Fiscal risks and their impact on banks' capital buffers in South Africa

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Abstract

South Africa's fiscal balances have deteriorated significantly over the last decade, while the economy has been recording disappointing economic growth rates even prior to the COVID-19 crisis. In this paper, we estimate a series of equations using the Arellano and Bond (1991) estimator to test how sovereign risk premia affect capital buffers, while controlling for variables identified in the literature, such as size of banks, the economic cycle, competition and equity prices. Unlike other studies, we use actual capital buffers provided by the South African Prudential Authority. We show that these are substantively different to the proxy buffers calculated using the common approach in the literature, indicating that results based on proxy measures should be interpreted with caution. Our overall results show a positive relationship between the sovereign risk premium and capital buffers, and the results are robust across different specifications. This suggests that banks are accumulating capital to mitigate against fiscal and other domestic policy risks, and the related financial stability issues. It is likely that this is contributing to higher lending rates.

JEL classification: C23, E62, H32, G28

Keywords: Fiscal policy, capital buffers, financial regulation, sovereign-bank nexus, South Africa

1 Introduction[1]

South Africa's fiscal balances have deteriorated significantly over the last decade, while the economy has been recording disappointing economic growth rates even prior to the COVID-19 crisis (Burger and Calitz 2020; Loewald, Faulkner and

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Makrelov 2020). South Africa's credit rating has been reduced to 'junk status', while sovereign risk premia have increased significantly, driven by global risk aversion and deteriorating domestic fiscal and economic conditions.

In this paper, we assess how the deteriorating fiscal conditions are affecting banks' capital buffers in South Africa. Banks and the sovereign are closely interlinked through several channels. For example, fiscal dynamics are an important determinant of bank equity and solvency value as they depend on changes in the perceived solvency and market value of government debt (Dell'Ariccia et al. 2018). A drop in bond prices also reduces the market value of banks' bond holdings, eroding their collateral value.[2] Government plays an important role as a backstop in the event of financial sector distress. Unsustainable fiscal balances reduce the ability of government to play this role and increase risks of bank runs and contagion if the banking sector faces solvency challenges (Kallestrup, Lando and Murgoci 2016). Higher fiscal risks can also increase the financial sector's funding costs and risk aversion, causing banks to hold more capital than required by regulators (Borio and Zhu 2012). Increasing capital buffers is costly for banks and can increase the cost of lending and reduce economic activity.[3]

In South Africa, fiscal risks have increased, while banks and the financial sector in general have increased their holding of government debt. Banks, pension funds and insurance companies held government debt of just over 40% of GDP in 2020/21, up from 20% in 2012/13.[4] At the same time, the government debt-to-GDP ratio deteriorated from 41% to 80.3%, and sovereign risk premia have increased steadily by over 200 basis points, indicating rising fiscal risks.

We estimated a series of equations using the Arellano and Bond (1991) estimator, controlling for variables such as size of banks, the economic cycle, changes in equity prices, and – most importantly – sovereign risk premia. The results are robust across different specifications and they show a strong relationship between the sovereign risk premium and the banks' capital buffers. For every one percentage point increase in the sovereign risk premium, the capital buffers increase by 1.7 to 1.9 percentage points, on average, across the banks.

Our contribution to the literature is threefold. Firstly, we provide the first estimates of how rising fiscal risks are affecting capital buffers in South Africa. Previous studies on other countries have relied on proxy measures for banks' capital buffers to study their determinants. In our analysis, we use the actual capital buffers provided to us by the South African Prudential Authority. Secondly, we highlight significant differences between the actual capital buffers and the proxy measures used in the literature. We show how the proxy measures are not a good indicator of actual buffers. Thirdly, we illustrate how potential growth revisions affect estimates of the cyclicality of capital buffers.

The results suggest that fiscal policy decisions need to take into account the adverse impacts of negative fiscal shocks on the financial sector, as these

[2] Bonds are used for example as collateral in some transactions with the Reserve Bank.

[3] See for example Woodford (2010).

