Financial Stability Focus

SOUTH AFRICAN RESERVE BANK

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The Financial Stability Focus is a compilation of South African Reserve Bank Topical Briefings

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TOPICAL BRIEFING: No. 1

Financial Stability Department

South African Reserve Bank

Measuring the risk and potential policy responses to capital flow stops in emerging market economies – Relevance for South Africa[1]

Abstract

In this paper we estimate the sensitivity of capital flows into EMEs and into South Africa specifically to changes in domestic ('pull') and external ('push') factors including the recent Covid-19 shock in spring 2020. We use a 'capital flows at risk' (CF@R) approach which focuses on, in particular, the impact on the lower tail of the capital inflow distribution – outright capital stops.

We find that over the 1996 Q1-2019 Q4 period portfolio capital flows into South Africa and into EMEs, in general, are especially sensitive to changes in external shocks. Moreover, the model estimates that the capital stop in EMEs during the first half of 2020 was caused mainly by the external Covid-19 shock. In South Africa's case though the deterioration in 'pull' factors in recent years, have likely also played an important role.

We also find that capital stops caused by negative external shocks have increased in frequency over time. Since portfolio debt flows have become a bigger share of total capital inflows into EMEs, including into South Africa, raises the possibility that capital flow volatility caused by external events may become a more regular challenge for EME central banks.

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Given this context, we suggest that central banks, including in South Africa, should consider using a broad policy toolkit, including various macro prudential instruments to help either to affect domestic demand (macro prudential) and/or limit exchange rate volatility (macro prudential). Although South Africa has smaller external foreign currency liabilities and mismatches than many EMEs, these have increased significantly over the past decade especially those of the corporate sector. There may be a case for increased monitoring of the foreign currency mismatch positions, including by maturity, of individual banks, large private corporates and state-owned enterprises (SOEs).

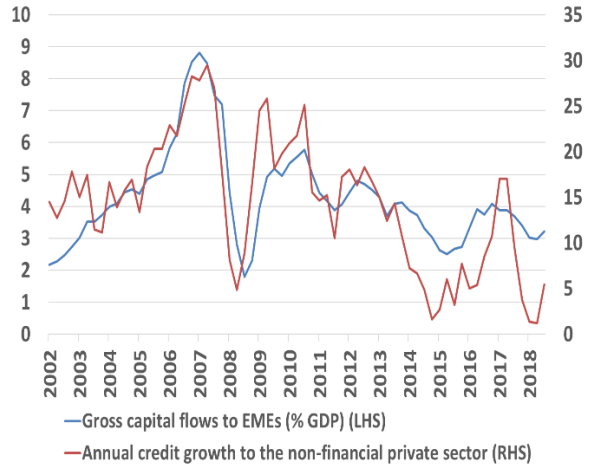
One of the biggest risks facing South Africa is the sustainability of the government's debt position which has increased significantly since the Covid-19 shock. This may also cause financial stability risks for the banking sector given the latter's large and growing exposures to the government. This highlights the importance of supervisors closely monitoring the risks of this lending.

1. Introduction

The capital stop in spring 2020 caused by the Covid-19 shock is the latest bout of capital flow volatility to affect EMEs. Large swings of gross capital flows into emerging market economies (EMEs) have in the past often been associated with credit cycles (**Chart 1a**) and capital flow stops have frequently been a feature of financial crises (**Chart 1b**). In this paper we estimate the role played by external shocks in affecting different types of capital inflows. In particular, we focus on the impact during periods of capital inflow stops. In the following section of the paper we turn to the various policy options that EMEs, including South Africa, have used to deal with capital flow volatility including to mitigate the impact of Covid-19. Monetary policy is a key tool in most countries but many central banks use a range of other tools including, in particular, various types of standard macro prudential ones as well as foreign currency measures. We attempt to draw out experiences from other countries that may be useful in further developing the South African Reserve Bank's (SARB's) own macro prudential policy toolkit.

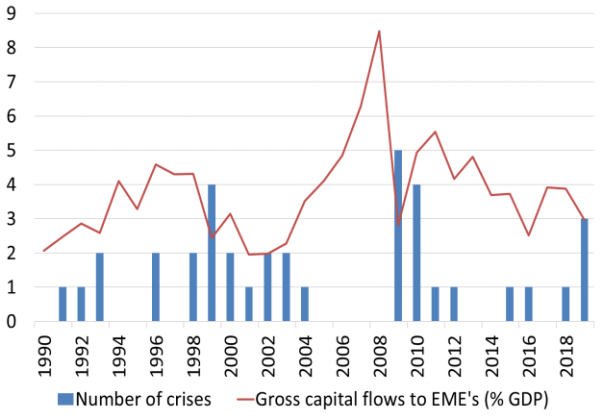
Chart 1: Gross capital flows to EMEs

a/ Gross capital inflows and credit growth, 2002 Q4-2019 Q2



Source: IMF BOPS and BIS Credit Statistics

b/ Gross capital inflows and external debt crises, 1990-2019



Source: IMF

2. Capital Flows at Risk[2]

From a financial stability perspective, the policy maker's main concern over capital inflows is the risk of a sharp reversal – an outright capital stop (usually referred to as a 'sudden stop' in the academic literature). In this paper we focus on the behaviour of foreign investors. So, unless otherwise stated, all data on capital inflows are gross inflows from non-residents rather than inflows net of outflows from residents. **Box 1** shows how gross inflows are related to gross outflows and to the other items in the balance of payments identity.

Box 1: Financing a shock to gross capital inflows

The focus in this paper is on gross capital inflows from non-residents. Following a large negative shock to gross capital inflows (a capital stop), the balance of payments identity shows what, in an accounting sense, needs to adjust to fill the financing gap.

The balance of payments identity linking the current and capital acounts can be written as:

Current account deficit (CAD) = capital inflows – capital outflows - change in foreign currency reserves + official financing[3]

Rearranging:

Capital inflows = capital outflows + CAD + change in reserves – official financing

↓ ↓ ↓ ↓ ↑

So if there is a sudden capital inflow stop there needs to be a corresponding reduction in (resident) capital outflows and/or a narrowing in the current account deficit (CAD), a sale of foreign currency reserves or an increase in official bilateral or multilateral financing (eg from the IMF). Sharp adjustments in the balance of payments though are often not costless.

If domestic entities face a sudden reduction in their external financing they may have assets held abroad which can be liquidated. For example, during the global financial

[2] This section draws heavily on the Bank of England working paper by Eguren-Martin *et al* (2020).

[3] In practice, there is also a residual item in the balance of payments to capture unrecorded transactions or errors in the current and/or capital account. Also note we us BPM6 notation.

crisis, UK resident banks witnessed a 20% reduction in their cross border liabilities and in response sharply cut back their cross border assets especially to non-'core' markets [4]. But such sudden balance sheet deleveraging may be costly for the entities concerned (e.g. due to asset fire sales) and to their borrowers. A reduction in the current account deficit can be achieved through exchange rate depreciation which switches expenditure to exports and import substitutes. But an abrupt narrowing in the deficit usually entails the need for some cutback in domestic demand and output to curb imports. There is a financial opportunity cost in holding a cushion of foreign currency reserves since they earn very low interest rates and, depending on the private sector's interpretation, running down either reserves or official financing from abroad may give a negative signal to financial markets.

Many EMEs do not have large private sector external assets. So, often in the past, reductions in gross capital flows to EMEs have been reflected also in a decline in net capital flows (capital inflows minus outflows). However, even if, at the aggregate level, countries have large private sector foreign assets, they might not be easily and quickly repatriated (e.g. if held as foreign direct investment)[5]. Moreover, at the micro level, the domestic entities that are facing the withdrawal of external financing may not be the same entities that are holding liquid external assets[6].

In the case of South Africa, Smith (2019) finds that over the 1989-2018 period there were 7 episodes of gross capital flow stops. Three of these cases also resulted in net capital outflow stops. In these episodes, the balance of payment adjustment came through a run down in foreign currency reserves and other unrecorded transactions (1998 and 2001) and a reduction in the current account deficit (2008-09). But in the other 4 cases of gross capital inflow stops there was a large countervailing repatriation of foreign assets by domestic residents. This is attributed to South Africa's strong financial frameworks and fundamentals – credible inflation targeting framework, flexible exchange rate, low foreign currency debt, deep and liquid capital markets and large institutional investor base. South Africa continues to enjoy strengths in these

4 See Hoggarth, Mahadeva and Martin (2010).

5 South Africa's direct investment now accounts for almost one-half of its external assets following marked valuation gains in recent years.

6 Al-Saffar, Ridinger and Whitaker (2013) found that the size of banks' external balance sheets maturity (and foreign currency) mismatches was a contributing factor to the extent that GDP fell (relative to trend) in a sample of 24 high income countries during the Global Financial Crisis.

areas. That said, some other domestic fundamentals have worsened significantly over the past decade especially the government's debt position and GDP growth.

During 2019 there were strong gross capital flows into South Africa (3% of GDP). But during 2020 H1 – in the wake of Covid-19 – there were large gross capital outflows (3 ½% of GDP). This marked turnaround in gross capital flows (6 ½% of GDP) also resulted in one in net capital flows. The balance of payments gap was balanced mainly by a combination of a marked narrowing in the current account deficit and a run down in foreign currency reserves.

The recent experience in Spring 2020 with the outbreak of the Covid-19 crisis is the latest example of a gross capital stop affecting many EMEs. Concerns over financing the balance of payments led to some EMEs, including South Africa, taking out short term emergency financial assistance from the IMF (*the Rapid Financial Instrument*).

In order to estimate empirically the risk of a capital stop the focus of interest should be on the lower tail of the capital inflow distribution. Conventional (OLS) estimation though focuses on the impact on the mean average of capital inflows. It is possible – in fact probable – that there are non-linearities in the sensitivity of capital inflows to a given change in domestic and external shocks with the greatest sensitivity likely during periods of outright capital stops.

In order to better measure the determinants of capital stops (and surges), the capital flows-at-risk framework is based on the use of quantile regression methodology. It models separately each quantile of the entire distribution of gross capital inflows based on a set of domestic and external factors but with particular focus on the 5% percentile of the distribution located in the left hand tail ('capital flows at risk' (CF@R)).

But to carry out separate estimates of each 5% of the whole distribution of past capital inflows requires a lot of data. Therefore, we estimate CF@R for a set of 13 EMEs (including South Africa) rather than for South Africa alone over the 1996 Q1-2019 Q4

period. We estimate aggregate gross capital inflows as well as their main constituent parts – FDI, bank loans and portfolio inflows[7].

We use this capital flows at risk framework to see how well it could have predicted the very large capital stop in EMEs as a whole, and South Africa in particular, during 2020 H1 given the observed shock to global financial markets caused by Covid-19. We draw out the potential implications for South Africa.

In the baseline specification, the distribution of capital inflows is estimated conditional on distinguishing between measures of domestic ('pull') and external ('push') factors. The widespread capital stop across most emerging market and developing economies (EMDEs) in the first half of 2020, for example, was clearly mainly caused by an external event (the global outbreak of Covid-19).

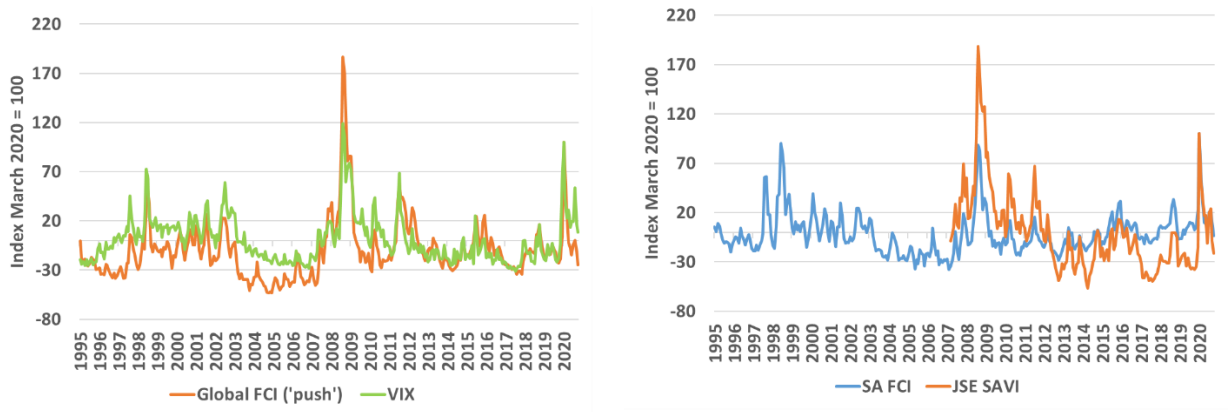
The framework makes use of the Bank of England's in-house financial conditions indices (FCIs), which measures at the individual country level the co-movement (the first principal component) in a number of financial market indicators – long-term government bond yields, term spreads, sovereign spreads, interbank spreads, corporate spreads, equity returns, equity volatility and financial market capitalisation (normalised by the equity market as a whole).

The global average of these indices for 21 high income countries and 13 EMEs is our summary (financial market-based) measure of global "push" factors. In practice, this measure has been highly correlated with the VIX over the past quarter of a century (see **Chart 2a**) – a US stock market volatility index commonly used to measure risk aversion in global financial markets. Our FCI for South Africa is also fairly strongly correlated with the (narrower) measure used by SARB in its *Financial Stability Review* (**Chart 2b**).

[7] See also Gelos *et al* (2019) who adopt a similar CF@R approach in modelling the determinants of EME gross portfolio inflows. They find that portfolio capital stops are associated especially with a rise in investor risk aversion proxied by increases in US corporate BBB bond spreads (over US Treasuries).

Chart 2: Financial Market Conditions Indices (FCIs), January 1996 - December 2020 (March 2020=100)

(a) Global ('push') **(b) South Africa (headline 'pull')**



Source: St. Louis Fed FRED (VIX), SARB (JSE SAVI) and Bank of England calculations (Global and SA FCIs). Note: VIX is the expected volatility in US (Chicago) stock prices and JSE SAVI is the corresponding expected price volatility on the Johannesburg stock market. Global and SA FCIs are broader Bank of England measures of financial market conditions globally and in South Africa respectively based on long-term government bond yields, term spreads, sovereign spreads, interbank spreads, corporate spreads, equity returns, equity volatility and financial market capitalisation An increase (decline) in the FCI means a tightening (loosening) in financial conditions. All indices have been rescaled to March 2020=100.

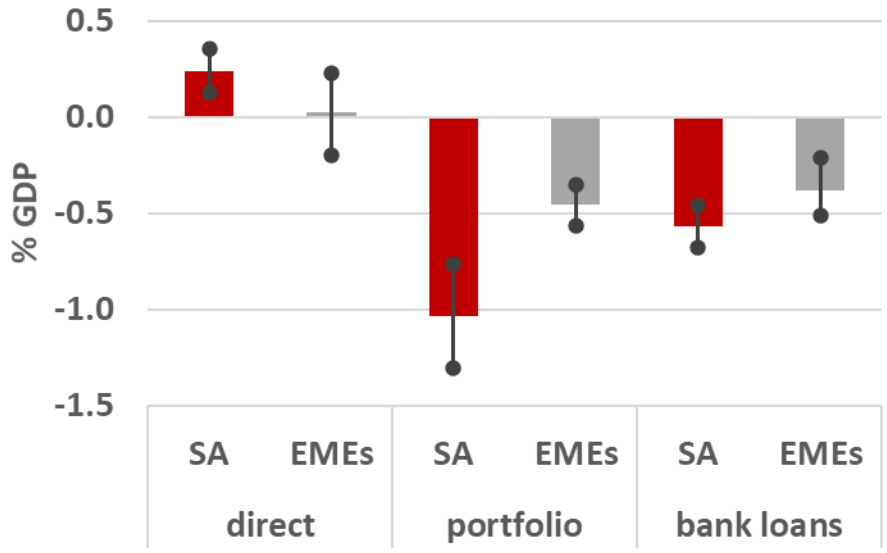
However, these headline individual country FCIs do not capture country fundamentals alone since they are also directly affected by global financial conditions. Instead, our summary measure of the country specific risk ("pull" factors) for each EME (*i*) used in the estimation is the residual obtained from regressing the respective country indices on the global FCI. This presents a more accurate picture of the domestic conditons independently of global financial conditions.

Then for different time horizons (h) and 5% quantiles (ϕ) of the distribution, a panel regression of capital flows at risks (CF@R) is performed on a constant, and these proxies for pull and push factors:

$$CF@R_{i,t+h,\phi} = \alpha_{h,\phi} + \gamma_{h,\phi} Pull_{i,t} + \beta_{h,\phi} Push_t + \varepsilon_i \qquad (1)$$

This specification is estimated on quarterly gross capital inflows (% of quarterly GDP) from non-residents to a set of 13 EMEs over the period 1996 Q1-2019 Q4[8]. The analysis focuses on the effect of push and pull shocks on capital flows in the current and subsequent two quarters. Gross capital inflows are estimated both in aggregate and separately for FDI, portfolio flows and bank loans (the 'other' component in the balance of payments). The EMEs included are Argentina, Brazil, Chile, Colombia, Hungary, India, Indonesia, Mexico, Peru, Philippines, Russia and Turkey as well as South Africa.

Chart 3: Impact of a tightening in global financial conditions on gross inflows by type (% of GDP) into South Africa and EMEs as whole (OLS estimates)



Note: The chart shows the impact of a one standard deviation tightening in global financial conditions on gross capital flows (% of GDP), on average, in the current and subsequent two quarters. The red and grey bars show the OLS estimates and the black lines with round ends the associated one standard deviation confidence bands.

As a starting point, we estimate equation (1) using OLS (ie not distinguishing by quantiles). We have sufficient observations to carry out the estimates on South Africa capital flows data alone as well as on data for our panel of all 13 EMEs. The results are shown in **Chart 3**. They highlight that portfolio flows seem particularly sensitive to

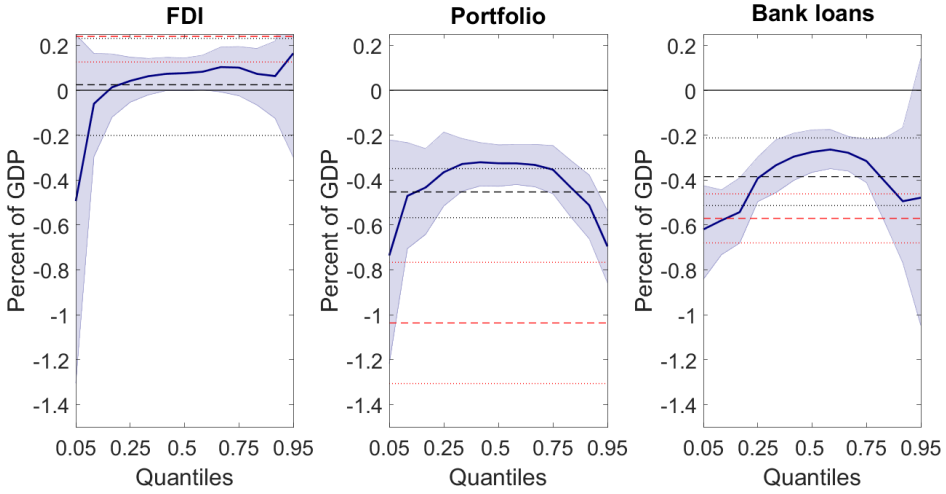
[8] 'Gross' inflows are the inflows from non-residents net of their outflows. So, for example, in a global crisis non-residents may both reduce their new investments and repatriate or redirect (to reserve currency assets) some of the stock of their existing ones.

external shocks and more so in South Africa than in EMEs on average[9]. A one standard deviation tightening in global financial conditions is found to reduce portfolio inflows into EMEs as a whole and South Africa by around 2% and 4% (of quarterly GDP) respectively.

These OLS results though may not be a good guide to the sensitivity to external shocks during episodes of capital stops and booms – the most important periods in affecting financial stability. So, for the whole panel of 13 EMEs –where we have sufficient degrees of freedom – we re-estimate the model for each 5% of the capital flow distribution (ϕ).

Chart 4 shows the sensitivity of different types of gross capital inflows to a one standard deviation tightening in global financial conditions. The dotted horizontal lines in the chart repeat the OLS estimates from **Chart 2**. By construction, the estimated impact on different parts of the capital inflow distribution are the same. The bold blue lines in **Chart 4** show the quantile regression estimates. These results vary across the distribution and, in particular, show for all types of inflows that the sensitivity to a given external shock is biggest in the left 5% tail of the distribution. This gives empirical justification to this capital flow 'at risk' approach.

