on financial corporations engaged in lending, financial leasing as well as

¹¹ OFIs are comprised of all financial institutions that are not central banks, banks, public financial institutions, insurance corporations, pension funds, or financial auxiliaries.

		factoring companies located in Germany (annual frequency).
Market intermediation dependent on short-term funding	Broker-dealers (security and derivatives dealers)	Supervisory data of the Bundesbank and BaFin, balance sheet information on security and derivative dealers (annual frequency).
Facilitation of credit intermediation	N/A – German authorities classify no entities into this economic function	N/A
Securitisation-based credit intermediation	Financial vehicle corporations (FVCs)	Statistics on FVCs of the Bundesbank, balance sheet information on FVCs located in Germany (quarterly frequency).

Source: Bundesbank

In terms of exposure, the German investment fund sector represents about 95% of Germany's narrow measure of NBF1 which relates to 'collective investment vehicles', hence supervisors place a high level of emphasis on analysing risks from this sector and its interconnectedness within the financial system and among financial sectors more broadly.

Monitoring indicators for the rest of the financial sectors by Bundesbank is shown in Table 3A.

Table 3A: Bundesbank financial sector indicators

Sector /area of focus	Indicator/Measure
Equities	Implied equities volatility, profits, equity risk premia
GDP (real)	GDP (Europe) and global, growth at risk
Credit default spreads	Europe and global
Market liquidity (bonds issued by non-financial sector)	Secondary market (bid-ask spreads, trading volumes) Primary market (new bond issuance)
Financial conditions for enterprises: - difficulty in obtaining credit	Rejection of loans, long process times, short term loans, high loan collateral, small credit volumes
Securities, portfolios of German financial institutions banks, investment funds, insurers	Price effects, volume effects
Loans disbursed and newly committed by banks	Domestic non-financial corporates Enterprises in the accommodation and food services activities sectors
Corporate insolvencies	Credit claims of banks on domestic enterprises by sector - SIFIs - other banks
Risk premia on corporate bonds by sector	Leisure, automotive, real estate, energy, etc. Internal comparison of banks' tier 1 capital ratios (German and global) Credit lines disbursed and newly committed to non-financial corporates Funding premia in interbank market (Euro, USD) Gains/losses at large SIFIs resulting from changes in market prices World-wide claims of German banks broken by debtor
Credit risk	Loss allowances on banks' loans to non-financial corporates Loss allowances on loans' to households
Common equity tier 1 capital ratio of banks in various scenario's	Severe stress scenario, comprehensive stress scenario Decomposition of changes in tier 1 capital ratio of selected categories of banks: credit risk, market risk, operational risk, other risks (SIFIs, savings banks and co-operatives)
Allocation of risk in the domestic loan portfolio of banks	Enterprise debt overhang ratio Enterprise interest coverage ratio
Macroprudential instrument	CCyB

Sources: Deutsche Bundesbank, Financial Stability Review 2020, various banking sector reports

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