[4] See the second edition of the 2020 *Financial Stability Review* available at https://www.resbank.co.za/en/home/publications/publication-detail-pages/reviews/finstab-review/2020/Second_edition_Financial_Stability_Review.

contribute to smaller fiscal multipliers. Macro- and microprudential regulators need to review the role of government debt as a low-risk asset in the regulatory framework and identify interventions to reduce bank exposure to sovereign debt instruments as fiscal risks increase. This will also support more prudent fiscal policy and enhance macro-economic stability.

The paper is ordered as follows. In the next section, we present a review of the related literature. This is followed in Section 3 by a brief discussion of South Africa's fiscal risks, macroprudential regulation and structure of the banking sector. The methodology is presented in Section 4. The data is discussed in Section 5 and the results in Section 6. We conclude with some policy-related comments in Section 7.

2 Related literature

Increasing the level of capital can be costly due to differential tax treatment of debt and equity; government guarantees that change the relative costs of capital to debt; or transaction costs associated with higher equity issuance (Elliott 2013).[5]

Despite these costs, banks choose to hold capital above the regulatory requirements. In summarising the literature, Fonseca and González (2010) identify three reasons why banks hold higher capital than required. The first reason is that bank shareholders have an incentive to maintain a capital buffer when bank liabilities are not totally insured. In this case, the capital buffer reduces the cost of deposits by signalling lower bank risks to depositors.

The second reason is that banks can also hold extra capital because they want to preserve their monopoly rents. Shareholders may choose to fund the bank using capital rather than cheaper deposits if this reduces the likelihood of failure, preserves the monopoly profits and provides for cheaper borrowing. This suggests that costs of deposits and competition are likely to be important determinants of capital buffers. The third reason is that breaching the minimum regulatory requirement is costly. These costs are linked to supervisory actions and reputational risks, and incentivise banks to hold more capital than required (Borio and Zhu 2012).

Furthermore, banks may hold higher capital buffers to respond to higher loan demand in the future (Jokipii and Milne 2008). In the absence of capital buffers, banks will not have the required capital to expand lending.[6]

Increasing capital buffers has implications for economic activity. In the model of Repullo and Suarez (2013), capital buffers increase as a precaution against shocks that may hinder future lending. The increase is larger if the regulatory regime requires higher capital during recessionary periods and for

[5] These market frictions reduce the validity of the Modigliani and Miller theorem. See .()Modigliani and Miller (1958).

[6] Banks, of course, can reduce risk-weighted assets, creating scope for more lending or appropriate capital from reserve accounts.

high social costs of bank failure. The framework generates credit rationing of borrowers under recessionary conditions.

In the framework developed by Borio and Zhu (2012), banks' efforts to avoid breaching the minimum requirement and maintain a capital buffer affect the availability and funding of credit extended to customers. These increase lending spreads. In the theoretical model developed by Woodford (2010), increasing bank capital is costly, and it leads to lower levels of intermediation, higher interest rate spreads, and lower economic activity. In the model of Van den Heuvel (2008), the negative impacts operate through the liquidity preferences of households. Empirical studies support the relationship between increasing bank capital and decreased lending (Aiyar et al. 2014; Bridges et al. 2014; Noss and Toffano 2016).

Capital buffers, however, can also have welfare-enhancing effects to the extent that they can prevent very large increases in the lending spreads in response to sudden loan losses and the need to rebuild net worth (Benes and Kumhof 2015).

The relationship between economic activity and capital buffers also moves in the opposite direction, creating a feedback loop between economic activity and capital buffers. The size of the capital buffer is a function of the economic cycle as it changes probabilities of default, valuations and perceptions of risk. This shifts the relative position of bank capital to regulatory capital and thus affects bank behaviour (Borio and Zhu 2012). Lower interest rates and stronger economic growth are likely to reduce the size of the capital buffer (Aiyar, Calomiris and Wieladek 2016).

This suggests that determinants of the business cycle and perception of risks affect the willingness of banks to hold higher capital above the required level. In South Africa, there have been several factors contributing to a slowdown in economic activity in the period since the Global Financial Crisis of 2008. These include a fall in export commodity prices; large supply shocks such as agricultural droughts, disruptive strikes in the mining and manufacturing sectors, and electricity shortages; as well as a significant fiscal deterioration, evident in the large increase in government debt stocks and risk premia.