Chart 4: Impact of a tightening in global financial conditions on gross inflows by type (% of GDP) into EMEs at different parts of the distribution (β_ϕ)



Note: Estimated effect of a one standard deviation tightening in global financial conditions on the three different types of capital inflows (% of GDP) across quantiles, on average, over the current and two

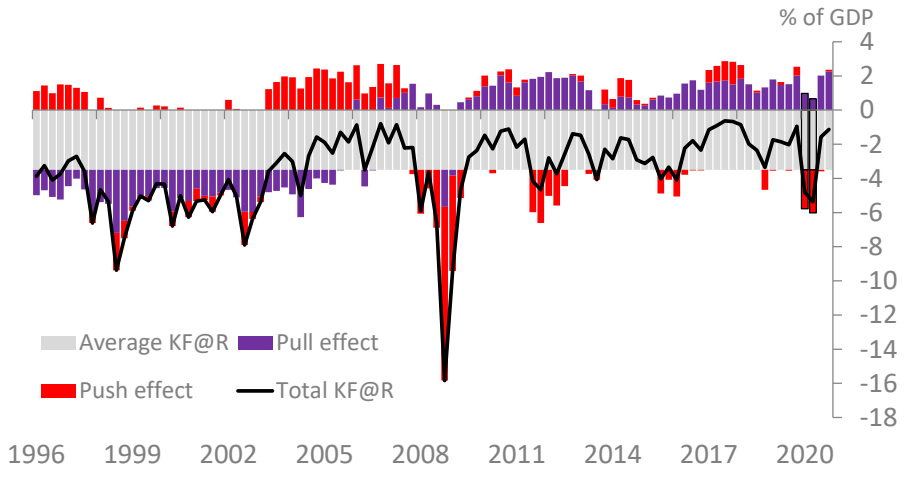
[9] This is consistent with a recent survey of 34 empirical studies by Koepke (2019) who finds that push factors are important for gross portfolio flows (especially portfolio debt).

subsequent quarters. One standard deviation confidence intervals based on block bootstrap methods. Black dashed lines show the OLS estimates and black dotted lines the associated one standard deviation confidence bands. Red dashed lines show the OLS estimates for South Africa, along with associated red dotted lines with one standard deviation confidence bands.

The impact on FDI though are not statistically significant (shown by the confidence interval around the estimate cutting across the 0 axis). In contrast, portfolio flows, in particular, are sensitive to global shocks across the whole distribution. The sensitivity though is biggest in the left hand tail where a one standard deviation tightening in global financial conditions reduce EME portfolio inflows by more than 3% of quarterly GDP. The sensitivity of cross border bank lending to external shocks is estimated to be a bit less than this in the left tail (2.5% of GDP)[10].

Chart 5 below shows how *estimated* aggregate EME capital inflows at risk (i.e. the left hand tail of the distribution) has evolved over the whole sample period. The estimate is broken down into the contribution from domestic and external factors in the model (purple and red bars respectively). The chart highlights that, for EMEs as a whole, domestic pull factors usually acted to increase CF@R prior to the Global Financial Crisis (GFC) but have attenuated CF@R since then. This reflects the improvements in fundamentals in most EMEs over time.

Chart 5: Estimated EME capital flows at risk, 1996 Q1-2020 Q4



Note: the chart shows the estimated impact (percent of quarterly GDP) on capital flows at risk, on average, in the current quarter and two following quarters.

[10] In contrast, banking inflows are found to be relatively more sensitive than portfolio flows in the left tail of the distribution to changes in domestic pull factors.

On the other hand, an easing in global financial conditions generally acted to reduce CF@R ahead of the GFC but there have been a number of tightening spikes in global financial conditions since that have acted to increase CF@R. Not surprisingly, there was a big spike in 2020 Q1-Q2 caused by Covid-19 where the model estimates that total CF@R rose to around 5% of EME GDP for two consecutive quarters. This rise though was significantly less than during the GFC when, unlike in the current shock, there was a large withdrawal also of foreign bank lending. For EMEs as a whole, most of the estimated rise in CF@R in 2020 H1 was attributable to the global shock rather than country specific factors (shown by the relative size and direction of the red and purple bars respectively).

However, in South Africa's case, there has also likely been a bigger domestic driven cause of the capital stop in 2020 H1 and more generally in recent years. This is reflected in our model by the rise in South Africa's FCI. The rise in South Africa's government's debt in recent years (**Chart 6a**) is likely to be an important reason why our measure of FCI in South Africa (excluding the global influence) has bucked the trend of most other EMEs by suggesting a worsening rather than improvement in domestic fundamentals (**Chart 6b**)[11]. The rise in debt culminated in a sovereign debt downgraded by Moody's to sub-investment grade status in March 2020. South Africa's sovereign debt is now assessed to be non-investment grade status by all three of the major international credit rating agencies implying that South Africa is now excluded from the FTSE World Government Bond Index (WGBI). This index is passively tracked by a large number of global investors.

Our preiminary results suggest that around one-half of the estimated capital flows at risk in South Africa in 2020 Q1-Q2 was due to the weak domestic conditions rather than due to the external shock *per se*.

[11] Fedderke (2020) finds that the rise in South Africa's government debt-GDP ratio is associated with a more than 2½ pp rise in the ten year sovereign spread (over US treasuries) during the 2008-2019 period.

Chart 6a: Net government debt (% of GDP), 2000-2020

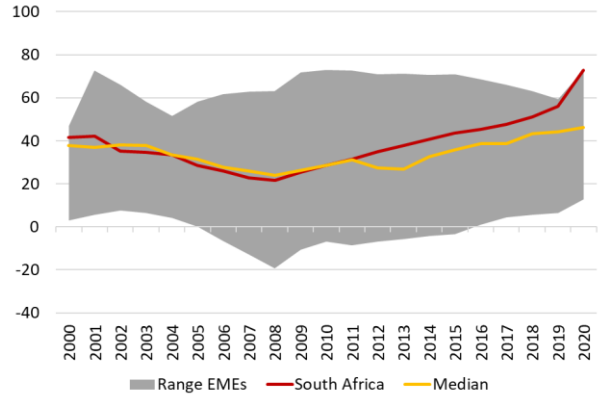
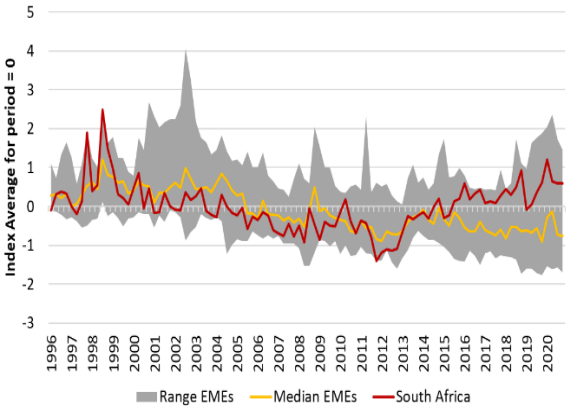


Chart 6b: FCIs (excluding global influence), 1996 Q1-2020 Q4

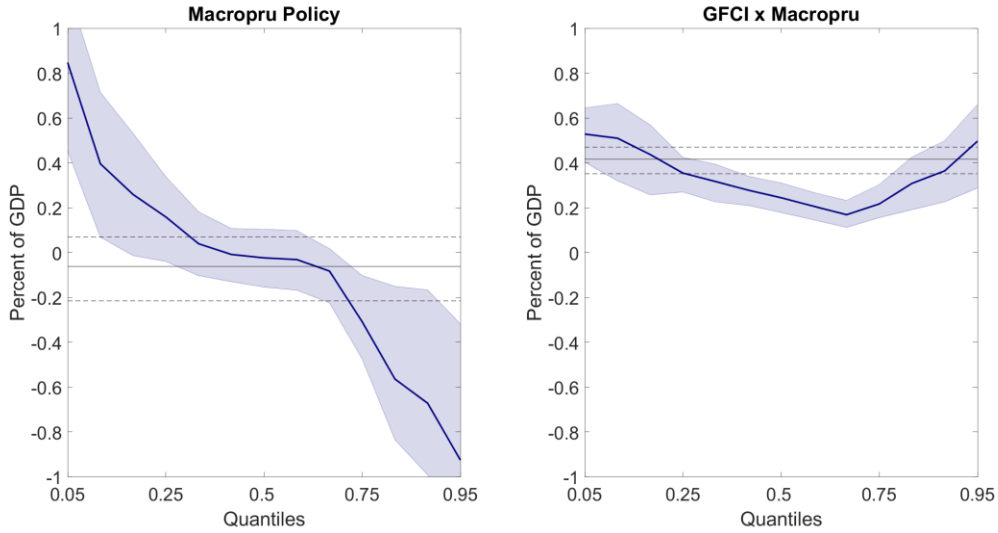


Source: IMF Fiscal Monitor October 2020.
Note: Sample of EMEs is Brazil, Chile, Colombia, Hungary, Indonesia, Mexico, Peru, South Africa and Turkey.

Given the sensitivity of capital inflows to external shocks naturally raises the question of whether *ex ante* policy actions can reduce the impact. So in a second specification the role of some policy factors (X) in affecting the sensitivity of capital flows-at-risk to global push shocks are included. This is done both by adding the policy variable alone and its interaction effect with global push factor (equation (2)):

$$CF@R = \alpha + \gamma\ Pull + \beta\ Push + \delta\ X + \theta\ (Push * X) + u \qquad (2)$$

Chart 7: Impact of tighter macro prudential policy and higher foreign currency reserves on capital flows into EMEs (% of GDP)



Note: The chart shows the effect of a one standard deviation increase in the ratio of foreign currency reserves to short-term debt and rise (tightening) in the macro prudential policy index on the distribution of gross portfolio capital flows (percent of quarterly GDP), on average, in the current quarter and two subsequent quarters. Confidence interval based on block bootstrap methods. The horizontal bold lines show the OLS estimates and dashed lines the associated one standard deviation confidence band.

The time horizon and quantile subscripts are dropped here for simplicity. The factors (X) provisional included are the role of macro-prudential policy and a measure of reserve adequacy (the ratio of foreign currency reserves to short-term external debt)[12]. Tighter (*ex ante*) macro prudential policy is found to reduce both the risk of capital flow booms and busts in general and when global financial market conditions (GFCI) tighten – δ and θ in equation (2) are both positive in the lower tail and negative in the upper tail of the distribution (**Chart 7**). Higher *ex ante* foreign reserves are associated in general with less risk of capital inflow booms and bust.

3. Policies to deal with booms and bursts in domestic credit combined with capital flows

As highlighted above, EME capital stops caused by external shocks seem to have become more frequent over the past decade or so. Moreover, portfolio inflows seem particularly sensitive to externally-induced shocks. This is consistent with data on

[12] Data are from Cerutti, Claessens and Laeven (2017), which measure the use of macro prudential policies in a large dataset of countries. It focuses on the introduction of new measures considering twelve different instruments although does not capture the intensity of measures nor how intensity has changed over time. In each quarter, the use of any additional macro prudential measure adds 1 to a country index. Removal of a measure are recorded as -1. These variations are cumulated over time in each country given that these policies may have a lasting effect.

South Africa which shows that, even before the Covid-19 shock, gross portfolio debt inflows, in particular, have been highly correlated with those in other EMEs - especially since the GFC – and more so than other types of capital inflows **(Table 1)**[13].

This suggests that portfolio debt investors partly treat emerging markets as a homogenous asset class suggesting that inflows into most EMEs are simultaneously sensitive to marked changes in global investors' risk sentiment.

In addition, since the GFC there has been a growing share of portfolio debt inflows to EMEs, including into South Africa **(Chart 8)**. This suggests that a given negative external shock will result in a bigger stop in total gross capital inflows than in the past[14]. The corollary of this is that a bigger improvement in domestic fundamentals (pull factors) will be needed to attenuate the risk of a capital stop.

Table 1: Correlation of gross capital flows into South Africa with other EMEs 1990 Q1-2019 Q4

	Direct		Portf. Debt		Portf. Equity		Other		Total	
	EM	Peers	EM	Peers	EM	Peers	EM	Peers	EM	Peers
1990-1995	0.39	0.14	0.13	0.14	0.03	-0.22	0.08	0.34	0.61	0.23
1996-2000	-0.12	-0.11	0.56	0.44	-0.18	0.12	0.08	-0.21	0.36	0.55
2001-2005	0.27	-0.01	-0.08	-0.16	0.08	-0.11	0.41	0.13	0.47	0.22
2006-2010	0.06	0.15	0.57	0.46	0.55	0.40	0.40	0.31	0.49	0.48
2011-2019	-0.07	-0.17	0.54	0.38	0.13	0.32	-0.05	0.05	0.31	0.32
Before GFC	0.29	0.23	0.31	0.28	-0.06	-0.14	0.20	0.11	0.40	0.31
After GFC	-0.10	-0.15	0.51	0.38	0.28	0.37	-0.03	0.06	0.26	0.28
Total Period	0.31	0.22	0.38	0.31	0.13	0.07	0.14	0.10	0.42	0.34

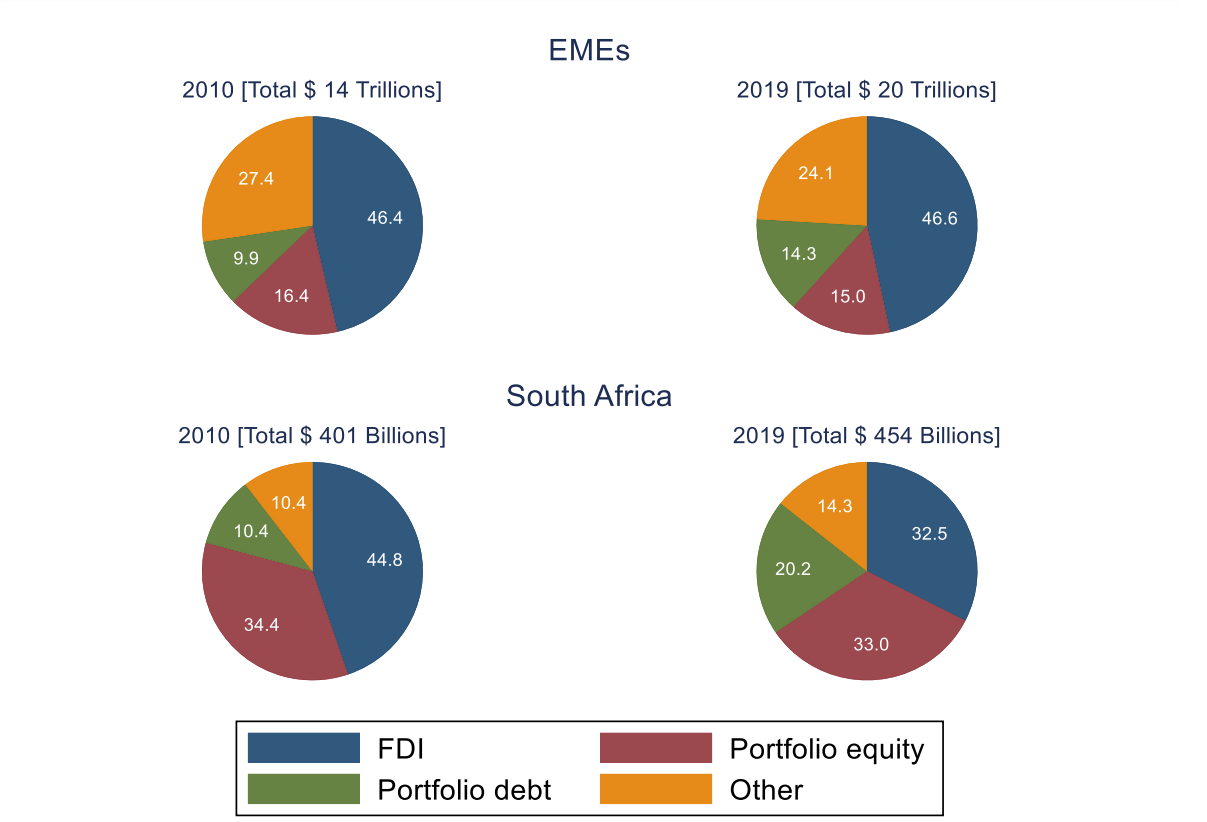
Source: authors' calculations.

Note: Colours represent statistical significance. Red, orange and yellow represent respectively statistical significant at the 1%, 5% and 10% levels. There are 74 emerging and developing countries (EMs). Peers are Brazil, Turkey, Mexico and Russia.

[13] Given Covid-19 was a common shock facing all EMEs, including 2020 Q1-Q2 data would increase the correlation of debt (and equity) flows into South Africa with its peers and other EMEs more broadly since the GFC.

[14] The empirical analysis of CF@R above are based on constant estimated parameters over the whole estimation period. So, in fact, these estimates may understate the sensitivity of total capital flows to external shocks in recent years given the increasing share of the most sensitive component (portfolio inflows).

Chart 8: Share of external liabilities by type (%)



Source: IMF balance of payments statistics.

What are the range of policies that EME central banks, including SARB, could use potentially to deal with this seemingly increased external-induced risk of capital flow volatility[15]*? The policy choices become especially difficult if capital stops (surges) are associated with, or cause, a tightening (loosening) in domestic financial conditions.*

3 (i) Monetary policy

To the extent that a tightening (loosening) in financial conditions is expected to cause inflation falling below (rising above) target, then a reduction (increase) in the monetary policy rate is the key policy to deal with such a risk at least for inflation targeting central banks with floating exchange rates such as South Africa – since it reaches 'all the cracks' (Stein (2013)).

However, although lower (higher) policy rates should act to loosen (tighten) domestic financial conditions, if unexpected, it may cause a further decline (increase) in capital

[15] The IMF is currently in the process of re-visiting its assessment of the appropriate mix of central bank policies - monetary, exchange rate, macro prudential and capital flow management policies – for managing large and volatile capital flows (see IMF (2020a)).

inflows and thus further downward (upward) pressure on the domestic currency.

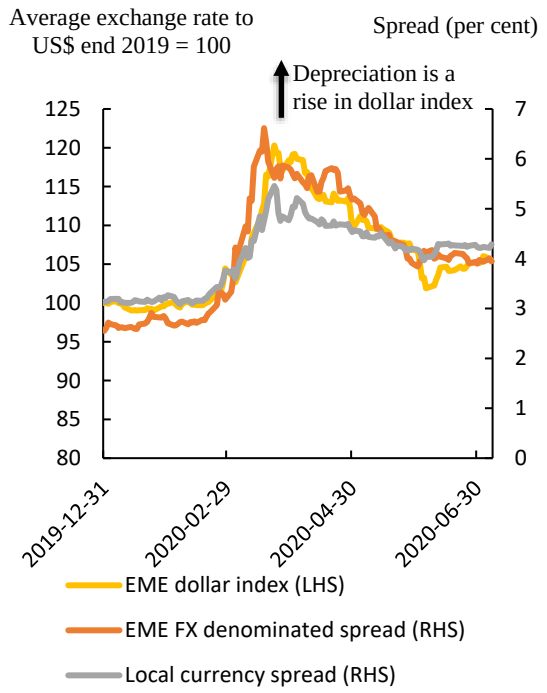
In any case, financial risk channels may cause a negative feedback loop between domestic financial conditions, on the one hand, and capital inflows and the exchange rate on the other. If domestic borrowers have net foreign currency liabilities, domestic currency depreciation – whether caused by a negative external shock or perceived worsening in a country's domestic fundamentals – would reduce their net worth. This, in turn, may increase their credit risk premium and encourage a further reduction of finance from abroad. The same 'financial risk channel' acts in reverse when the local currency appreciates. This channel though does not seem to be a key risk in South Africa – at least not for the central government since most (90%) of its borrowing is in rand.

Borrowing in local currency, however, does not extinguish the currency risk but rather transfers it to the creditor. Global institutional investors tend to invest in EME local currency markets unhedged. When the local currency depreciates, foreign investors face a financial loss. They may be encouraged, or forced by their mandates, to further sell local currency assets resulting in a further round of capital outflows, domestic currency depreciation and a tightening in domestic financial conditions due to an exchange risk premium. In addition, foreign investors reliant themselves on short-term funding, such as open-ended investment funds, may face funding pressures forcing them to sell their higher credit risk assets (e.g. EME bonds).

Unlike in high income countries, in South Africa and other EMEs, there does seem to be a high positive correlation between increases in local currency sovereign bond spreads and exchange rate depreciation, including during the Covid-19 crisis (see **Charts 9** and **10)**[16].

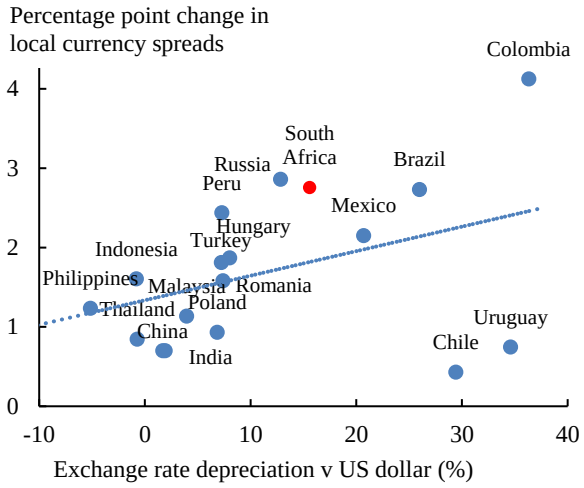
[16] See Hofmann**,** Shim and Shin (2020). During the height of the Covid-19 shock – between mid-Feb and mid-March – the daily correlation between local currency sovereign spreads for EMEs in our sample and their exchange rate was very close to one, since both variables went up in a synchronised way in the period of stress. For (non-reserve) high income countries, the correlation is much lower (0.35).

Chart 9: Exchange rates and sovereign spreads in EMEs, on average, during 2020 H1



Source: Thomas Reuters Eikon.
Note: Figures are averages for 20 EMEs.

Chart 10: Change in EME exchange rates and local currency sovereign spreads during height of Covid-19 shock



Source: Thomas Reuters Eikon.
Note: the dates represent the local trough to peak in the VIX index (February 12 – March 16, 2020). Correlation between series is 0.39 (p-value: 0.11).

Nonetheless, during the Covid-19 capital stop there seems to have been some investor differentiation between EMEs according to their initial underlying fundamentals 'pull' factors (**Chart 11** and **12**). In addition, Moody's downgraded the South African Government's debt to sub-investment grade towards the end of 2020 Q1. This may be one reason why sovereign spreads rose more in South Africa than most of its peers (over and above taking account of its initial pre-Covid-19 fundamental position).

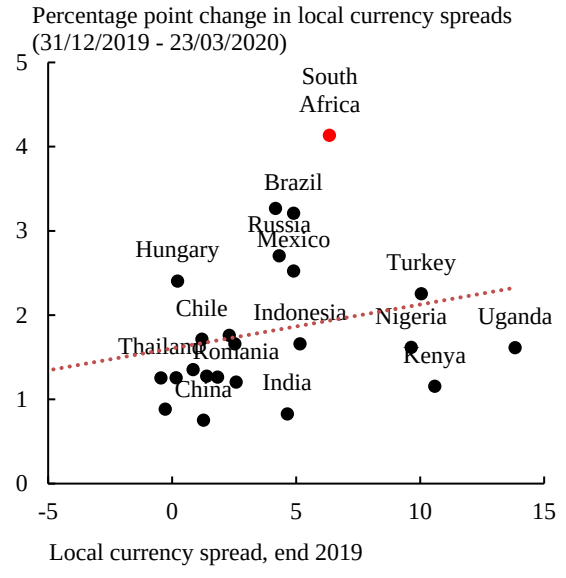
SARB partly mitigated the Covid-19 related increase in local currency sovereign bond yields by purchasing local currency government debt on the secondary market[17]. But this purchase programme is a temporary measure aimed at reducing disorderly conditions in the government debt market rather than a permanent measure aimed at making it cheaper than otherwise for the government to finance its ballooning

[17] Arslan, Drehmann and Hofmann (2020) estimate that bond purchases in South Africa reduced 10-year bond yields by 150bps and without resulting in further rand depreciation.

outstanding debt. And despite SARB's asset purchases, longer-term government bond yields remain elevated[18].

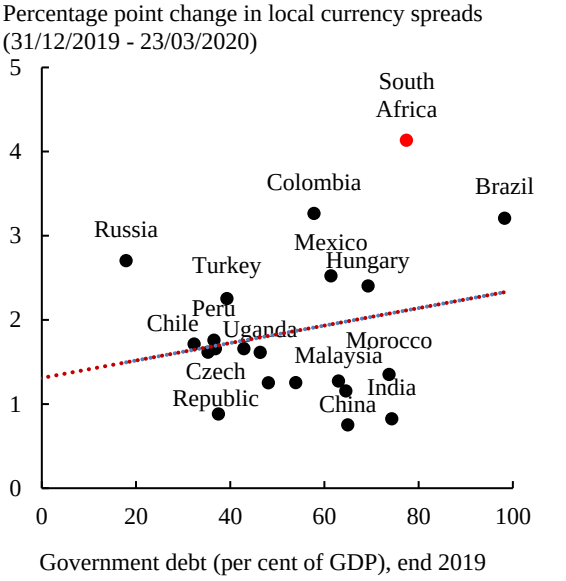
Therefore, a key challenge for South Africa in order to reduce future risks of a capital stop and tighter domestic conditions is to improve domestic macroeconomic fundamentals. Important in this respect will be to ensure that there is a credible and transparent plan to reduce the government's debt over the medium term.

Chart 11: Change in local currency sovereign spreads during the Covid-19 shock and pre-Covid-19 spreads



Source: Thomas Reuters Eikon.
Note: Correlation between series is 0.23 (p-value: 0.29).

Chart 12: Change in local currency sovereign spreads during the Covid-19 shock and pre-Covid-19 government debt



Source: Thomas Reuters Eiko and IMF.
Note: Correlation between series is 0.22 (p-value: 0.33).

Other central bank measures can complement monetary (and fiscal) policy.

3 (ii) Macro prudential policies

There is a spectrum of policies that fall under the broad macro prudential umbrella. Faced with the combination of tighter (looser) domestic financial conditions and capital stops (surges), these measures could play a complementary role to monetary policy. They could be used to either target the resilience of the domestic financial system and domestic borrowers (macro prudential) and/or help to offset the impact on domestic

[18] See South African Reserve Bank (2020).

demand (macro prudential).

In principle, macro prudential policies give central banks an additional instrument to affect domestic demand through influencing the supply of bank credit. In so doing they can directly affect domestic demand without affecting the exchange rate and capital outflows. For given domestic monetary policy rates, changes in the macro prudential stance can increase (reduce) domestic demand through easing (tightening) liquidity conditions such as changing lending standards on mortgage finance or changing banks' capital or liquidity requirements.

How effective are macro prudential policies in practice?

The use of macro prudential measures, in both high income and emerging markets, increased markedly after the GFC. With the notable exception of the recent Covid-19 episode, for most of this period countries tightened macro prudential policy. Overall the evidence suggests that a tightening in domestic macro prudential tools can reduce credit growth, especially in boom periods, and strengthen lenders and borrowers balance sheets (see **Annex A** for a survey of the empirical literature on the use of macro prudential measures).

Measures aimed at borrowers, particularly in the housing market, seem to be especially effective in affecting the growth in credit and house prices as well as strengthening borrowers' balance sheets. A number of recent studies also find that macro prudential tightening can reduce the sensitivity of capital inflows to adverse external shocks and/or strengthen the banking system in face of such shocks. Recent studies also find evidence that a tightening in foreign currency measures or those aimed more directly at capital inflows (capital flow management measures (CFMs)) can be effective in reducing capital inflows and/or the growth in domestic credit.

But the effectiveness of many macro prudential tools – especially if narrow in scope - is found to be partially offset by 'leakages' to the non-domestic regulated sectors - domestic non-banks and foreign creditors. This, in turn, raises questions on the desired breadth of the regulatory perimeter and to what extent it is important to have in place reciprocity agreements with other authorities in order to reduce external leakages.

Use of macro prudential measures

In general, according to the most recent comprehensive cross-country survey by the IMF, EMEs (and most high income countries) use a range of macro prudential tools[19]. Such tools are used more sparingly in South Africa (**Table 2**, page 26). In particular, SARB has fewer sectoral measures, such as applied to households and corporates, and liquidity measures in foreign currency, than its peers[20].

A number of EMEs (as well as high income countries) eased macro prudential policies in 2020 H1 as part of a package of measures either to support domestic demand to mitigate the impact of the Covid-19 crisis and/or to alleviate some of the downward pressure on the exchange rate (**Table 3**, page 27).

In South Africa's case, in order to reduce the risk of a reduction in the supply of credit to the real economy, SARB reduced temporarily the Pillar 2A capital buffer, the capital conservation buffer (CCoB) and the liquidity coverage ratio (LCR)[21]. None of these tools though are formally countercyclical measures but rather were used on an ad hoc basis to deal with this unprecedented event.

Counter Cyclical Capital Buffer

SARB does, however, have in place one countercyclical tool – the Counter Cyclical Capital Buffer (CCyB). Although, in practice, as in a number of other EMEs, the CCyB has not deviated so far from 0% (**Table 2**). The BIS recommends a range for the CCyB of 0-2.5% of risk-weighted domestic assets. A number of recent international studies suggest that, faced with a marked cyclical downturn, such as in the GFC, the capital ratio could fall by a lot more than this 2.5% range (e.g. Aikman *et al* (2019)). This may suggest that in a cyclical boom the CCyB needs to be increased more aggressively. It also suggest that the level set in 'normal' times should be above 0%[22]. This would leave more space to both increase the CCyB gradually during a boom and to release

[19] This survey though has not been updated since 2018.

[20] There are also prudential limits on South African banks, institutional investors and investment funds in buying foreign assets.

[21] See Palesa, M, Rapapali, M and Simbanegavi, W (2020).

[22] The Bank of England, for example, aims to move its CCyB to 2% to be held in normal times. As a step along that path, the CCyB was increased from 0% to 1 % in December 2019 (Bank of England (2019)). Although given the large negative shock from Covid-19 since then the policy was temporarily reversed in March 2020 (Bank of England (2020)).

capital in a recession. For example, in response to the Covid-19 crisis, the Bank of England cut the CCyB from 1% to 0%, which freed up to £190 billion (8 ½% of annual GDP) of bank lending to businesses.

Regulatory capital ratios

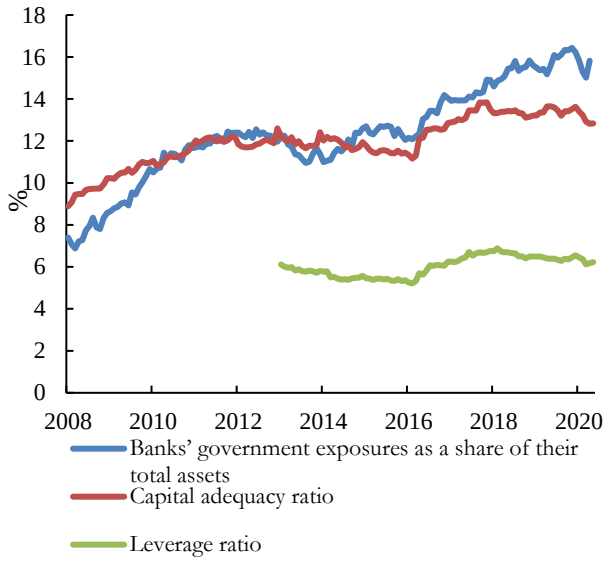
Ex post, the risk-weights in banks' capital adequacy ratios were found to have been understated in many countries prior to the GFC. There are still question marks whether banks' risk-weights are measured accurately including in the internal risk-based (IRB) approach.

In South Africa, since the GFC there has been a gradual trend rise in the aggregate banking sector's risk-weighted capital ratio. Over the same period banks' government exposures as a share of their total assets has doubled (**Chart 13**). In contrast, since its inception in 2013, the leverage ratio – the ratio of capital to unweighted assets – has remained broadly constant hovering around 6%. This suggests that the increasing share of government assets in banks' portfolios has reduced banks' overall measured risk weights and, therefore, helped boost their capital adequacy ratios.

South African banks' exposures to the government are likely to increase a lot further over the next few years given the large fiscal stimulus needed to deal with the Covid-19 crisis. The large South African banks make an assessment of the government's risk of default in using the IRB approach to setting capital risk weights. But other banks that use the credit ratings approach apply a zero risk weight and so assume that there is no sovereign risk.

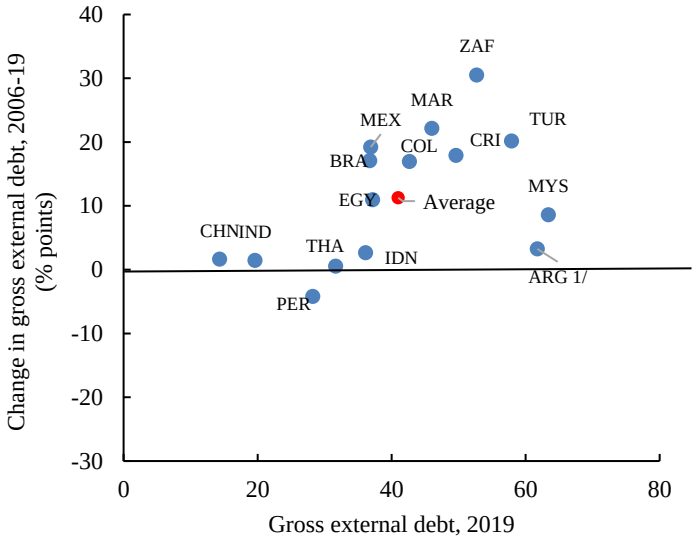
Many past crises, in some high income countries as well as in EMEs, have witnessed pernicious feedback loops between the government and banking sector due to their interrelated exposures ('doom loop'). Given the heightened risk of the public sector in South Africa and the banking system's growing exposure to this sector, there is a question whether the risk weights should be set higher than zero for all banks and whether there should be a closer ongoing monitoring of how the risk-weights are derived by the large banks in the IRB approach. At a minimum, this emphasises the usefulness of the (non-risk weighted) leverage ratio as a backstop measure of capital adequacy.

Chart 13: South African banking system's capital adequacy ratio, leverage ratio and share of exposures with the government, 2008-2020



Source: SARB.
Note: The capital adequacy ratio is Tier 1 capital as a percent of risk-weighted assets; leverage ratio is Tier 1 capital as a per cent of (unweighted) assets. So an increase in the leverage ratio measure means a reduction in leverage. The banking system's holding of government assets include those with state-owned enterprises.

Chart 14: EMEs: Gross external debt (per cent of GDP), 2006-19



Source: IMF External Sector Report (2019), July and World Bank for 2019.
1/Argentina's external debt excludes holdouts from debt restructuring.

Foreign currency and maturity measures

At the aggregate macro level, South Africa's external balance sheet does not seem to be exposed to valuation or funding risk. Unlike most EMEs, South Africa's external assets are now larger than its liabilities. Moreover, whereas external assets are mainly in foreign currency, the lion's share of its liabilities are in equity (FDI and portfolio) and so denominated in rand. This means that when the rand weakens, everything else equal, the overall net foreign assets (net international investment position, (NIIP)) increases. Indeed, and notwithstanding continuous current account deficits, valuation gains from currency depreciation since the GFC has helped improve South Africa's NIIP[23].

[23] See Morule and Steenkamp (2018).

Most (90%) of the South African government's outstanding external debt too is denominated in rand, so is not directly exposed to foreign currency risk induced by rand depreciation. Also, the South African banking system, at the aggregate level at least, does not have mismatches between its foreign currency assets and liabilities.

These factors may suggest there is less need for foreign currency macro prudential measures in South Africa than for many of its peers. That said, the aggregate data may mask foreign currency and maturity mismatches facing a number of individual banks or other financial institutions.

As for the non-financial corporate sector (including SOEs), although foreign currency denominated debt remains relatively low compared to the average in EMEs, as elsewhere, it has risen a lot over the past decade (to 40% of their total debt, around 15% of GDP at end 2019)[24]. It is unclear precisely the extent to which corporate exposures have natural or financial hedges.

In addition, debt owed to non-residents (external debt) is above the EME average and has increased more than in other EMEs since prior to the GFC (**Chart 14**). A non-trivial amount of this debt is in foreign currency (25% of GDP) with almost one-half at short maturity. This may suggest that parts of the non-government sector have foreign currency risks especially at short maturities raising the question over the possibility of foreign currency liquidity risk. Therefore, there may be a case for closer monitoring of the foreign currency mismatch positions, including by maturity, of banks (e.g. through the Liquidity Coverage Ratio (LCR) in foreign currency and foreign currency exposures to the corporate sector), large private corporates and SOEs.

3 (iii) Foreign currency intervention

There is a growing literature that suggests that the net benefits of free floating exchange rates, especially for EMEs, is less than previously thought[25]. On the current account side, a lot of trade is invoiced in dollars implying the increase in export volumes following currency depreciation may not be as large, especially in the short run, as for high income countries. On the capital account side, as described above, depreciation may cause a tightening in financial conditions. Depreciation may result in

[24] See Avdjiev, McGuire and von Peter (2020).
[25] IMF (2019), BIS 2019).

an increase in net debt for borrowers in foreign currency. This direct risk is avoided for borrowers in local currency[26]. Nonetheless, borrowers in local currency may face higher funding costs reflecting the creditors' higher currency risk premia. In fact, Hofmann and Park (2020) find in a sample of 21 EMEs, including South Africa, that a generalised dollar appreciation reduces EME growth.

The BIS (2019) suggests that foreign currency reserve intervention could act both as an EME crisis management and prevention tool. In an exchange rate crisis, foreign currency reserves could help limit the scale of domestic currency depreciation (see the discussion in Patel and Cavallino (2019)). Gelos *et al* (2019) find that foreign exchange intervention seem to help, in the short run at least, to mitigate downside risks to portfolio inflows caused by worsening global conditions. The signalling effect of large ex ante foreign currency reserves may also deter a withdrawal of capital by foreign investors in the first place (BIS (2019)).

In addition, in a capital flow boom, foreign currency intervention could put a break on the positive loop between exchange rate appreciation, capital inflows and looser domestic financial conditions and thus reduce the risk of a large future reversal in financial conditions (see Ehlers and Takats (2013)). Relatedly, the IMF (GFSR, 2020b) find that a higher foreign currency reserve cover (relative to short-term external debt) is associated with less volatility of portfolio debt inflows and a lower probability of both surges, especially of local currency denominated debt, and of a capital inflow stop.

Most of South Africa's EME peers intervened in the foreign currency market in the spring of 2020 – both in the spot and derivative markets[27] – in face of the Covid-19 shock. In South Africa's case, its free floating exchange rate regime has served it very well. And there are costs with foreign currency intervention (e.g. fiscal, reducing two way market pricing). Still, South Africa has currently relatively low levels of foreign currency reserves on standard measures of foreign currency reserve cover such as relative to short term external debt, the external financing requirement and the IMF's

[26] However, foreign investors' credit risk to EMEs with net foreign currency liabilities will have increased. If investors have value at risk constraints, they may be forced to reduce credit supply to all EMEs, including those which borrow in local currency.

[27] Over time, EMEs have intervened more through derivative markets. These instrument provide the opportunity for market counterparties – which increasingly are made up of non-bank financial institutions – to hedge their foreign currency risk. Derivatives also allow central banks, in the short run at least, to economise on their use of foreign currency reserves and relatedly, therefore, to avoid the need to report a reduction in reserves.

reserve adequacy metric. Over the medium term, once international investors' risk appetite is more normalised, SARB may want to take opportunities when inflow pressures are strong to build up a foreign reserve buffer that could potentially be used as a financial stability instrument

4. Conclusion

In the spring of 2020, the Covid-19 shock caused a large increase in both global investor risk aversion and in portfolio outflows by non-residents from EMEs. In South Africa, gross portfolio outflows were $9½ bn (over 6% of GDP) in the first half of 2020. A number of countries, including South Africa, took the precaution of short term emergency financial assistance from the IMF to deal with potential balance of payments financing needs.

Using a quantile regression approach we find that, even ahead of the Covid-19 shock, gross capital flows were especially sensitive to changes in external conditions in periods of capital stops. This is estimated to be particularly the case for portfolio flows. We also find that over the past decade or so there has been an increased frequency in which external shocks have caused capital stops. The model estimates that for EMEs as a whole, most of the gross capital outflows in 2020 H1 was attributable to the external shock rather than to domestic factors.

Given the seemingly increased frequency of large negative external shocks and the growing reliance on portfolio debt inflows suggests EMEs may need a broad toolkit to deal with capital flow volatility going forward[28]. Policy is especially challenging when capital stops coincide with depressed domestic demand (and likewise when there is a boom in both domestic demand and capital inflows). In these circumstances, reducing policy rates can help boost demand but may accentuate the exchange rate depreciation. The latter should help switch expenditure to net exports but may cause financial stress. Borrowers in foreign currency will face higher debts in local currency terms. Even though borrowers in local currency, such as the South African government, do not face this exchange rate risk, they may still face a higher cost of borrowing to reflect the increased foreign currency risks faced by foreign investors.