Fiscal dynamics are an important determinant of bank equity and solvency values as they depend on changes in the perceived solvency and market value of their government's debt. Dell'Ariccia et al. (2018) calculate that a 10% loss on a sovereign bond portfolio, which is 10% of banks' assets, would imply a 15% reduction in bank capital for a bank with a 6.6% leverage ratio. They also find a very strong relationship between sovereign risks as captured by credit default swap (CDS) spreads, the valuations of banks and the cost of funding. The impact is proportional to the stock of 'home country' government debt held by a bank and the strength of its balance sheet.

The second (November) edition of the 2020 Financial Stability Review[7] outlines four channels that describe the relationship between fiscal dynamics and

[7] The review is available at https://www.resbank.co.za/content/dam/sarb/publications /reviews/finstab-review/2020/financial-stability-review-2nd-edition-2020/Second%20edition%202020%20Financial %20Stability%20Review.pdf

the financial sector.[8] The first channel is related to the direct holding of government debt by the financial sector and leads to large capital losses when an adverse shock materialises, as illustrated in the previous paragraph. The second channel refers to government's role in acting as a backstop in the event of financial sector distress. When a government's financial position deteriorates, its ability to serve in this role diminishes, increasing risks of bank runs and financial contagion in the presence of solvency challenges. The third channel operates through the impact of the fiscus and the financial sector on economic activity. This channel reflects the feedback loop, which amplifies economic and financial shocks. For example, in the model developed by Corsetti et al. (2013), strained government resources increase the cost of financial intermediation as rising fiscal risks affect the economic environment and the ability of banks to monitor and enforce loan contracts. Unsustainable fiscal balances can also lead to higher distortionary taxes, lower private and public investment, and less scope for countercyclical fiscal policy, all impeding long-term growth and increasing bank risk aversion (Barro 1979; Burriel et al. 2020; Checherita-Westphal and Rother 2012; Ostry, Ghosh and Espinoza 2015). The last channel operates through the borrowing rates of government, which are important reference rates in the economy. Higher rates reduce the demand for investment and financial services.

These relationships are part of the so-called sovereign-bank nexus. Shocks to the sovereign or financial sector balance sheets generate large economic losses by impacting each other directly and indirectly, creating feedback loops ('doom loops') (Brunnermeier et al. 2016; Dell'Ariccia et al. 2018). This suggests that in the presence of looming fiscal risks, banks are likely to hold larger capital buffers to reduce the strength of the feedback loops.

The current literature on the determinants of capital buffers tends to focus on the cyclical behaviour of the cushion, controlling for variables such as size, risk profile, funding cost and competition. The impact of fiscal dynamics is not tested directly.

Large banks are likely to have smaller buffers for three reasons. Firstly, they have lower costs of screening and monitoring because of economies of scale and they require less capital to substitute for these activities. Secondly, large banks also have more diversified portfolios, which will reduce their probability of experiencing large drops in their capital ratios. The third reason is that large banks tend to be classified as 'too big to fail' and receive larger government support in response to shocks to their balance sheets, compared to smaller banks (Jokipii and Milne 2008). The empirical evidence indicates that bank size is an important determinant of capital buffers, with large banks having smaller buffers (Carvallo and Jiménez 2018; Moudud-Ul-Huq 2019; Valencia and Bolanos 2018).

The size of the cushion also depends on factors such as the quality of accounting information, restrictions on bank activities and supervision (Fonseca and González 2010). The quality of accounting information can reduce asym-

[8] See also ...Dell'Ariccia et al. (2018), Acharya, Drechsler and Schnabl (2014), and Kallestrup, Lando and Murgoci (2016).

metric information problems and enforce greater market discipline. Tighter restrictions on bank activities can reduce the incentives for depositors to monitor banks, thus reducing market discipline and the need to hold higher capital buffers.