A key risk facing the South African economy is the large and growing government debt. As seen in spring 2020, the government's cost of funding is sensitive to common external shocks that affect all EMEs. This was likely accentuated in South Africa's case by the relatively weakening fiscal position in recent years and the credit rating downgrade in March 2020. It is difficult to distinguish between the impact of push and pull factors. However, our preliminary

[28] Policies are also needed at the creditor end to reduce the need for forced selling of EME assets during periods of heightened risk aversion (e.g. liquidity matching for open-ended investment funds).

results suggest that around one-half of the estimated capital flows at risk in South Africa in 2020 Q1-Q2 were due to weak domestic conditions rather than due to the external shock *per se*.

EMEs may need to strengthen their defences against the risk of capital flow stops. In South Africa's case, a key measure is the need for the government to have a credible and transparent plan to reduce its debt burden over the medium-term. In the meantime, given the increasing exposures of the banking system to the government sector may suggest the need for closer monitoring by supervisors of the underlying risk of banks' exposures to the government sector, including to SOEs.

SARB's monetary policy framework of inflation targeting has been very successful. However, it may want to consider expanding its regular macro prudential toolkit to either influence domestic demand and/or to reduce volatility in capital flows or more broadly to address potential financial stability risks. It currently actively uses fewer cyclical macro prudential tools (such as the CCyB), sectoral and foreign currency liquidity ones than a number of other central banks. Foreign currency mismatches at the aggregate economy and sector level (government, banking and corporates) seem to be lower in South Africa than in many other EMEs, implying that expanding foreign currency measures may not be needed. Still data are patchier at the disaggregated level so it may be useful to collect more granular data and to more closely monitor the available data on the foreign currency mismatches – including by maturity – of large individual banks and their corporate customers including SOEs.

The latest external shock also suggests there is a need for a bigger domestic (and multinational) safety net[29]. The floating exchange regime has served South Africa well but when investor 'risk on' returns, SARB may want to take the opportunity to build up a bigger foreign currency reserve cover that can help cushion against future 'risk off' episodes.

[29] See Eguren Martin *et al* (2020) for recent estimates of the shortfall in the global safety net for high income countries and EMEs.

Table 2: Macro prudential tools in selected G20 EMEs

Type of tool	South Africa	Argentina	Indonesia	Russia	Turkey	Brazil	Mexico	*Memo* Korea Rep.
Broad-based								
Capital Conservation Buffer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Leverage Ratio	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Countercyclical capital ratio – Framework	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
– Positive rate	No	No	No	No	No	No	No	No
Household								
Capital ratios	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Loan-to-value ratio	No	No	Yes	No	Yes	Yes	No	Yes
Loan-to-income ratio	No	No	No	No	No	No	No	Yes
Debt service-to-income ratio	No	No	No	No	No	No	No	Yes
Corporate								
Capital ratios	No	Yes	No	Yes	No	No	No	No
Banks' liquidity								
Reserve requirement	No	Yes	No	No	Yes	Yes	No	No
Liquidity asset ratio	No	No	No	No	Yes	No	No	No
Liquidity coverage ratio	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Net Stable Funds Requirement	Yes	Yes	Yes	No	No	Yes	No	Yes
Banks' foreign currency								
Liquidity (including reserve requirements)	No	Yes	Yes (LTF)	Yes	Yes	No	Yes	Yes
Loan limits	No	No	Yes	No	Yes	Yes	No	No
Maturity mismatches	No	No	No	No	Yes	No	Yes	Yes
Banks' structural								
Systemic Financial Institution surcharge	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

Source: IMF (2018).

Table 3: Measures taken in reaction to Covid-19 in selected G20 EME central banks, as of end-June 2020

Country/policy	Change in policy interest rate (since end Jan 2020, bps)	Other monetary policy	Financial markets	Financial stability policies	External policies	Change in exchange rate (v$), end December 2019-end June 2020	(known) use of global financial safety net	Memo: Fiscal policy
South Africa	-250		Increased purchases of government securities in secondary market across the yield curve	Temp relief on capital requirements and LCR reduced by 20 pp; Guidance on banks' dividend payment	None	-19.5	RFI, $4.3bn	Fiscal measures (10.3% of GDP)
Turkey	-250		Increased outright purchases of government bonds, widened pool of collateral; measures to support primary dealers	The regulator increased LTV on mortgages by 10pp	Reduced fx reserve requirements by 500 bps	-13.1	Swap agreement with Qatar increased from $5 trillion to $15 trillion equivalent	Fiscal stimulus (2% of GDP)
Russia	-150	Introduced temporarily long-temp repos New facility for SME lending		Forbearance on provisioning, deferral on loan repayments, liquidity regulation eased for systemic banks; favourable treatment for banks' loans in fx	FX sales; Increased limits on fx swaps	-12.8	None	Fiscal stimulus (estimated at 3 ½ % of GDP)
Mexico	-200	Reduced mandatory regulatory deposit ratio; increased liquidity facilities, widened collateral and bank access		Regulator introduced temp easing in banks' liquidity requirements and in accounting standards	FX intervention; Extended NDF hedging in domestic currency from $10bn to $30bn	-18.3	Drawn on $60bn temp swap line with the US Fed; IMF FCL	Above the line measures on health and real economy (0.7% of GDP); below the line measures 0.5% of GDP
Brazil	-200	Reduced reserve requirements by 14pp Accept broader collateral in lending (including corporate bonds)		Reduced capital conservation buffer; temporary relaxation of provisioning (if lending to SMEs)	FX spot sales and swaps; fx repos	-26.7	Temp $60bn swap line with the US Fed (not yet activated)	Fiscal stimulus 11% of GDP (direct impact on 2020 deficit 6.5% of GDP)
India	-115 (repo) -155 (reverse repo)	Liquidity injection 4% of GDP. Large broadening of liquidity facilities Introduced long-term repos; Cash reserve ratio reduced 100bps	Liquidity measures for mutual funds	LCR reduced 20bps Deferred loan repayments Delayed introducing NSFR and CCoB	FX intervention; fx swaps; eased capital inflow controls on purchasing domestic corporate and government bonds	-5.5	None	Central and local government fiscal stimulus over 6% of GDP

Country/policy	Change in policy interest rate (since end Jan 2020, bps)	Other monetary policy	Financial markets	Financial stability policies	External policies	Change in exchange rate (v$), end December 2019-end June 2020	(known) use of global financial safety net	Memo: Fiscal policy
Indonesia	-75	Lengthened maturities on repos and reverse repos; Reduced reserve requirements	Purchasing government debt on the primary market	Regulator (OJK) relaxed banks' loan classification and restructuring procedures	FX intervention in spot and NDF market; increased frequency of fx swap auctions; Reduced fx reserve requirements	-2.8	None	Fiscal stimulus (4 ½ % of GDP)
Memo **South Korea**	-75	OMOs unlimited, broadened firm access and accepted collateral	Stabilisation Fund for money makers and equity markets Purchasing of Korean treasury and corporate bonds	Temporary easing in loan-deposit ratio and the LCR	Raised cap on banks' fx forward positions; Temporary reduction in the LCR in fx	-3.9	Temp $60bn swap line with the US Fed (not yet activated)	Fiscal stimulus 1% of GDP
UK	-65	Expansion of scheme for term funding for lending (especially to SMEs) Introduction of Operation of Government guaranteed loans to businesses(15% of GDP)	Increase in government and corporate bond purchases on secondary market by £300bn (13 ½ % of GDP)	Reduction in CCyB to 0% from 1% (and a pre-existing path towards 2%) PRA: Expectation banks will suspend dividend payments and bonuses for senior staff; Pillar 2A requirements set at nominal amounts	None	-6.4	Increased liquidity of $ swap line with the US Fed (and other reserve currencies)	Fiscal stimulus [1](8% of GDP)
Europe (ECB)	0	Temporary additional liquidity including long-term, easing in collateral	Increase in asset purchases	Temporary reduction in systemic risk buffer, capital conservation buffer and LCR Recommended national authorities to reduce the CCyB Temp flexibility in provisioning of NPLs Greater flexibility in accounting and prudential rules on bank's capital; Request banks not to pay dividends	None	0.1	Increase liquidity of $ swap line with the US Fed (and other reserve currencies)	Not applicable

Sources: IMF Covid-19 Policy Mapper, UK Office for Budget Responsibility
Monetary policies – policy rates, liquidity to banking system
Markets – asset purchases (long-term)
FS policies – reduce CCyB, reduce systemic risk or capital conservation buffers, reduce liquidity requirements, reduce provisioning, loan restructuring, reduce dividend payments
External – foreign currency (fx) intervention, reduction in banks' fx reserve or liquidity requirements, fx swaps/repos
Government – corporate loans (eg purchasing short-term corporate paper or use the central bank as an agent) or credit guarantees
GFSN – fx swaps, IMF credit facilities, regional financial arrangements

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Annexure A: Evidence from the recent literature on using macro prudential policies

Macro prudential policies in their modern guise have had a short shelf life with their usage only expanding rapidly since the GFC. So policy makers are still learning lessons and some new instruments have been used only by a few authorities (e.g. the Counter Cyclical Capital Buffer (CCyB)). Second, unlike for conventional monetary policy, where a policy interest rate is the key tool of most central banks, there are a whole array of potential macro prudential tools and it is also difficult to measure the scale of a tightening (loosening) in any particular policy instrument. This creates big challenges in making comparisons across time and countries. And third, most changes in instruments since the GFC have been to tighten the policy stance. There are more limited observations on policy loosening although a number of countries did so in the wake of the Covid-19 crisis in spring 2020.

With these caveats born in mind, a numbers of papers show that a tightening in macro prudential tools can reduce aggregate credit growth ((Lim *et al* (2011), Akinci and Olmstead-Rumsey (2018), Kuttner and Shim (2013) and Bruno, Shim and Shin (2015)). These policies are found to have effects by mitigating financial risks, including reducing banking sector risk, and curbing credit growth (Boar *et al* (2017), Altunbas, Binici and Gambacorta (2018), Gambacorta and Murcia (2019)).

Cerutti and Laeven (2017) is perhaps the more comprehensive study to date. They find that macro prudential policies are usually associated with lower credit growth and house prices. Measures regulating household credit through borrower-based policies (such as caps on loan-to-value (LTV) and debt-to-income (DTI) ratios) are particularly effective but financial-institution based policies (such as limits on leverage and dynamic provisioning) are also found to be significant. These impacts are strongest in EMEs. Policies are most effective when credit growth is strong. The IMF-FSB-BIS (2016) highlight that capital-based tools tend to boost resilience and credit growth during cyclical downturns but have more limited effects during recoveries.

Sectoral housing tools aimed at limited mortgage borrowing such as sectoral capital requirements, limits to LTV ratios and caps on debt service-to-income (DSTI) or LTI ratios seem to be effective in increasing the resilience of borrowers and at reducing the pro-cyclical feedback between credit and house prices (He, Nier and Kang (2016)). That said, although Kuttner and Shim (2013), find that housing-related policies reduce the growth in housing-related debt, they find limited impact on house price inflation.

Forbes, Fratzscher and Straub (2015) finds that macro prudential policies can reduce some measures of financial fragility and potential vulnerability (such as bank leverage and inflation expectations) but not broader financial variables such as the level and volatility of the exchange rate, aggregate portfolio flows, interest-rate differentials and equity indices. But some studies find evidence that implementation of macro-prudential policies raises average GDP growth rates and reduces their volatility (Boar *et al* (2017), Agénor *et al* (2018)).

Macro prudential and monetary policy: On the interaction between domestic macro-prudential policy and foreign monetary policy, Aizenman, Chinn and Ito (2017) find that macro prudential policies can reduce the sensitivity of EMEs to changes in advanced country monetary policy especially for EMEs with a weak external account (e.g. a large current deficit and low cover of foreign exchange reserves) and already are facing a portfolio capital inflow combined with domestic credit boom. The International Banking Research Network (IBRN) uses bank level data to examine the influence of domestic prudential policies on spillovers from US monetary policy. They find significant evidence that macro prudential policy in recipient countries – both AEs and EMEs – can partly offset the spillover effects of monetary policy conducted in core countries (Bussiére *et al* (2020)). Hoggarth and Reinhardt (2016), and Avdjiev *et al* (2017) also find higher capital ratios reduce the sensitivity of bank inflows to changes in external push factors. Similarly, Gelos *et al* (2019) finds that a macro prudential tightening can help reduce the likelihood of portfolio inflow surges following a period of very lax global conditions.

On the interaction of macro-prudential with domestic monetary policy, Bruno**,** Shim and Shin (2017) find evidence that these policies are most effective when they are re-enforcing.

Leakages: The evidence suggests leakages can reduce the effectiveness of macro prudential policies on their aggregate goal of financial stability especially, not surprisingly, for narrower targeted measures. Following a tightening in domestic macro-prudential measures, borrowing by the domestic non-bank private sector from (non-domestic regulated) foreign banks increases (Reinhardt and Sowerbutts (2015), Kang *et al* (2017), Buch and Goldberg (2017)). Ahnert *et al* (2018) find that tighter regulations on domestic banks' foreign currency lending leads to an increase in foreign currency debt issuance by domestic corporations. Crowe *et al* (2013) find that leakages may be greater when capital requirements target specific sectors, possibly contributing to less evidence of the effectiveness of these tools compared to those applied more broadly. Similarly, Basten and Koch (2015) finds that sectoral CCyBs have more limited effects on loan growth than broader CCyBs, potentially since the former generates leakages of loan supply towards better-capitalized institutions. Cerutti, Claessens, and Laeven (2017) also find evidence of leakages with tightening of domestic macro prudential policies

leading to greater borrowing from abroad and more broadly that macro prudential measures are particularly effective in (relatively) less financially open economies.

Overall the evidence is that macro prudential tools can reduce credit growth, especially in boom periods, and strengthen lenders and borrowers balance sheets. Measures aimed at borrowers seem to be especially effective in limiting credit growth. But the effectiveness of many tools is partially offset by leakages to non-domestic regulated creditors – domestic non-banks and foreign creditors.

Foreign currency measures applied to domestic residents: There has been less research focused on the macro prudential tools targeting foreign currency borrowing, mismatches, and liquidity. Ahnert *et al* (2018) find that foreign currency-related macro prudential measures cause a significant reduction in bank borrowing and lending in foreign currency but that this is partially offset by corporates issuing more foreign currency denominated bonds to non-bank investors. Cerutti, Claessens, and Laeven (2017) find that limits on banks' foreign currency loans and on reserve requirement (cyclically-adjusted) lead to a significant reduction in domestic credit growth especially in EMDEs, but also to an increase in cross-border borrowing - suggesting there is some avoidance and leakage of the policies. De Crescenzio, Golin, and Molteni (2017), find that the introduction and tightening of foreign currency-based macro prudential measures after the GFC reduced domestic banks' external borrowing especially of short-term maturities and from other banks.

Capital Flow Management Measures: (CFMs) On measures that are more directly aimed at capital flows, the pre-GFC literature found that these measures can change the composition of inflows (e.g. towards longer-term debt) but were effective only in the short-run and did not affect total net inflows nor the exchange rate (e.g. see Forbes (2007) for a good summary).

The recent literature is more supportive of such measures. It finds that countries that implement CFMs during capital inflow booms tend to have weaker real exchange rates than otherwise (Ostry *et al* (2012), Erten and Ocampo (2017), Magud**,** Reinhart, and Rogoff (2018)). Ahmed and Zlate (2014) found that capital inflow measures have had a significant impact in reducing both total and portfolio net inflows. Several recent studies have found that countries that had tightened CFM policies prior to the GFC were more resilient during the crisis and experienced less overheating afterwards (Ostry *et al* (2011), (2012), Erten and Ocampo (2017)).

Ostry *et al* ((2011), (2012)) also find that inflow controls are associated with a lower proportion of foreign currency lending in total domestic bank credit, and with a lower proportion of portfolio

debt in total external liabilities. In addition, Ostry *et al* (2012) find that tighter domestic macro prudential policies (e.g. loan-to-value ratios and sector-specific credit policies) and foreign currency-related regulations (e.g. limits on banks' open foreign currency positions or exposure to currency mismatch) complement capital controls in limiting capital inflows and in reducing domestic credit booms and overall financial fragility.

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TOPICAL BRIEFING: No. 2

Financial Stability Department

South African Reserve Bank

The financial stability implications of crypto assets in South Africa

1. Introduction

The date 3 January 2021 marked the 12th anniversary of the mining of the Bitcoin genesis block. Various high-profile individuals, such as, post-2000 Nobel Prize for Economics laureates Joseph Stiglitz, Robert Shiller, James Heckman, Thomas Sargent, Angus Deaton, Oliver Hart and Christopher Sims have predicted that the value of Bitcoin and crypto assets would go to zero, or close thereto, (Eglitis and Seputyte, 2017; Wolff-Mann, 2018), however, such predictions seem increasingly unlikely to materialise soon. Despite Bitcoin's growing longevity and some significant price-related action, since early December 2020, that culminated in the global crypto asset market breaching a $1 trillion valuation for the first time ever on 7 January 2021, $1.5 trillion on 14 February 2021 and $1.9 trillion on 31 March 2021, the Financial Stability Board's 2018 assessment that crypto assets "do not pose a material risk to global financial stability at this time" (FSB, 2018:1) continues to hold true. Moreover, compared to the approximately $10 trillion valuation of the entire gold market (at current prices) and the roughly $40 trillion worth of global narrow money (i.e. banknotes, coins and money deposited in savings or checking accounts), crypto assets only constitute around 10% and 2.5% of the respective valuations of these markets. Accordingly, although crypto assets do not currently pose a threat to financial stability, this note considers the conditions under which this assessment could change.

The key question this note endeavours to respond to is: what are the financial stability implications of crypto assets in South Africa? In order to provide a holistic view of the crypto asset-related developments that have led to the current conjuncture, the note firstly briefly considers the evolution of the crypto-asset ecosystem since the mining of

the Bitcoin genesis block in 2009. Although Bitcoin is not a specific focus, its launch remains a pivotal development in the crypto asset ecosystem, it is currently the most widely referenced crypto asset and it is therefore a useful central point for discussing the relevant crypto asset-related developments that have led to the current state of play.

Secondly, this note considers the sustained, and indeed growing, interest in crypto assets by retail and institutional investors (based on daily trading values internationally and domestically) since the crypto asset market crash at the end of 2017 and into 2018. In order to articulate the financial stability implications of crypto assets, both globally and in South Africa specifically, pertinent historical market trends are highlighted that could lead to crypto assets becoming systemically important – both globally and domestically over the next few years. Specifically in the South African context, the fact that South Africa has remaining Exchange Control Regulations in place, is flagged[30], with the potential implications from a domestic financial stability perspective also being considered.

The note is structured as follows: Section 2 provides a timeline of crypto asset developments; Section 3 reviews the growth observed in the international and domestic crypto trading volumes and value; Section 4 considers the developments that could lead to crypto assets posing a risk to global and domestic financial stability, and reflects on the developments that could necessitate crypto asset trading platforms to be designated as domestic systemically important financial institutions; Section 5 highlights areas for further research; and Section 6 provides a summary and conclusion[31].

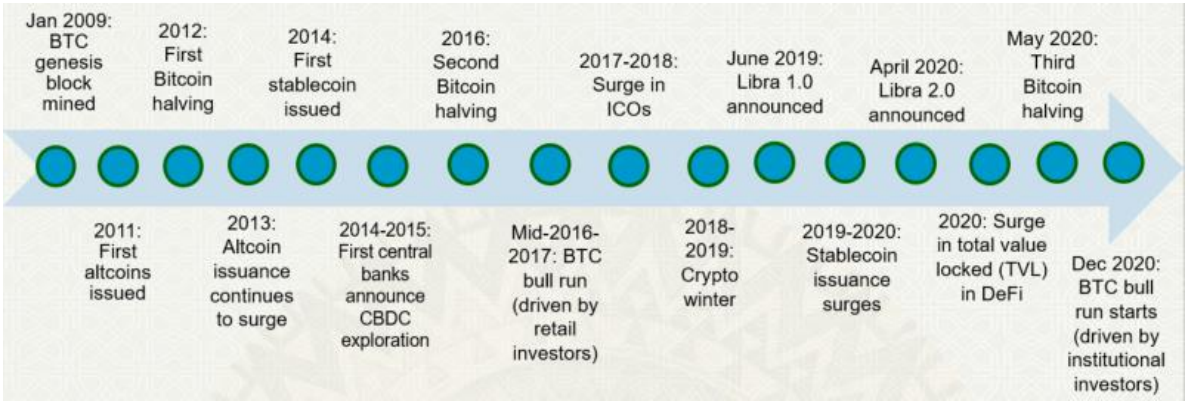
2. Timeline of crypto-asset developments

To more broadly contextualise the current conjuncture in the crypto asset ecosystem, the key crypto asset-related developments identified in Figure 1 below are discussed.

[30] The ongoing developments relating to the modernising of South Africa's capital flow management system – the preferred term going forward for replacing references to 'exchange controls' – are acknowledged as per the recent Budget Speech by the Minister of Finance (Mboweni, 2021). However, until such time that the new regulations are issued, the current system exchange control system remains in force and is accordingly referenced in this note.

[31] The crypto asset topic is a fast developing and constantly evolving theme. Therefore, this note incorporates developments to 31 January 2021.

Figure 1: Timeline of crypto asset developments



Following the mining of the Bitcoin genesis block on 3 January 2009, and keeping in mind that the original vision of Bitcoin was to be a "peer-to-peer electronic cash system" (Bitcoin White Paper (Nakamoto, 2008)), critics of Bitcoin pointed out that Bitcoin does not satisfy the three functions of money, namely being a medium of exchange, a store of value and a unit of account. Bitcoin's historical and continued volatility has meant that it is unsuitable as a widely used means of payment. In addition, Bitcoin's fixed and limited supply[32] in the face of growing demand, which is characteristic of a 'good' investment asset (Bowman, 2020) further supports its use case as an emerging alternative asset class rather than a medium of exchange. Bitcoin's volatility further makes it unsuitable as a stable store of value and, by extension, a unit of account (Carstens, 2018; Carney, 2018b). In addition to this inherent volatility, Bitcoin's suitability as a payment instrument was further questioned due to its 10-minute block time, which creates practical challenges should it be used to pay for the proverbial 'cup of coffee'. Other issues such as widespread acceptance, scalability, the cost of transactions and ease of use further weakened the argument for Bitcoin to function as a widely used medium of exchange.

Given these limitations, approximately two years after the launch of Bitcoin the first of the so-called 'alternative coins' (i.e. alternatives to Bitcoin) or 'altcoins' started to emerge, primarily trying to solve Bitcoin's perceived shortcomings as a payment instrument by aiming to be cheaper, faster and/or easily scalable. To this end, the first altcoins, such as Litecoin, Namecoin, Peercoin and Dogecoin, started to emerge in

[32] Refer to section 3.1 for an overview of the rate of supply of the top two mineable crypto assets by market capitalisation, namely Bitcoin and Ethereum.

2011 and offered proposedly more efficient ways of transferring value. These first altcoins, however, did not address the issue of volatility, which paved the way for the release of the first stablecoin, Tether, to be issued in 2014. Tether is currently the third-largest crypto asset by market capitalisation after Bitcoin and Ether, increasing its market capitalisation almost ten-fold from the start of 2020. In addition, there are now two stablecoins (USD-linked) in the top 15 crypto assets by market cap (and four in the top 50), compared to none two years ago (CoinMarketCap, 2021). Stablecoins have also become the preferred crypto asset trading conduit over the last two years as they give traders the ability to negate crypto asset volatility over the short term by moving into stablecoins during periods of extreme market volatility. Stablecoins have also been cited as potentially accelerating the crypto asset payment use case (Arner, Auer and Frost, 2020).

The years 2014 and 2015 saw numerous central banks starting to explore, issuing their own forms of digital currency, or central bank digital currency (CBDC), partly to remain relevant in response to emerging private forms of digital 'money' (Niepelt, 2019). In the 18 months following the second Bitcoin block reward halving on 9 July 2016, Bitcoin and various altcoins experienced significant price growth, with some altcoins recording annualised growth rates of several thousand percent in 2017. The sharp rise in crypto asset prices in 2017 prompted unprecedented initial coin offerings (ICOs) being launched in 2017 and into 2018, by the end of which the crypto market had entered into what would become known as the 'crypto winter' (Lee, 2019).

Since the end of 2019, growing retail interest in decentralised and peer-to-peer activity caused a surge in the total value locked (TVL)[33] in self-executing and disintermediated DeFi applications. TVL in DeFi has roughly doubled every three months since the beginning of 2020, currently totalling almost $70 billion. Given that stablecoins are largely used as conduit for entering into DeFi contracts given their perceived stable value, stablecoin issuance and popularity have also increased over the past two years. Moreover, the sustained growth in TVL in DeFi represents a shift in retail consumers' behaviour compared to how the crypto market has broadly evolved to date where crypto asset trading platforms have generally – and highly ironically – been the preferred intermediary through which retail investors have gained exposure to crypto

[33] At an industry level, TVL represents the total value deposited into the DeFi ecosystem via smart contracts (Acheson, 2020).

assets. Although existing CATPs remain centrally involved in the process through which retail consumers gain access to DeFi tokens (i.e. by being listed on their trading platforms), once the consumer has acquired the DeFi token and entered into a smart contract using it, the CATP will no longer be centrally involved as the decentralised blockchain will execute the agreement once the set conditions have been met. The marked move towards disintermediation and decentralisation is closely aligned to the original objectives and value proposition contained in the Bitcoin white paper.

Just as the third Bitcoin block reward halving[34] was approaching, the novel COVID-19 pandemic started impacting on global financial markets during the first four months of 2020. Whether the price-related action observed in the months following the third Bitcoin block reward halving was prompted by the event itself on 11 May 2020, a broader collective, global shift towards increased digitalisation (expressed as an increasing preference for digital assets and digital payment options) possibly partly prompted by the Coronavirus-induced lockdowns (Arner, Auer and Frost, 2020), or a combination of factors, is difficult to answer definitively.

In summary, Bitcoin was conceptualised at the height of the financial instability experienced during the 2007/08 financial crisis, and subsequently created following the loss of confidence in some of the advanced economies' banking and broader financial systems. In little more than a decade, crypto assets have evolved from an obscure, single token with almost no market support and acceptance to an increasingly complex ecosystem involving thousands of altcoins, stablecoins and, more recently, global stablecoins, and their burgeoning real-world usage as enable through smart contracts and DeFi applications. Section 3 explores the monetary value created through crypto asset mining activity, and reviews the global and domestic growth in the asset class.

[34] Refer to Box 2 for a detailed discussion of the Bitcoin block reward halving.

3. Monetary value created through mining activity, and growth in crypto trading volumes and values

3.1 The monetary value created through crypto asset mining activity

One of the core attributes of crypto assets is that they are decentralised (Lansky, 2018). The challenge, however, is how to incentivise the network to validate transactions by running a 'node' (i.e. a computer keeping an updated copy of the ledger), thereby keeping the network decentralised. In order to incentivise node operators to keep the blockchain updated by adding new verified transactions, many (though definitely not all)[35] crypto asset protocols reward node operators, also called 'miners', with newly 'minted' or 'mined' crypto assets for verifying transactions. Crypto assets employing this model are broadly referred to as 'mineable' crypto assets (IMF, 2018). To this end, the following table lists the monetary value of the two largest mineable crypto assets, namely Bitcoin and Ethereum (measured by market capitalisation as at 15 March 2021[36]), and provides the block times[37], reward rate[38] and the concomitant monetary value created per crypto-asset over a 24-hour, monthly and yearly period.

Table 1: Monetary value created through crypto asset mining activity

Crypto asset	Block time	Reward rate	24-hour monetary value created	Monthly monetary value created	Annual monetary value created
Bitcoin	10 minutes	6.25 BTC	$54 million	$1.62 billion	$19.71 billion
Ethereum	12 seconds[39]	5 ETH	$66.6 million	$1.99 billion	$24.3 billion

While by no means systemically significant, especially on a global scale, the monetary value created by mining Bitcoin and Ethereum is also not insignificant. Despite being an exciting area for further research, the impact of monetary value created through

[35] The debate around what constitutes a 'true' crypto asset is not touched on at all for the purposes of this paper.
[36] For the purposes of the calculations, a Bitcoin price of $60,000 and an Ethereum price of $1,850 were used.
[37] The block time is the frequency with which a new 'block' of transactions is added to the network.
[38] The reward rate is the total number of newly minted crypto assets that are created when a new block of transactions is added to the network.
[39] A new Ethereum block is added to the Ethereum network every 10-19 seconds, with the average block time being around 12 seconds. The average block time of 12 seconds has been used for calculations.

crypto asset mining activity on the existing monetary policy implementation mechanism falls wholly outside of the scope of this note[40].

3.2 International growth in crypto trading volumes and values

As may be observed from Figure 2, the market capitalisation of the global crypto asset industry breached $500 billion on 21 November 2020 for the first time since 20 February 2020. Thereafter, on 2 January 2021, the market capitalisation of all crypto assets exceeded the previous all-time high of $831 billion recorded in January 2018 before breaching $1 trillion on 7 January 2021. Although it falls outside of the data period selected for this note (30 November 2018 to 31 January 2021), it is interesting to note that the crypto market breached $1.5 trillion for the first time on 14 February 2021 and $1.8 trillion on 13 March 2021.

Figure 2: Total crypto market capitalisation

Source: CoinMarketCap, 2021

Similarly, Figure 3 depicts the 24-hour trading value of all crypto assets over the same period, with daily trading values breaching $100 billion for the first time on 14 May 2019, $200 billion on 13 March 2020, and $300 billion on 17 November 2020. On 4 January 2021, a record $431 billion worth of crypto assets were traded within 24 hours. Daily trading values currently range between $150 billion and $250 billion.

[40] Refer to section 5 for areas for future research, all of which by implication are excluded from the scope of this note.

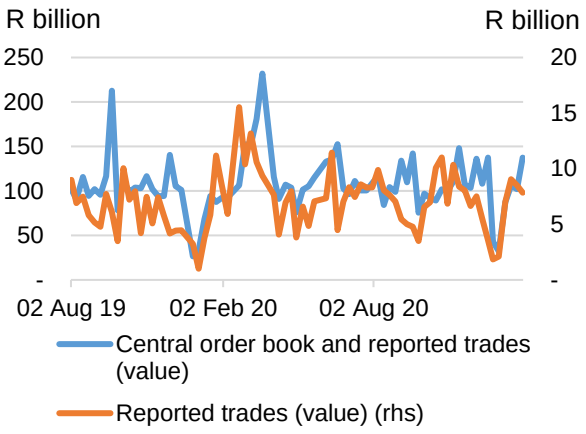
Figure 3: Global 24-hour trading value of all crypto assets

Source: CoinMarketCap, 2021

3.3 Growth in South African crypto trading volumes and values

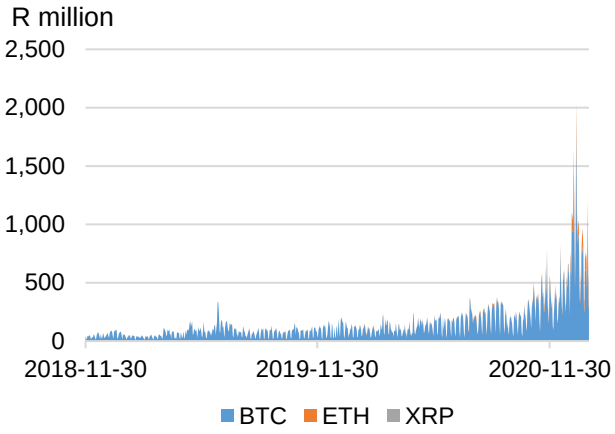
There has been significant growth in trading crypto assets on South African domiciled exchanges in recent years, particularly towards the end of 2020 and beginning of 2021[41]. However, the trading volumes and values are not significant when compared to those on the JSE. The average weekly equity trades on the JSE since August 2019 amounted to R107 billion (or R21 billion per day) (Figure 4).

Figure 4: Weekly equity trades on the JSE



Source: JSE

Figure 5: Value of BTC, ETH and XRP traded



Source: Crypto exchanges

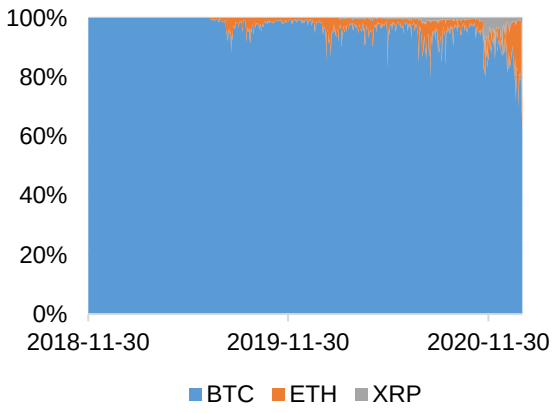
The total value of the crypto assets traded per day did not exceed R500 million for most of the period analysed (Figure 5) but it peaked at over R2 billion in January 2021 Although Bitcoin (BTC) trading constitutes the largest proportion of crypto asset trading (of the three crypto assets analysed), the month-on-month growth in value

[41] Daily trading values and volumes of the Bitcoin (BTC), Ether (ETH) and Ripple (XRP) tokens (traded on the three largest South African domiciled crypto asset exchanges, (Luno, VALR and AltCoinTrader) were tracked from 30 November 2018 to 31 January 2021. These three tokens were selected due to data availability and because they were consistently the three largest crypto assets measured by market capitalisation over the last three years (although recent market developments have led to other tokens such as Tether, Cardano's ADA, Polkadot's DOT and Binance's BNB overtaking XRP in terms of market capitalisation).

traded in both Ether (ETH) and Ripple (XRP) is higher than Bitcoin. A potential reason for this exceptional growth is related to price effects following the third Bitcoin blockchain halving reward in May 2020.

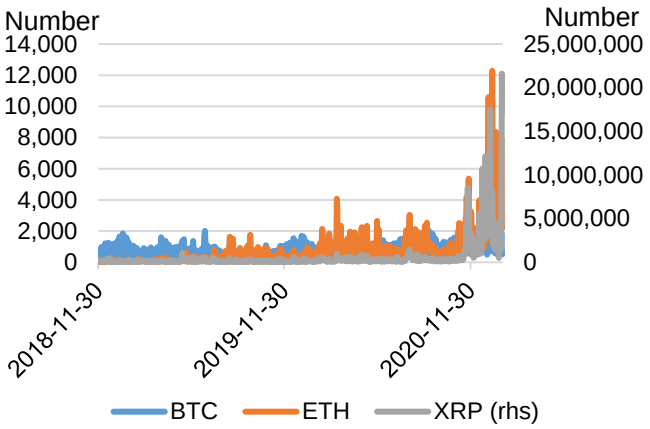
Figure 6 shows the constantly changing composition of the crypto assets: while Bitcoin was initially the most and almost exclusively traded crypto asset, Ether and Ripple both increased towards the end of 2020 and beginning of 2021 (noting data limitations[42]). The growth in Ether traded could be attributable to it being the preferred protocol for entering into smart contracts, and the growth in the value of Ether traded broadly mirrors the exceptional increase in the TVL in DeFi.

Figure 6: Composition of crypto assets traded (by value)



Source: Crypto exchanges

Figure 7: Daily volume of BTC, ETH and XRP traded



Source: Crypto exchanges

During 2019, the daily crypto asset trading volumes on South African exchanges were dominated by Bitcoin, but there has been increased activity in Ether and Ripple towards the end of 2020 and the beginning of 2021 (Figure 7).

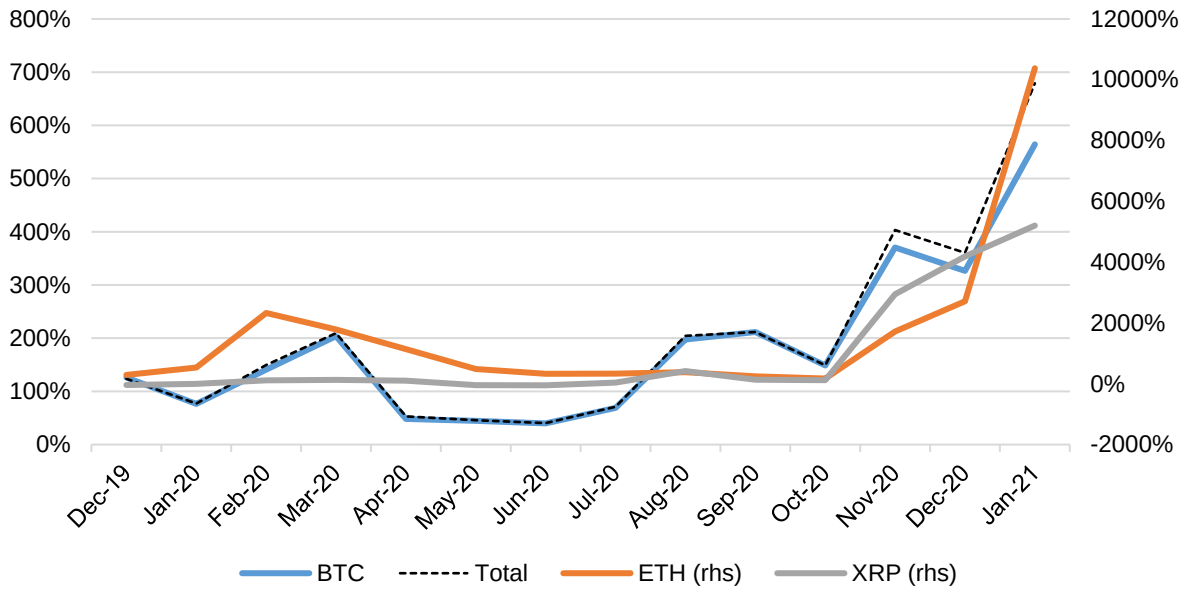
The year-on-year (y/y) growth in the value of all three selected crypto assets has been exceptional, with total growth in value exceeding 100% y/y for every month in each crypto asset since August 2020 (Figure 8)[43]. Although the crypto asset market is not

[42] Historical data from Luno and VALR is limited. Luno data for ether is available from 9 July 2019 and for ripple from 3 March 2020. VALR data is available from: for bitcoin – 11 June 2019, ether: 11 July 2019 and XRP: 10 March 2020. AltCoinTrader data is available for the whole period analysed.

[43] The average y-o-y growth of all crypto assets analysed from December 2019 to January 2021 was 198%.

considered to pose a systemic risk to the South African financial system currently, crypto assets will pose a systemic risk should the high growth rates be sustained in the medium term to long term if the asset class remains outside of the financial sector regulatory framework[44]. Section 3.1 explained how events such as the upcoming fourth Bitcoin block reward halving in 2024 could contribute towards this risk being realised.

Figure 8: Growth in the value of South African crypto asset trading



Source: Crypto exchanges

Increased domestic demand for and interest in crypto assets would deepen the market and improve market liquidity. This could lead to a reduction in the spread between the Rand/crypto asset and foreign currency (FX)/crypto asset price. According to Chainalysis' 2020 Global Crypto Adoption Index (Chainalysis, 2020), South Africa ranks seventh globally for crypto asset adoption after Ukraine, Russia, Venezuela, China, Kenya and the US, which prompts an interesting question around why South Africans are buying crypto assets at the above-mentioned premium on South African exchanges. Although the premium varies greatly depending on market factors, Rand

[44] At a y-o-y growth rate of 198%, a daily trading value of R500 million will exceed the average daily trading value of equities traded on the JSE (R22 billion during 2020) in four years.

crypto asset prices generally trade at a 3% to 5% premium on South African exchanges compared to USD crypto asset prices (Ryan, 2020).

The most well-known crypto asset premium, is the South Korean 'Kimchi premium' named after the popular dish of fermented cabbage of the same name (Makarov and Schoar, 2020). Of note is the fact that both South Africa and South Korea have remaining capital controls in place, and that while it is possible for individuals to legally send funds offshore to acquire crypto assets from foreign-domiciled exchanges, it is both an arduous and complex process in both jurisdictions. By way of example, Box 1 below describes the challenges posed by crypto assets from a South African exchange control perspective, and notes the bureaucratic process facilitating crypto asset price arbitrage[45].

Box 1: Arbitrage opportunity of ZAR/crypto asset prices and FX/crypto asset prices facilitated by the South African regulatory framework

For individuals, the Exchange Control Regulations do not explicitly allow transmission of funds (i.e. Rand exchanged for foreign FX in South Africa) abroad specifically for purchasing crypto assets. However, individuals are currently not expressly prohibited from doing so either, and it is this technicality that allows individuals to arbitrage the Rand/crypto asset price by: (i) exchanging Rand for FX in South Africa; (ii) sending the FX abroad to a foreign bank account of an offshore crypto asset exchange via the banking system; (iii) purchasing crypto assets on the foreign crypto asset exchange; (iv) sending the crypto assets from the foreign crypto asset exchange to a local, South African crypto asset exchange; and (v) selling the crypto assets introduced for Rand thereby realising a potential profit on the South African crypto asset exchange. For businesses, however, the Exchange Control Regulations explicitly stipulate the categories for which business may send funds abroad, and crypto assets are not recognised as an asset.