The evidence is inconclusive as to whether capital buffers are pro- or countercyclical. There are differences between countries, and there are different results for different types of banks within a country. For example, Valencia and Bolanos (2018) find pro-cyclical behaviour of capital buffers in developing countries and countercyclical behaviour in advanced economies. Similar results are found by Chen and Hsu (2014) in a study of 171 countries over the period 1995 to 2009. Fonseca and González (2010) find no systemic relationship between capital buffers and the cycle for a sample of 1 337 banks from 70 countries in the period 1995–2002. At a country level, García-Suaza et al. (2012) find that in Colombia larger banks have capital buffers which show stronger negative correlation with the economic cycle.[9]

The empirical literature indicates that market power is associated with higher capital buffers, supporting the so-called 'competition stability' view[10] (Carvallo and Jiménez 2018; Fonseca and González 2010; Saadaoui 2014; Schaeck and Cihak 2012). This relationship, however, is not as strong in emerging markets (Valencia and Bolanos 2018). In this case, market power may be associated with lower adjustment and capital costs, and larger margins and profitability. This increases bank revenues, reducing the role of capital as a buffer to absorb future losses (Elizalde and Repullo 2007).

Other drivers include: costs of deposits, the share of non-performing loans and profitability (Fonseca and González 2010). Bank shareholders have an incentive to hold higher capital, as this signals that the bank is well-capitalised and less risky, reducing the cost of deposits. This relationship holds only when banks' deposits are not explicitly or implicitly insured. Non-performing loans are an indicator of risk behaviour, associated with lower capital buffers (Atici and Gursoy 2013; Fonseca and González 2010). Profitability is associated with higher capital buffers as retained earnings and appropriated profits can increase, which in turns leads to higher capital holdings (Atici and Gursoy 2013; Carvallo and Jiménez 2018).

There are four main gaps in the literature that we attempt to address. The first is that studies of capital buffers use proxy measures, and we show later in the paper that these can be quite different from the actual capital buffers. Using the proxy measures can generate misleading results. The second gap is that, as far as we know, the impact of fiscal dynamics on bank capital buffers has not been assessed, neither in the South African nor global literature. Thirdly, there

[9] See also Tabak, Noronha and Cajueiro (2011) for discussion of capital buffers in Brazil, Jokipii and Milne (2008) for the European Union, and Vu and Turnell (2015) for Australia.

[10] The competition-stability view stipulates that market power can increase bank risk. The higher rates charged to customers encourage moral hazard and adverse selection. Banks can reduce risk by increasing capital holding. Under the competition-fragility view, banks engage in more risk taking as lower profit margins translate into lower franchise value. For a detailed discussion see Berger, Klapper and Turk-Ariss (2017).

are no specific studies looking at the determinants of capital buffers for South Africa. The fourth gap is that the cyclicality of capital buffers is sensitive to estimates of potential growth, which are subject to revisions. It is possible that the banks base their decisions on the 'wrong' cyclical estimate or have a better sense of the cycle than the official estimates. We illustrate how potential growth revisions affect our findings.

3 The South African context

In this section, we provide a short overview of South Africa's capital regulations, the structure of the banking sector and recent fiscal developments.

3.1 Changes to capital requirements

South Africa began phasing in the Basel III regulations from the beginning of 2013 and completed the process in 2019. Table 1 summarises the capital requirements structure. Banks are required to hold significantly more capital than the Basel minima. The systemic risk capital (Pillar 2A) should not exceed 3.5% together with the systemically important banks buffer.[11] Individual bank capital requirements fall under Pillar 2B. These can vary substantially and there are no upper limits. Smaller banks and those that are unsecured lenders have higher 2B pillar requirements.

In addition, banks are required to have a buffer stack, consisting of a countercyclical buffer, capital conservation buffer and systemically important banks buffer. The countercyclical buffer is currently set at 0%. The capital conservation buffer is set at 2.5%[12] and the systemically important banks buffer varies between 0.5% and 2.5%. It is also recommended by the regulators that banks hold additional capital. The total capital requirements per bank are not publicly disclosed.

The regulations are also clear that breaching the prescribed requirement is costly, leading to the imposition of capital conservation ratios and limits to discretionary payments (such as dividends).