As a result, legal entities other than natural persons are not currently allowed to send funds abroad for the purpose of purchasing crypto assets, and thus the arbitrage process as described is driven via individuals using the annual R1 million single

[45] This information is provided courtesy of the Intergovernmental Fintech Working Group's (IFWG) frequently asked questions, and is available on the IFWG's website at https://www.ifwg.co.za/regulatory-guidance-unit/.

discretionary allowance (SDA) and/or R10 million foreign capital allowance (FCA) via a local Authorised Dealer in foreign exchange (i.e. a commercial bank). Furthermore, in terms of the Exchange Control Regulations, neither individuals nor legal entities are currently allowed to purchase crypto assets in South Africa and send these assets abroad. It should be noted that the SARB's Financial Surveillance Department (FinSurv) does not currently approve applications received from individuals to expropriate more than R10 million per calendar year, and that the repatriation of value to South Africa, specifically through crypto assets, is currently not acknowledged as a repatriation of an individual's SDA or FCA as such transactions are currently not reportable on the FinSurv reporting system. The funds-in-funds-out principle in terms of the Exchange Control Regulations does therefore not apply to crypto assets for the purposes of increasing the remaining balance of an individual's SDA or FCA.

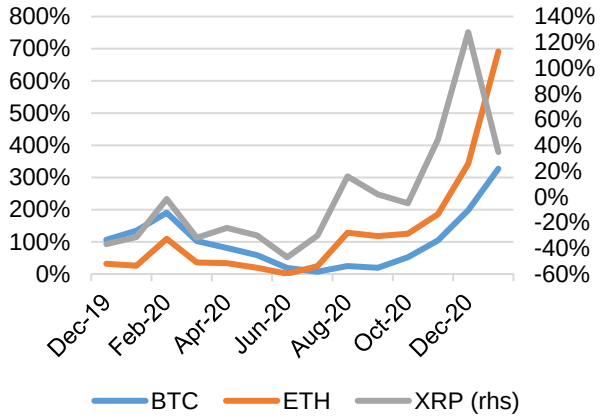
Given the South African premium on crypto assets purchased locally, crypto asset arbitrage trading has become increasingly popular over the last few years. The question, however, is where the almost insatiable domestic demand for crypto assets being sold at a premium emanates from? To this end, Brown (2020) notes that most of the demand in South Africa is likely from retail investors in the form of middle- to high net-worth individuals (M&HNWI). Potential reasons for the increased demand for crypto assets are its emergence as a relatively domestic safe haven and hedge against a weakening domestic currency, given COVID-19 -induced market volatility, political uncertainty both globally and domestically, increasingly positive global investor sentiment and concerns over the deteriorating South African macroeconomic environment.

Additionally, crypto assets offered a higher potential return compared to the prevailing lower interest environment given that domestic interest rates were reduced to their lowest levels in decades in March 2020. Due to these factors, M&HNWIs had a higher level of savings during the Coronavirus-related restrictions, and crypto assets offered a strong holistic value proposition relative to other investment options (Brown, 2020). The sustained exchange of Rand for crypto assets by M&HNWI could over time lead to a large outflow of funds (albeit into crypto assets), highlighting a vulnerability in the

domestic financial system (Section 4 discusses in more detail the implications of this vulnerability to the financial system).

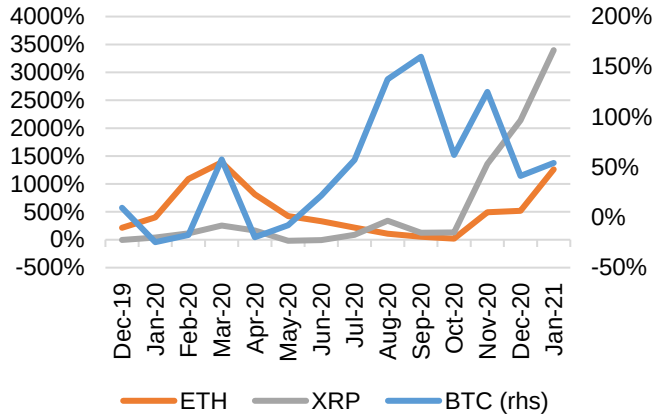
Figure 9 suggests that the increase in the value of trading in Bitcoin and Ether towards the end of 2020 and beginning of 2021 was partially a result of the rise in the underlying global crypto asset prices. With regard to Ripple, the average monthly growth in trading volumes increased towards the end of the period even though the average monthly price declined, likely due to the announcement by the US Securities and Exchanges Commission (SEC) of its decision to sue Ripple for what it deemed to be an unregistered securities offering on 22 December 2020 (SEC, 2020).

Figure 9: Year-on-year growth in crypto asset prices (using monthly averages)



Source: Crypto exchanges

Figure 10: Growth in crypto asset average monthly volumes (y/y)



Source: Crypto exchanges

As more South African investors and traders become familiar with the crypto asset market characteristics and infrastructure, there will likely be wider scale adoption of this asset class. The growth in crypto asset volumes traded indicates that there is increasing interest in crypto assets on South African domiciled exchanges (Figure 10). The growth in trading volumes for Ether and Ripple have been continuous throughout the period. Trading volumes in Bitcoin declined before and after March 2020 (the period during which the government announced restrictions in response to the Coronavirus pandemic) but increased significantly thereafter. For the three crypto assets analysed, the increase in total value traded is due not only to the increase in prices but also an increase in volumes (i.e. reflective of increasing demand).

4. The financial stability implications of crypto assets

4.1 Financial stability implications from a global perspective

The FSB (2018) notes that crypto assets could threaten financial stability through a variety of different channels, most notably through: (i) confidence effects; (ii) financial institutions' exposures to crypto assets, related financial products and entities that are financially impacted by crypto assets; (iii) the level of market capitalisation of crypto assets; and (iv) the extent of their use for payments and settlements. The most likely channel through which crypto assets could pose a risk to financial stability is through the increasing level of market capitalisation of crypto assets.

With regard to confidence effects[46], it may be noted that crypto assets' original vision as captured in the Bitcoin White Paper was around decentralisation and disintermediation, with the objective of creating a separate, segregated system not reliant on being, or aspiring to be, interoperable[47] or interconnected with the existing financial and banking system. However, the market has somewhat ironically evolved over the last decade to rely more on different types of intermediaries in the form of crypto asset trading platforms, or crypto asset exchanges. As a result, there appears to be growing appreciation for the existing and future linkages and potential synergies to be achieved, which will possibly negate rather than amplify concerns over confidence effects.

However, as evidenced by the massive surge in the TVL in DeFi in 2020 and thus far in 2021, indications are that there is growing retail demand for decentralised finance products and services. Should consumers increasingly move into the DeFi and disintermediated space in favour of peer-to-peer transactions, this could over time lead to crypto assets' original value proposition around decentralisation being realised, with potential other implications in terms of confidence effects should there be a market failure.

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[46] The FSB (2018, p.12) notes that "if crypto assets become a more significant part of the financial system, negative developments involving crypto-assets could undermine confidence in certain aspects of the financial system and in financial regulators".

[47] Interoperability refers to the ability of two or more proprietary platforms (or even different products) to interact seamlessly (World Bank, 2016).

Moving to the second channel through which crypto assets can potentially impact financial stability, namely through financial institutions' exposures to crypto assets, related financial products and entities that are financially impacted by crypto assets, the Bank for International Settlements (BIS) 2019 assessment that banks have limited direct exposure to crypto assets remains broadly relevant. However, recent statements by the Office of the Comptroller of the Currency (OCC) in the US explicitly note that federally chartered US banks may offer crypto asset safe custody services (OCC, 2020), and that banks may run a node on a public blockchain and use stablecoins for payment activities. Such developments may accordingly lead to a reassessment of the BIS's 2019 conclusion over the medium term.

Non-bank financial institutions' exposure to crypto assets will be discussed in section 4.2, together with the extent to which crypto assets are used for payment and settlement, which in turn is closely related to the growing institutional interest in crypto assets observed over the last 12 months. Institutional involvement in and demand for crypto assets predominantly take two forms: a willingness by large payments and other largely digitally focused firms to accept, enable and facilitate payments using crypto assets, and firms holding crypto assets on their balance sheet as a type of investment. On the payments side, recent announcements by PayPal (2021), Booking.com (Wintermeyer, 2021), Visa (Bambrough, 2021), MasterCard (Dhamodharan, 2021) and Tesla (Palmer, 2021) have strengthened the use case for crypto assets to become a widely used medium of exchange. Such institutional pronouncements, coupled with the increasing use of stablecoins both as trading pair, hedge against crypto asset price volatility and conduit into decentralised finance (DeFi) applications, have the potential to drive the crypto asset payment use case.

However, at the current conjuncture, crypto assets have not yet become a widespread medium of exchange, thus currently mooting the financial stability short-term threat arising from their use for payment and settlement (although the ongoing digital revolution of money could see an unbundling of the separate roles of money, with large platform ecosystems re-bundling the roles with increased capability over traditional money forms (Brunnermeier et al, 2019)).

With regard to institutional demand for crypto assets as an investment, two nuanced use cases are emerging: on the one hand, companies such as MicroStrategy, Mode

and Square are allocating a portion of their cash reserves to acquire deflationary crypto assets such as Bitcoin as part of their treasury strategies (Reynolds, 2020; Kuhn, 2021a), possibly as a hedge against fiat currency inflation resulting from the recent announcement of financial stimulus packages and quantitative easing, among other factors (Browne, 2020).

On the other hand, asset and fund managers such as BlackRock Asset Management, Ruffer, Grayscale, Stone Ridge Asset Management and Fidelity Investments continue to either add crypto asset-related product offerings, or express the sentiment to do so in the near future (Voel, 2020; Kuhn, 2021b). The increasing trend of corporate treasuries allocating a portion of short-term reserves to crypto assets suggests confidence in their ability to address short term demands for liquidity. Traditionally, corporate reserves are used to address liquidity management in groups, with reserves consisting of cash or near-cash instruments that could be used to address short term demands for cash in normal and stressed trading conditions.

The onset of COVID-19 restrictions has resulted in corporates increasing cash reserves in the face on increased uncertainty. In a low and in some instances negative yield asset environment in advanced countries as well as concerns of increased inflation, corporate treasurers have increased allocations to crypto assets (Fidelity, 2021). This development has also deepened liquidity of the crypto asset market, with improved market infrastructure facilitating direct corporate access to the crypto asset market. A detractor for institutions to hold crypto assets is the perceived criminal activity and related money laundering risk (Jakobson, 2019). Should the emerging practice of firms holding reserves in crypto assets and a market failure occurs, the growing interconnectedness between traditional and crypto asset markets could lead to implications for financial stability.

The fourth and final channel identified by the FSB (2019) through which crypto assets can potentially impact financial stability is through the level of market capitalisation of crypto assets. Even with the total crypto asset industry’s market capitalisation breaching $1.5 trillion for the first time on 14 February 2021 (CoinMarketCap, 2021), this does not yet present a global financial stability threat. The flexible and agile nature of the continuously evolving crypto asset ecosystem is likely to result in the

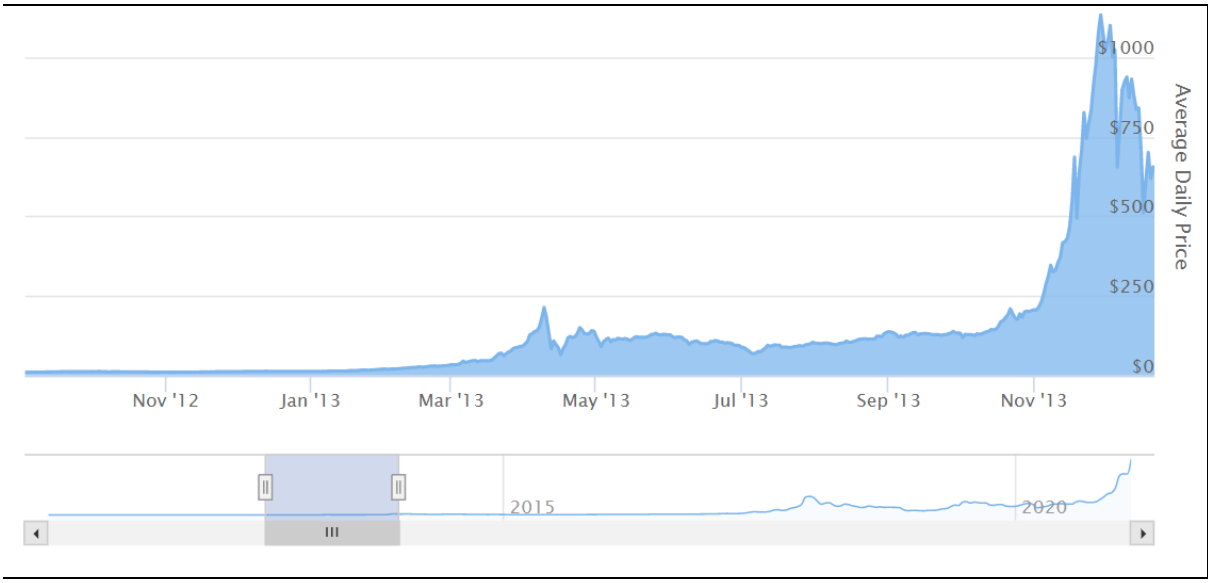
development of crypto assets to match all consumer needs, as well as find a solution to the broad adoption of crypto assets over time.

Box 2: Bitcoin block reward halving

A prominent historical driver of crypto asset prices is the Bitcoin block reward halving, which reduces the new Bitcoin 'minted' every 10 minutes with which Bitcoin miners are rewarded for validating transactions on the network. A Bitcoin block reward halving occurs every 210,000 blocks, or roughly every four years. There have been three Bitcoin block reward halvings, on 28 November 2012 (when the block reward rate reduced from 50 to 25); 9 July 2016 (reducing from 25 to 12.5); and most recently on 11 May 2020 (reducing from 12.5 to 6.25). The next Bitcoin block reward halving will likely take place in 2024, and will reduce the rate at which new Bitcoins are minted to 3.125 every 10 minutes. Interestingly, each Bitcoin reward halving has led to significant albeit lagged price increases[48] in the price of both Bitcoin and the wider crypto asset market. Before the first Bitcoin reward halving on 28 November 2012, it reached an all-time high of approximately $31 on 23 May 2011. As may be observed from Figure 11 below, the price of Bitcoin went from its pre first-halving high of around $31 to around $1,200 on 29 November 2013 within 12 months (and one day) after the halving date – roughly an increase of 38 times from its previous all-time high.

[48] While there are various potential reasons for this phenomenon, the one that is seemingly gaining the most support is that while the supply shock that immediately follows a Bitcoin halving event should have limited impact on price in the short term, there is a time lag as miners (i.e. representing the supply side) reposition towards market equilibrium over the medium term (Neo, 2020).

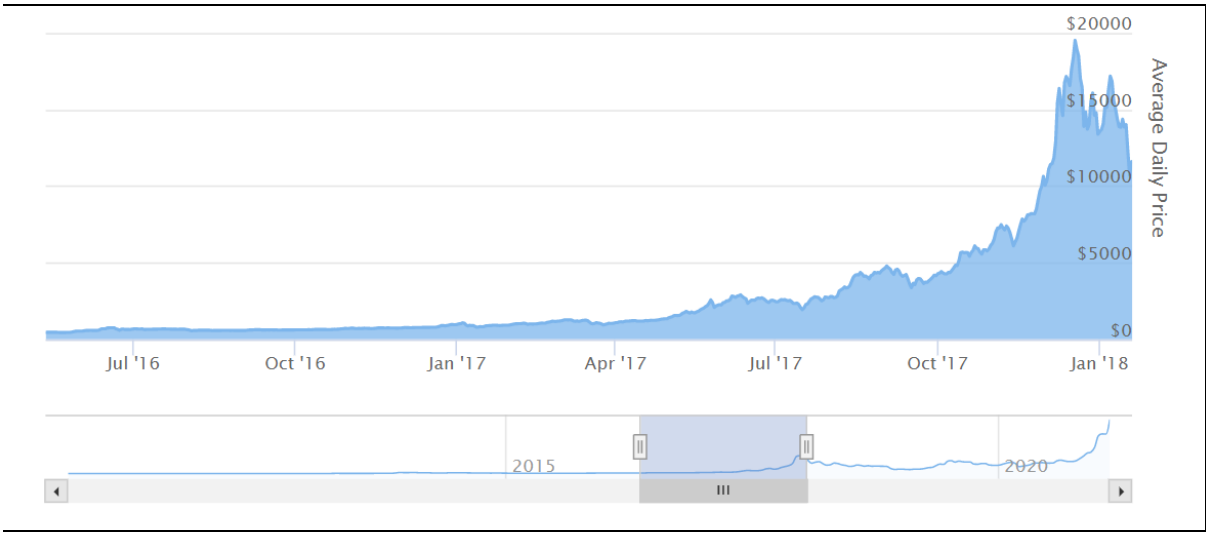
Figure 11: Bitcoin price around the first block reward halving (28 November 2012)



Source: 99Bitcoins (2021)

The second Bitcoin reward halving on 9 July 2016 saw the price of Bitcoin increasing from its pre second-halving high of around $1,200 on 29 November 2013 to almost $20,000 on 17 December 2017 – an increase of around 16 times from its previous all-time high and within 18 months of the second reward halving date.

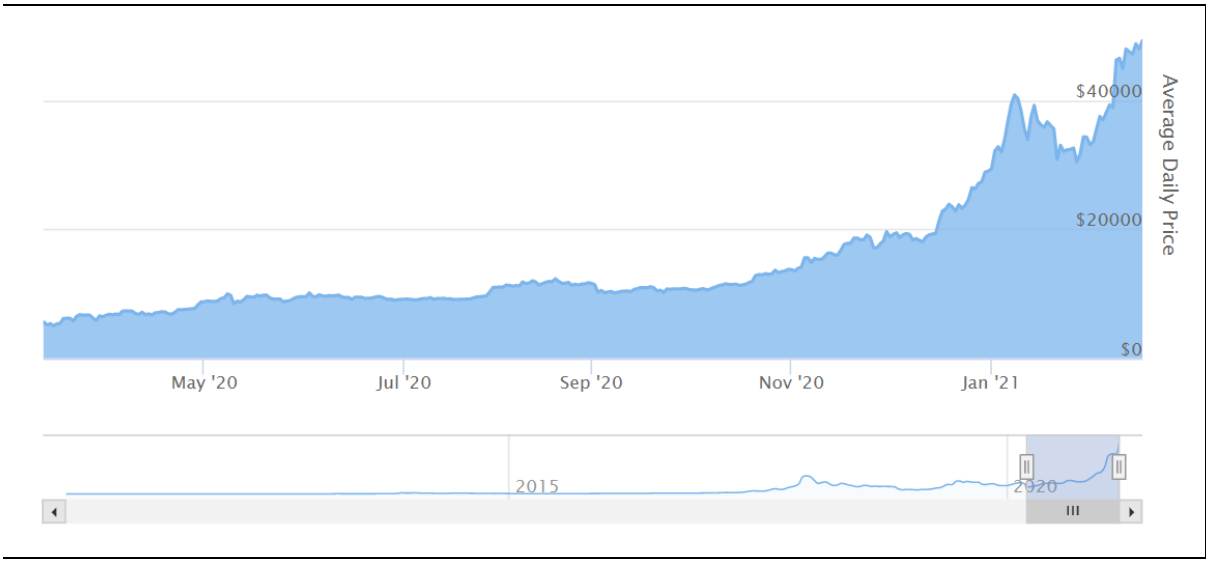
Figure 12: Bitcoin price around the second block reward halving (9 July 2016)



Source: 99Bitcoins (2021)

To date, the third Bitcoin reward halving on 11 May 2020 has resulted in the previous all-time high price of almost $20,000 increasing by 2.5 times to slightly over $50,000 on 17 February 2021.

Figure 13: Bitcoin price around the third block reward halving (11 May 2020)



Source: Source: 99Bitcoins (2021)

The price of Bitcoin has historically served as a proxy for the broader crypto asset market, and the total crypto asset market capitalisation increased from around $1.5 billion at the time of the first bitcoin halving to a new all-time high of around $15 billion a year later. Similarly, the total market capitalisation of all crypto assets was around $15 billion at the time of the second Bitcoin reward halving, increasing to around $830 billion 18 months later. In turn, following the third Bitcoin reward halving on 11 May 2020, the total crypto asset market capitalisation increased to over $1.5 trillion within 9 months of the halving date. While it remains to be seen whether the historical trend will continue in the months to come, this note focuses on the potential financial stability implications should the trend not only continue over the next few months, but also potentially following the next Bitcoin reward halvings in 2024, 2028 and 2032, at which date more than 99% of the 21 million Bitcoins would have been mined. It will take more than 100 years to mine the remaining Bitcoins, with the last Bitcoin currently projected to be mined around 2140.

4.2 Financial stability implications for South Africa

From a South African perspective, what role would crypto assets need to play or what function would they need to perform to emerge as a potential systemic risk to the financial system? Any role would most likely be related to amplifying an existing vulnerability in the financial system. Given crypto assets' truly global reach and intentional borderless and exclusively digital nature, domestic crypto asset-related developments, especially in terms of price and volume, will largely be tied to international developments (both crypto asset and non-crypto asset related). As a result, the most likely channels through which crypto assets could impact domestic financial stability are similarly through the level of market capitalisation of crypto assets. Although institutional demand for crypto assets by South African firms is currently mooted, given the current strong retail interest, this could change relatively quickly. As a result, domestic financial institutions' exposures to crypto assets - whether directly or indirectly – and related financial products and entities that are financially impacted by crypto assets could increase substantially over a short period. Unique to the South African context, however, is the vulnerability of the South African financial system to capital outflows via crypto assets as explained in Box 1. Although the existing South African Exchange Control Regulations currently do not allow capital (or the right thereto) to be expropriated via crypto assets, enforcement remains difficult. Moreover, given that crypto asset mining is not profitable in South Africa due to high electricity costs and an unstable national electricity grid, almost all crypto assets in South Africa were introduced into South Africa from abroad, thus making South Africa in essence a net importer of crypto assets. As a result, the vulnerability of the South African financial system to a constant and growing outflow of funds as a result of crypto asset/ZAR price arbitrage could lead to potential systemic risk over time should the aforementioned trends repeat themselves over the next few years.

Some commentators (e.g. Kshetri, 2019) are of the view that emerging markets' currencies are more vulnerable to emerging global stablecoins such as Facebook's Libra (now Diem) because of their almost invariable use of or pegging to the dollar (as a transactional currency or as a peg for domestic currencies), as well as distrust of local monetary authorities. Although this is not an immediate threat for South Africa,

longer-term financial stability implications could arise from the potential widespread adoption of crypto assets as a replacement for, or in addition to, fiat currency (whether in digital or physical form). In order for this to occur, there would need to be broader adoption of crypto assets from the current subset of M&HNWI[49]. Some challenges to broad adoption include increasing high-speed access to the Internet in a cost-effective manner for the broader population (both data and devices), improving infrastructure (including consistent and reliable electricity supply), the entrenched use of cash for transactions[50], low financial literacy and increasing acceptance of crypto assets by merchants for transactional purposes (i.e. as a payment instrument).

Factors that could facilitate broad-scale adoption of crypto assets include a youthful population (who may be more likely to be accepting of digital money), the increasing use of cashless payment mechanisms, access to a broad range of suppliers and services through a global platform using a stablecoin, increased and high mobile phone penetration and the large number of rest-of-Africa economic migrants in South Africa that remit funds to their home countries.

Depending on their design, a global stablecoin such as Diem can potentially have features that could be attractive to a broad South African (and potentially Southern African) consumer base, including being pegged to a stable sovereign currency(ies), access to a range of products/services on a global social media platform that consumers know and trust (and are already members of), and ease of being able to undertake cross-border transactions. These types of features make the existing financial system vulnerable to rapid adoption by South African consumers and merchants. High-level potential policy options in response to this type of event include preventing the stablecoin accessing the existing financial system or allowing access.

Preventing access could result in leakages from the regulated to the unregulated system. Similar to FinSurv's challenge described above relating to crypto asset arbitrage of the system of Exchange Control, it is likely that banning will have the unintended consequence of regulatory arbitrage. Allowing access has the advantage of establishing regulations for access (such as licencing of crypto asset service

[49] South Africa has one of the most unequal income distributions in the world, with a proportionally small population of M&HNWI.
[50] Unlike many other jurisdictions, cash continues to be a widely used mechanism for transactions in both urban and rural areas by the general South African populace.

providers, establishing frameworks for AML and consumer protection) as well as being able to monitor trends. It also allows for setting minimum standards for operators, such as the links between the token and the reserve asset, as well as establishing standards to verify the quality of the reserves held backing the stablecoin[51].

Lastly, section 29 of the Financial Sector Regulation Act No. 9 of 2017 (FSR Act) outlines the framework for designating institutions as systemically important. In considering whether a crypto asset trading platform (CATP) should be designated as systemically important, the Governor of the SARB will need to consider, among other things, its size, the complexity of its organisation and affairs, how interconnected it is with other financial institutions, and the substitutability of its products and services. Furthermore, if the Governor determines that a systemic event has occurred or is imminent, s/he can designate the CATP as systemically important without having to fully consider the previously mentioned aspects. Although not the only consideration, the increasing size of CATPs, the complexity of their products and services as well as how interconnected they are, are important considerations when considering the risk they pose to the existing financial system.

5. Areas for further research

Research in this field is restricted by the limited public data. Given this caveat, this note touches on potentially deep policy questions for the financial system and sets out the framework for more detailed work in specific areas. Future notes could look at the following areas and research questions:

- Would developments in and the implementation of proposed amendments to South Africa's regulatory frameworks reduce potential financial stability risks?
- Would wide-scale adoption and use of crypto assets by South African consumers within a regulated framework introduce systemic risk to the financial system?
- What is the potential impact of formally including crypto assets and crypto asset service providers into the regulatory framework on currently regulated financial firms? This could be from a financial and operational risk perspective, as well as in terms of competition.

[51] The issue of stablecoin issuance and the nuances around it, including but not limited to definitional issues (such as 'pegged' vs 'backed'), domestic legal mandates and powers to regulate stablecoins, and the quality and proportion of the reserves backing the stablecoin are accordingly flagged for further research and reflection.

- Is market capitalisation the predominant criteria for considering whether crypto assets pose a systemic risk to the financial system? If so, is there a limit or trigger level that capitalisation should breach that would lead to systemic risk? If not, what other proxy might be most appropriate to measure the systemic significance of crypto assets?
- The development of a summative, conceptual framework that would practically assist authorities in monitoring potential stability risks and identifying potential vulnerabilities related to crypto assets would be useful.
- Including other assets such as Tether, Cardano's ADA, Polkadot's DOT and Binance's BNB tokens in the analysis as some of their daily trading values are starting to exceed that of Ripple.
- Expanding the data set (both in terms of length and granularity).
- Focusing specifically on stablecoins, including the different design options and the potential implications of these differences in design, and potential regulatory options for stablecoins.
- Considering the unintended consequences of crypto asset regulation.

6. Summary and conclusion

This paper set out to outline the financial stability implications of crypto assets in South Africa. At current levels, the global market capitalisation of all crypto assets does not pose an immediate threat to financial stability, both globally and domestically. However, this assessment seems increasingly likely to change over the medium to long term following the next Bitcoin block reward halving in 2024. Specifically in terms of the four main FSB-identified channels through which crypto assets may pose a risk to financial stability, the most likely channel, is through the increasing level of market capitalisation of crypto assets. However, the flexible and agile nature of the continuously evolving crypto asset ecosystem does not preclude crypto assets from posing a risk to financial stability through the other three FSB-identified channels (i.e. confidence effects, financial institutions' exposures to crypto assets, and the extent of their use for payments and settlements) over the longer term.

Perhaps more pointedly, however, is the fact that the global discourse among central banks has over time moved from outright dismissal of crypto assets and their different value propositions, to a growing appreciation for the existing and potential future

interlinkages between the crypto asset and traditional financial systems. It is accordingly increasingly plausible to envision a future in which public and private assets, and potentially public and private payment systems, co-exist.

Given the fast-changing nature of crypto assets as well as the significant increase in the global price of this asset class, it is likely that crypto assets will continue to evolve and, in the future, consumers will have a combination of different crypto assets (for different and likely very specific purposes) in addition to fiat currency for general purposes. Including the asset class in the existing regulatory framework will assist in providing market conduct and microprudential supervisors the ability to monitor crypto assets and prevent market abuse. However, there is also a risk of driving crypto asset activities to less regulated offshore jurisdictions through a lack of regulatory clarity and certainty.

The immediate vulnerability for South Africa is the vulnerability in the financial regulatory framework which facilitates the opportunity for individuals to arbitrage the Rand/crypto asset and FX/crypto asset price, thereby incentivising an ever-growing amount of FX to leave South Africa (albeit temporarily and via official SWIFT international payment rails). In the medium to long term, in the absence of specific idiosyncratic domestic factors (e.g. a sovereign debt default), the most likely channel for the risks posed from this asset class are exogenous (such as increasing market capitalisation due to the Bitcoin block reward halving, widespread availability and adoption of a stablecoin on a global platform and/or improved access to credit through DeFi).

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The SARB's Systemic risk assessment and macroprudential frameworks for financial stability

1. Introduction[52]

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 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

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

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

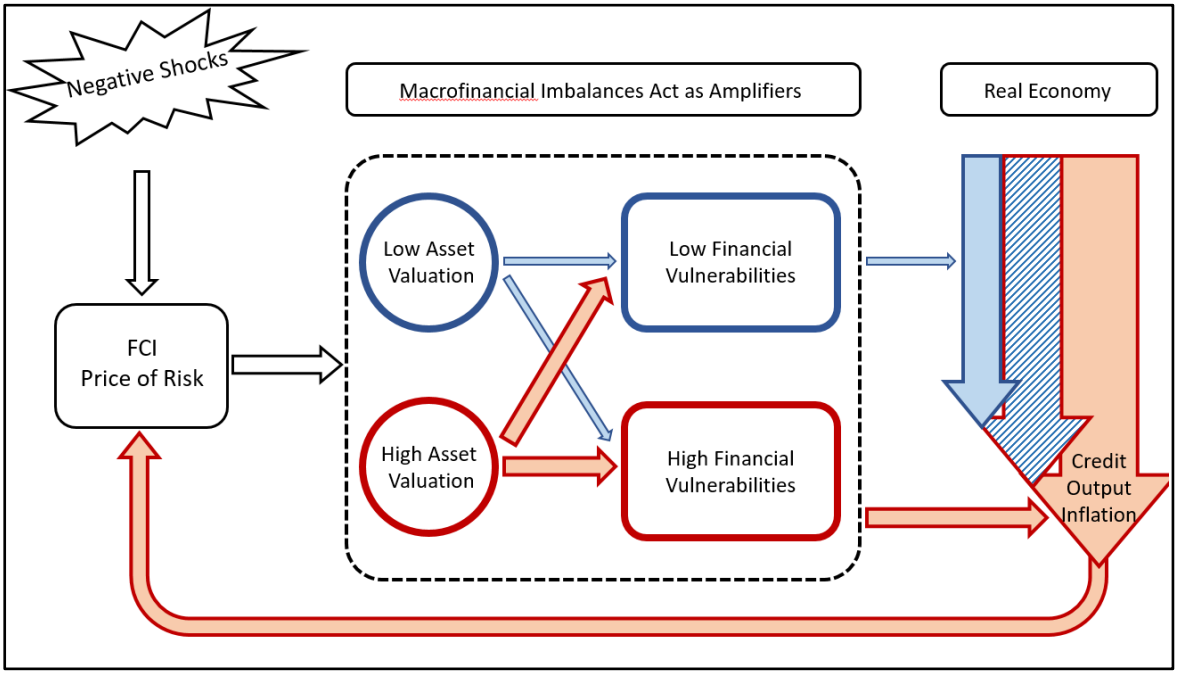
classes or they have indirect exposures via counterparty relationships. Adverse aggregate shocks could be amplified through spillovers, contagion, moral hazard, opacity and complexity of financial institutions, markets and products. Additionally, the degree of concentration in the financial system, where 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 conditions[53] indices and associated components. This involves GaR estimates for the short to medium term, which can be compared directly with their historical estimated

[53] 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.

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	*Leverage:* Regulatory capital; Stress test capital; Market-based capital measures; Off-balance-sheet assets and derivatives *Maturity and liquidity mismatch*: Short-term wholesale funds ratio; Liquid asset ratios; Regulatory liquidity; Asset-liability duration gap; Collateral eligible for the discount window *External debt claims and currency mismatch:* US$ funding needs' Cross-border funding; Reliance on cross-currency FX swaps *Interconnectedness and complexity:* Interbank claims; Non-bank financial claims; Cross-border activities; Price-based systemic risk measures
Nonbank Financial Firms and Market-Based Finance	*Leverage:* Regulatory capital; Leverage ratios; Off-balance-sheet: assets and derivatives; Securitizations (risk retention); Margin credit; Collateralized borrowing and haircuts *Maturity and liquidity mismatch:* Short-term wholesale funds ratio; Carry trades; Open-end funds and exchange-traded funds (with less liquid assets) *External debt claims and currency mismatch:* Open-end and other funds invested in foreign debt *Interconnectedness and complexity:* Claims on banks; Claims on other non-bank institutions; Financial innovations that introduce complexity; Common business models (e.g. index funds)
Central Counterparties (CCPs)	*Leverage: Capital; Default fund; Margins; Credit lines* *Maturity and liquidity mismatch:* Liquidity lines *Interconnections and complexity*: Members provide services to CCPs; Members are connected to multiple CCPs

	Types of indicators to be monitored
Private Nonfinancial Households	*Leverage:* Credit to GDP; Credit growth; Debt service; Lending standards *Maturity and liquidity mismatch:* Debt with adjustable rates *Interconnectedness and complexity:* Debt overhang; Home foreclosure externalities
Private Nonfinancial Business	*Leverage*: Credit to GDP; Credit growth; Interest coverage; Lending standards *Maturity and liquidity mismatch*: Short-term debt; Adjustable-rate debt; Liquid assets; Liquidity and depth of securities market *External debt claims and currency mismatch:* Debt issued in foreign currencies
Government Sector	*Leverage*: Government debt to GDP; Debt growth; Off-balance-sheet liabilities *Maturity and liquidity mismatch*: Debt maturity profile; Short-term debt; Liquidity and depth of market *External debt claims and currency mismatch:* 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

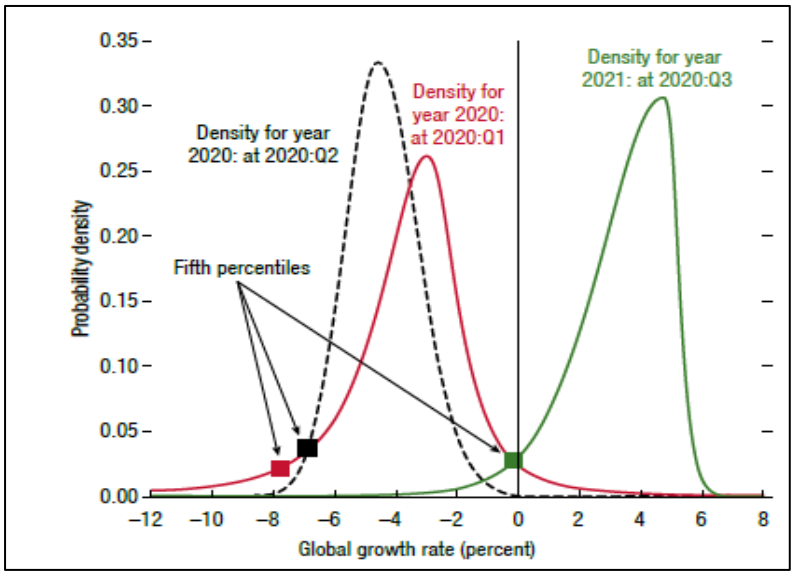
The IMFs GaR measure is a top-down approach and captures downside risks to GDP growth, by monitoring financial conditions (IMF, 2017). GaR links current financial conditions to the distribution of future growth outcomes. Prasad, Elekdag, Jeasakul, Lafarguette, Alter, Feng and Wang (2019) found that the 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), average annual growth since 1997)	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; 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

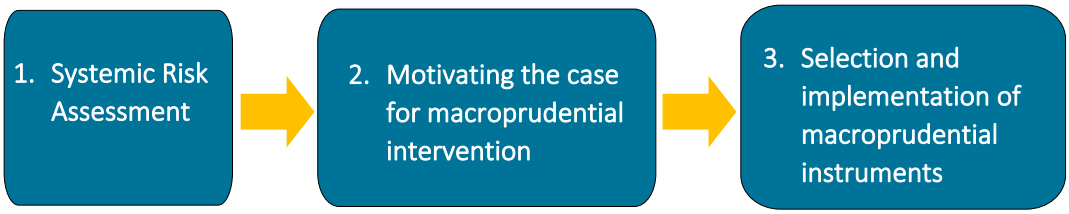
Source: Fed (2019)

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 policy[54] 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
- 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, NBFI, 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).

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

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, NBFI's 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[55]
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, trust companies, structure finance vehicle etc.	Distribution of assets among financial intermediaries, Size of the NBFI, Interconnectedness among financial intermediaries, non-bank credit-to-GDP gap, other financial institutions' (OFI) assets-to-GDP gap and NBFI 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

[55] Note: this is not an exhaustive list of indicators.

Monitoring area	Example of entities or activities	Examples of indicators[55]
		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 risk[56]	Financial Cycle (FC) Financial Conditions Index (FCI) Heatmap S-RISK GDP-at-risk	FC: credit aggregates, house prices and equity prices (JSE) FCI: 30 indicators from credit, foreign exchange, real estate, foreign, funding and equity markets Heatmap – uses all majority of the indicators in the different sectors mentioned above. GDP-at-risk- FCI, GDP growth Credit-to-GDP gap – Credit aggregates for non-financial sector and GDP figures

Source: SARB, 2021

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

(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)

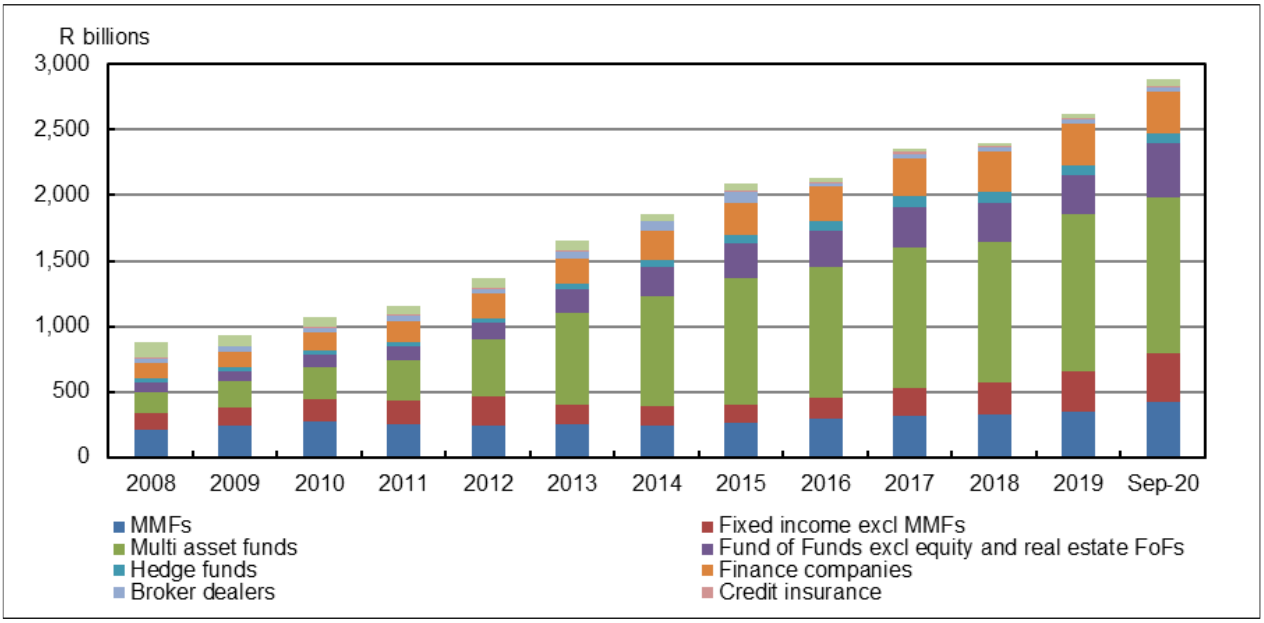
In 2018, the FSB adopted the term the 'non-bank financial intermediation' to replace the previously used term 'shadow banking'. According to the FSB (2019), non-bank financing is a valuable source of financing for many corporates and households[57]. It facilitates competition among financing providers 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,

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

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.