Our data covers the period 2008 to 2020, which overlaps with the introduction of BASEL III. Over this period, the minimum capital requirement as per BASEL III of 8% was effective from 2013. The other elements, however, were phased in (see Table 2). For example, the pillar 2A for total capital was introduced at 1.5% in 2013. It peaked at 2% in 2015 and decreased to 1% as the systemically important capital buffer was phased in from 2016. Pillar 2A was further reduced to 0% in 2020, in response to the COVID-19 crisis.

[11] The current systemically important banks are Absa, Capitec, First National Bank, Nedbank, Investec and Standard Bank.

[12] The capital conservation buffer is always set at 2.5% and can decrease to 0 if capital is depleted under certain conditions.

3.2 South Africa's banking sector

There are 36 banks in South Africa. The Basel III requirements apply to 33 of these banks as three are mutual banks and are regulated differently. There are 18 local branches of foreign banks and 15 domestic banks, including the top six banks according to asset size (Rapapali and Simbanegavi 2020).

Large banks are profitable, with a return on equity of over 17.3% in 2018. Smaller banks have seen a decrease in profitability, particularly over the last two years. The profitability of the sector as a whole is higher than in many other jurisdictions. This, in turn, facilitates the accumulation of capital through higher retained earnings (Davies, Harris and Makrelov 2019). Most recently, profitability has declined and credit impairments have increased as economic activity declined due to the COVID-19 crisis.

The higher profitability is a function of the level of competition in the sector. Rapapali and Simbanegavi (2020) reviewed the literature on competition in the South African banking sector and employed the Boone Indicator and Panzar–Rosse approaches to assess the current level of competition. They concluded that competition is low in the banking sector and has not changed since 2008, despite the entry of new banks as these have remained very small. The six largest banks account for 93% of bank assets (FSB 2020). This suggests that changes to the level of competition are less likely to explain changes in capital buffers over the period.

South African banks are well regulated and the financial sector is highly developed. According to a number of Global Competitiveness reports, South Africa continues to have one of the highest accounting standards.[13] This suggests that institutional factors related to monitoring banks are not an important determinant of the change in the size of capital buffers.

The financial sector regulatory authorities are currently improving the framework for resolution of banks. The SARB will become the sole resolution authority for all banks, as well as for any non-bank financial institutions that are designated as systemically important. These authorities are also planning the introduction of a deposit insurance framework. South Africa is the only Financial Stability Board jurisdiction without an explicit deposit insurance framework (FSB 2020).

3.3 The fiscal situation

South Africa's fiscal situation has deteriorated significantly in the post-Global Financial Crisis period. Government consumption expenditure achieved average growth of almost 4% per year and increased by more than 7% in 2019/20. Over the 10 years prior to the COVID-19 crisis, the share of government expenditure in GDP has increased from 25% to 33%. This increase was funded through a combination of tax increases and debt. Personal income tax and consumption taxes recorded the largest increases. At the same time, the debt-to-GDP ratio

[13] The Global Competitiveness reports are available at https://www.weforum.org/reports/the-global-competitiveness-report-2020.

increased from under 30% to over 80% in 2020.[14] South Africa's credit rating is currently at so-called junk status.

Measures of sovereign risk, such as the JP Morgan Emerging Market Bond Index spread, suggest that the South Africa's sovereign risk premium has been rising steadily since 2013 (Figure 1). More recently, domestic factors have been the main driver of the risk premium (Soobyah and Steenkamp 2020).

The May 2020 *Financial Stability Review* identified the government's large and increasing finance requirements as a major risk to the financial sector.[15] The deterioration in government finances has been accompanied by an increased exposure of the financial sector to the sovereign. The exposure accounts for more than 15% of total banking sector assets in 2020, almost twice as large compared to 2008. Banks that use the internal ratings-based (IRB) approach have been increasing risk weights for sovereign exposure in line with the rising public debt burden and deteriorating sovereign credit ratings. IRB banks are required to hold more capital against their sovereign exposures and some of their private sector loans. This may constrain lending and increase the cost of credit.