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 FSB[58], particularly in light of the frictions in the sector caused by the COVID-19 crisis.

[58] See FSB work priorities on: https://www.fsb.org/wp-content/uploads/P250221.pdf

(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 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)[59]. 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

[59] 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.

government guarantees (to parastatals and perhaps even to banks), and the ultimate holders of government debt (direct interconnectedness); local and foreign reserve holdings.

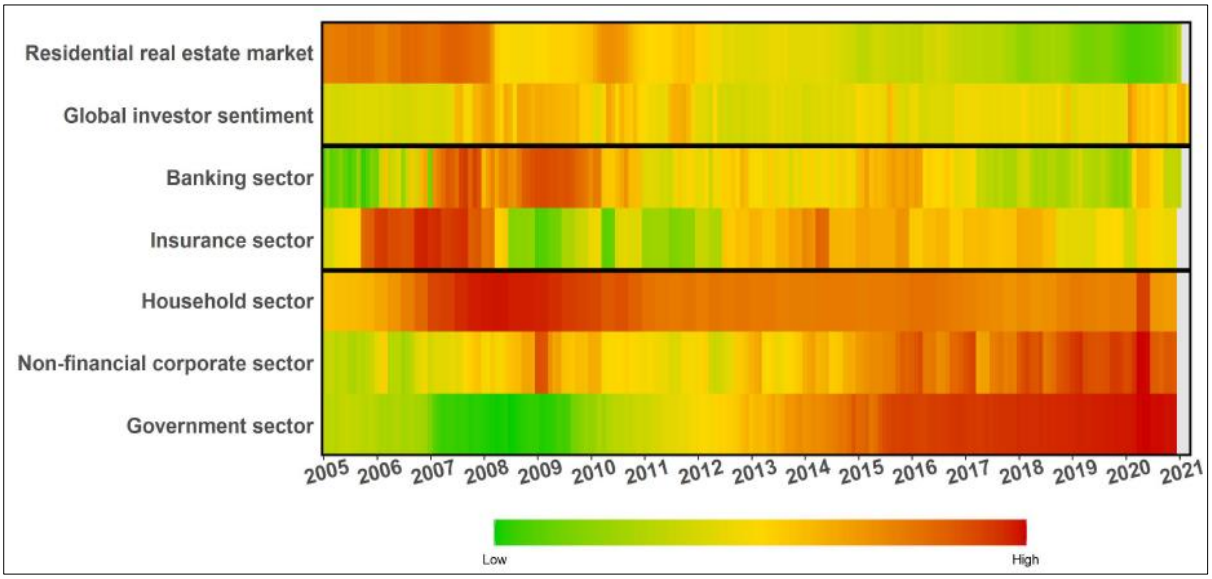
(vii) Other measures of systemic risk

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

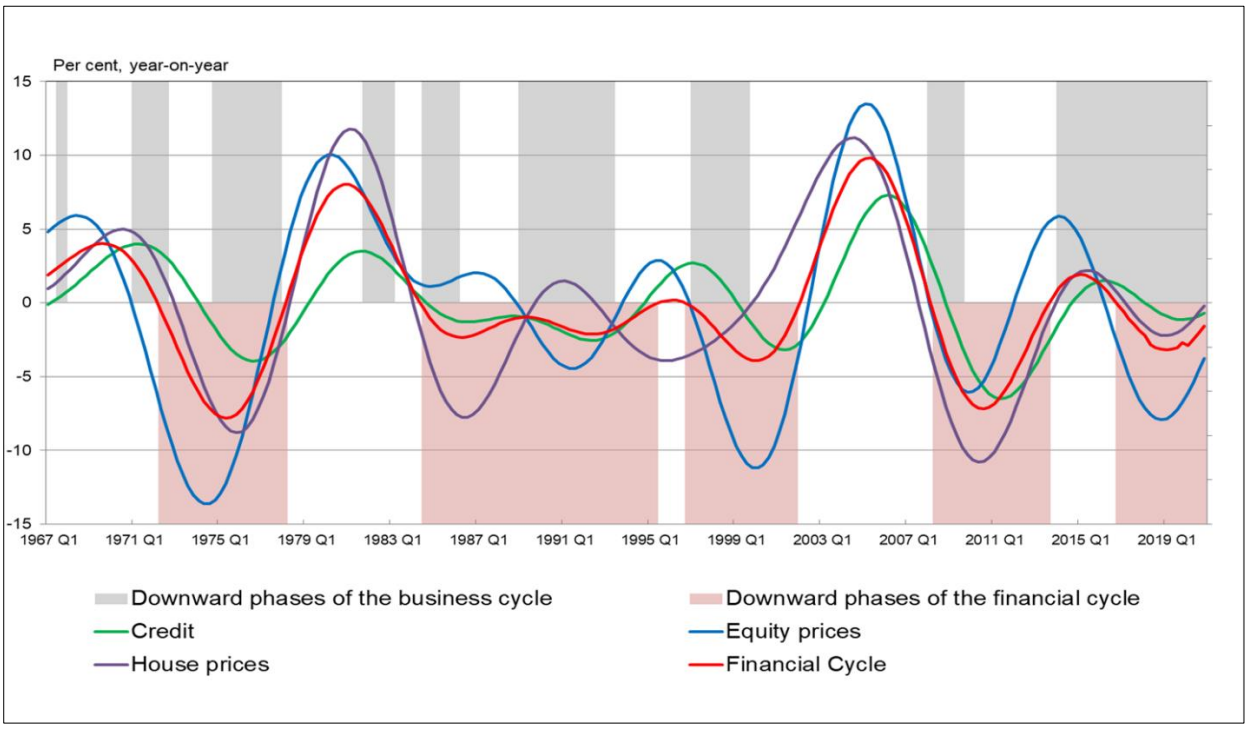
The financial cycle provides a broad indication of the change in risks to financial stability and as such, provides a useful monitoring tool for policymakers. The financial cycle denotes self-reinforcing interactions between perceptions of value and risk, attitudes towards risk and financing constraints, 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

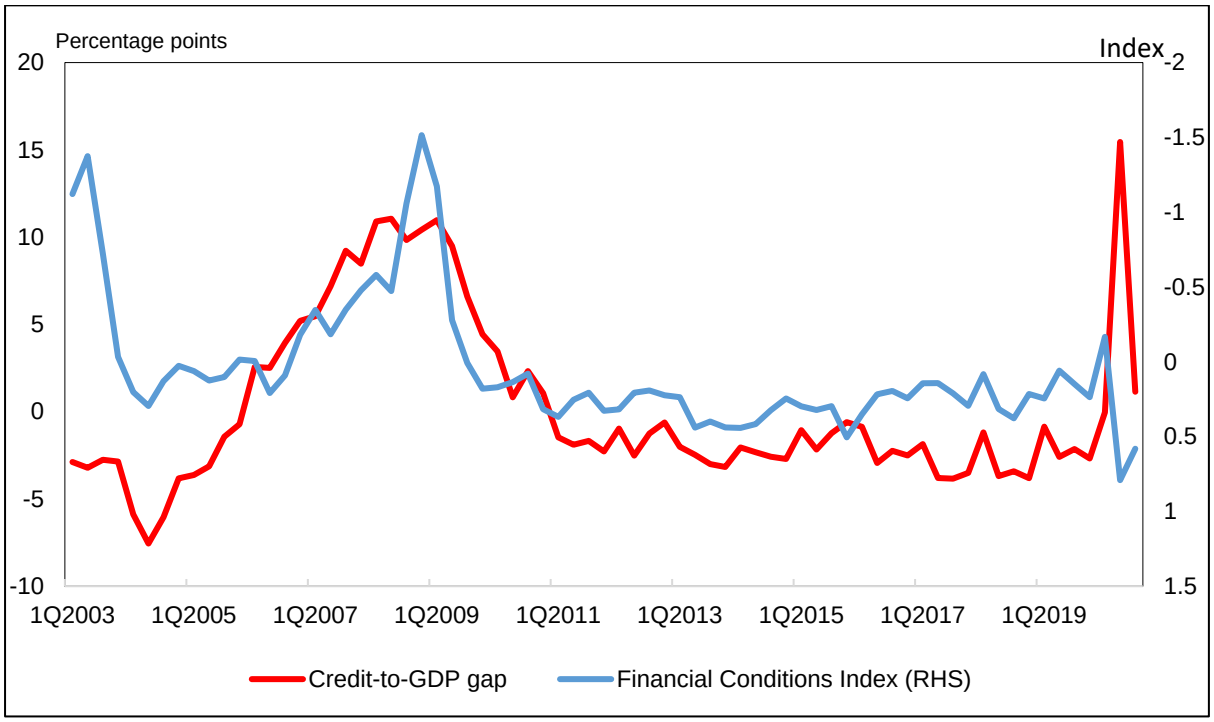
A financial conditions index (FCI) is a composite index that informs policymakers about the build-up of stress in the financial system and the driving forces behind it. Ndou, Gumata and Klein (2012) found that the estimated FCIs had powerful predictive information for the near- term GDP growth (up to 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 banks[60] 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 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,

[60] These banks constitute 92% of the total assets in the South African banking system.

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

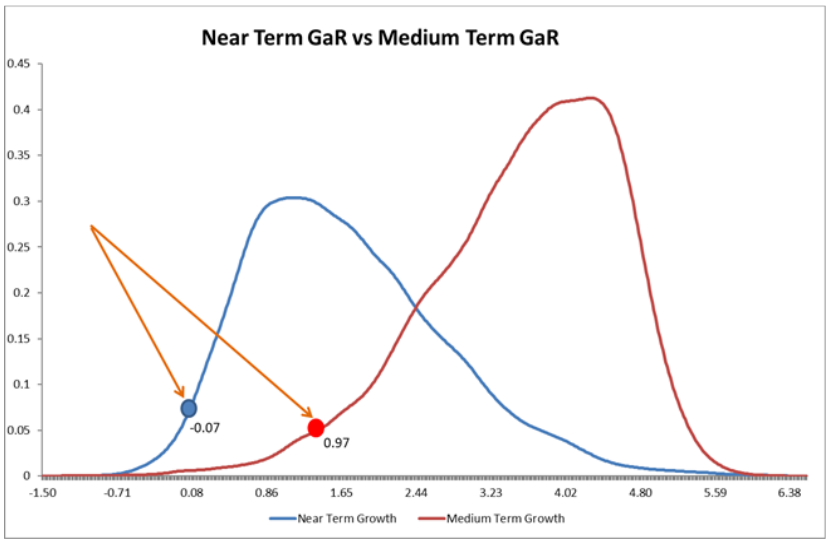
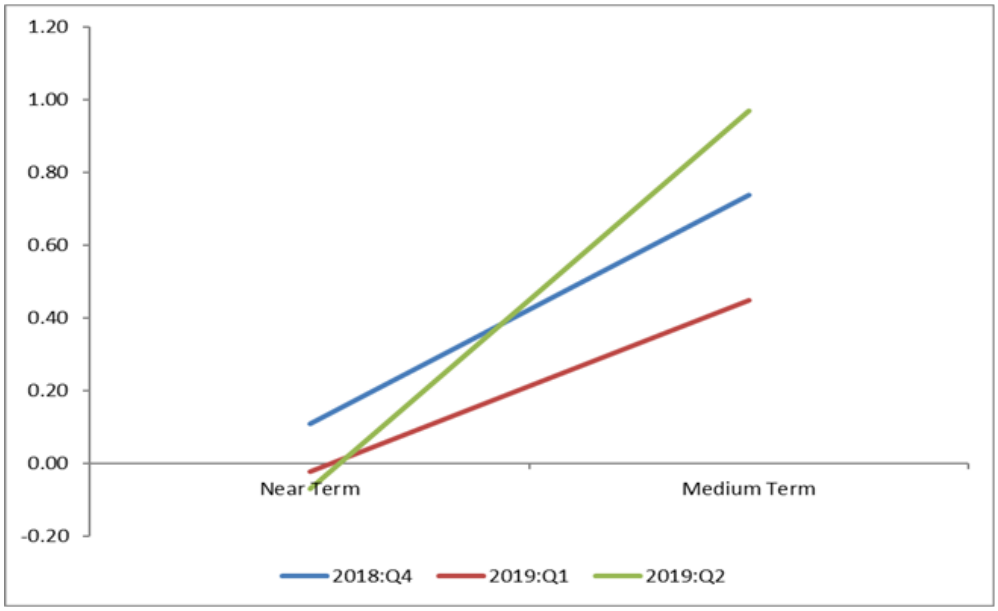


Figure 8(b): Growth at Risk for South Africa



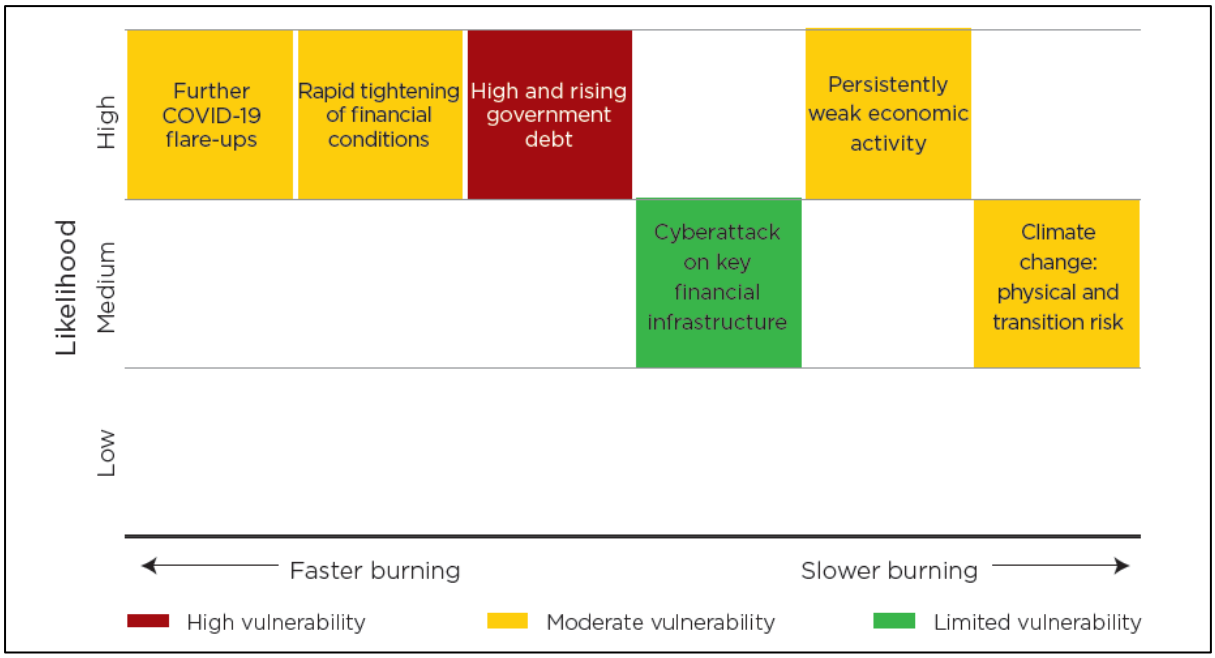
Source: SARB, Financial Stability Review, 2nd Edition 2019

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. Once 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.

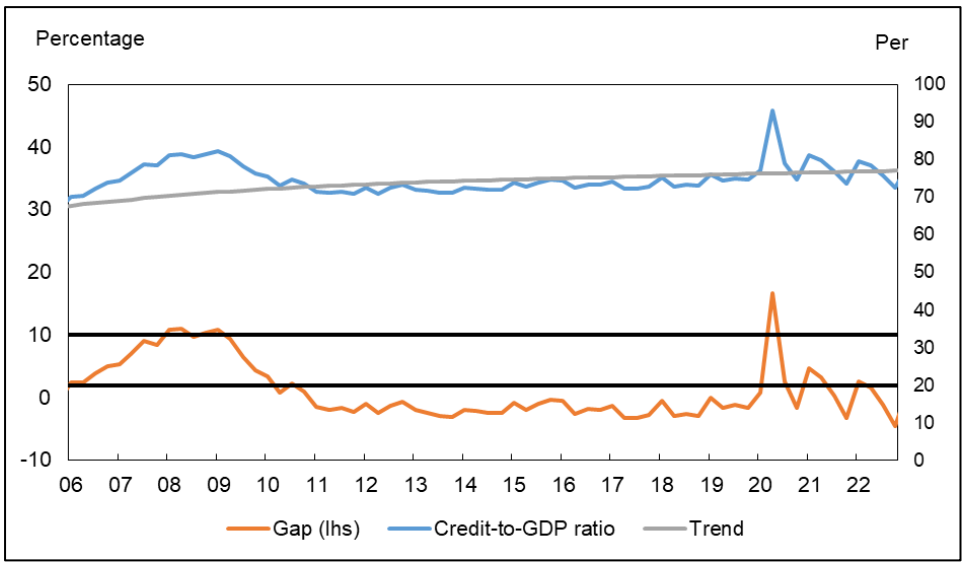
Figure 10: Process to arrive a risk assessment matrix

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 website[61].

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
Loan-to-value (LTV)s and Debt-to-income (DTI)s	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

[61] 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

	Indicators of cash-out refinancing
Liquidity-based instruments	
Policy instrument	**Potential indicators**
Countercyclical liquidity requirements: LCR and NSFR	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	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 polices 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 polices 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.

6 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 NBFI, 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

Leverage

Key Sector	Individual series
Household Credit Growth	HH Secured Credit growth
	HH Unsecured Credit Growth
PNFC Credit Growth	CRE Credit Growth
	PNFC Credit Growth (excl. CRE)
Debt to Income	Household Debt to Income
	PNFC Debt to Profit
Debt Service Indicators	Household Income Gearing
	PNFC Income Gearing
National Balance Sheet	Current Account
	Net Foreign Assets
	Gross External Debt
	Gross Capital Inflows

Asset Prices

Conditions and terms in the market	Real rate
	Term Premia
	Realised Equity Volatility
Equity	Price to Earnings
	Equity Risk Premium
Bonds	Investment Grade Spreads
	High Yield Spreads
Residential Property	House Price to Income
	House Price Growth
	DDM Risk Premium
CRE Property	CRE Price Growth
	CRE prime yields
	DDM Risk Premium

Terms of credit

Household	Mortgage spreads
	LTV
	LTI
CRE	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

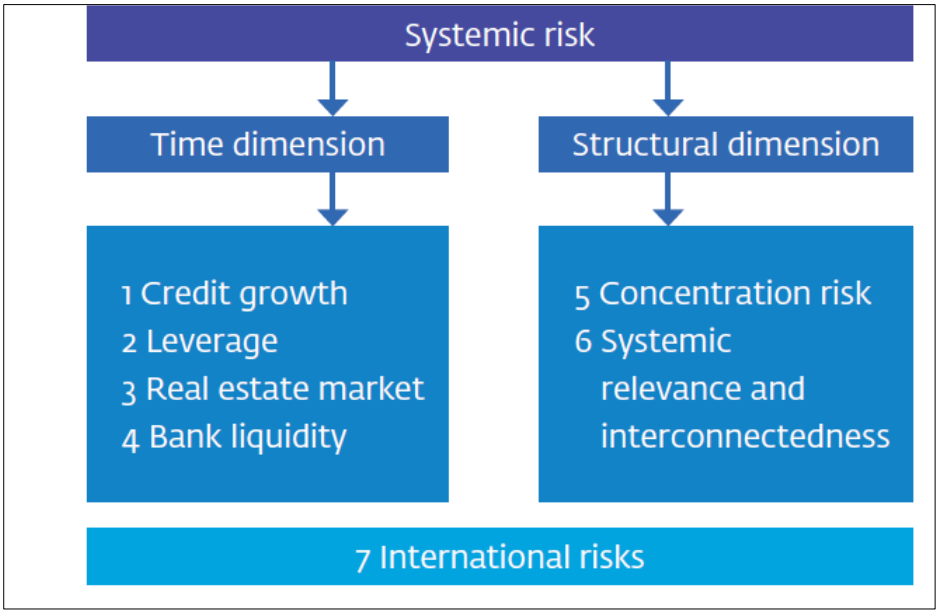
In addition to the monitoring exercise, the BoE has extra measures to capture the evolution of risks to financial stability over the financial cycle in the UK. Aikman, Bridges, Burgess, Galletly, Levina, O'Neill and Varadi (2018), use a framework to forecast early warning indicators of banking crises 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 intermediaries[62] (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 factoring companies located in Germany (annual frequency).

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

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 NBFI 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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