4 Methodology

Our aim is to test whether bank capital buffers respond to fiscal dynamics. We follow the methodology previously proposed in the literature (see for example, Fonseca and González (2010)) and estimate the following dynamic panel data model:

$$\begin{aligned} BUF_{i,t} = \beta_1 BUF_{i,t-1} + \beta_2 EMBI_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 LOANS_{i,t} \\ + \beta_5 NPL_{i,t} + \beta_6 INDUSTRY\_ROE_t + \beta_7 GRDEV_t + v_i + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where $BUF_{i,t}$ is the capital buffer for bank i in year t. This model captures the partial adjustment framework in which banks may be adjusting their capital buffers through the inclusion of the lagged capital buffer $BUF_{i,t-1}$. We use the difference GMM estimator developed by Arellano and Bond (1991) to estimate equation (1) and report robust standard errors throughout. We control for the potential endogeneity of SIZE, LOANS, and NPL in the GMM estimations using the second to fourth lags of the same variables as instruments.

This approach addresses three relevant econometric issues: (1) the presence of unobserved bank-specific effects, which are eliminated by taking first-differences of all variables; (2) the autoregressive process in the data regarding the behaviour of capital buffers (i.e. the need to use a lagged dependent variables model to capture the dynamic nature of the capital buffer); and (3) the

[14] See Loewald, Faulkner and Makrelov (2020) for a review of fiscal policy in the post-Global Financial Crisis period.

[15] The *Financial Stability Review* is available at https://www.resbank.co.za/en/home /publications/review.

likely endogeneity of the explanatory variables. The panel estimator controls for this potential endogeneity by using instruments based on lagged values of the explanatory variables (Fonseca and González 2010).

Our primary variable of interest is $EMBI$, which is a measure of South Africa's sovereign risk premium.[16] A deterioration in government's fiscal position is captured by an increasing risk premium. Hence, if banks respond to fiscal dynamics by increasing their capital buffers when the fiscal position worsens, we would expect that β_2 is positive. An increase in the risk measure can reflect both global and domestic factors. For example, a global economic shock can increase the flight to safety and reduce US bond yields, increasing the EMBI spread. In order to test separately for the global, $EMBI\_INT$, and domestic factors, $EMBI\_DOM$, we use the risk premium decomposition of Soobyah and Steenkamp (2020). The domestic measure is the residual factor after accounting for emerging markets and global factor drivers of the South African CDS spread. The domestic measure reflects fiscal risks, which can be due to discretionary fiscal changes or the impact of domestic developments on the fiscal matrix and perceptions of fiscal sustainability. We also use government debt to GDP as an alternative measure of fiscal risks.

As additional bank level controls, we include $SIZE$, which is the log of total bank assets; $LOANS$, which is loans over total assets; and NPL, which is the ratio of non-performing loans to total loans. Unfortunately, we do not have complete data on the return on equity for all banks, so instead we use a return on equity for the banking industry as a whole, $INDUSTRY\_ROE$, to capture the effects of higher profitability.

We use two measures of cyclical dynamics, $GRDEV1$ and $GRDEV2$. They both measure the deviation of actual growth from potential growth, but differ in the calculation of potential growth. $GRDEV2$ uses the $t-1$ estimate for potential growth in t. $GRDEV1$ is based on the most recent historical potential growth estimates, which incorporate additional information to those used in the calculation of $GRDEV2$. Both estimates of potential growth are produced by the SARB and are communicated widely. Since commercial bank decisions are likely to be based on the available information at the time, $GRDEV2$ is more likely to capture the information used by banks in their decision making. The two measures are better indicators of cyclical dynamics than just using economic growth as they capture the impacts of supply and demand shocks on the cycle.

We do not include any measure of market power (such as the Lerner Index) because the structure of the sector has remained relatively unchanged and we do not expect this measure to generate significant results.

In the next section, we provide more information on the data used in the regression analysis.

[16] The EMBI is the JP Morgan Emerging Market Bond Index. We use the EMBI+ index which provides a maturity weighted spread between United States and South African bond yields priced in the same currency.

5 Data

We use data on the universe of South African banks over the period 2008–2019.[17] Uniquely, we have data on banks' actual capital buffers provided to us by the South African Prudential Authority. Whereas the prior literature has inferred the size of banks' voluntary capital buffers, we are able to observe the true size of the voluntary buffer. There are elements of the minimum capital requirement that are common across all banks, but there are important bank-specific requirements that are typically unobserved. These bank-specific requirements are likely of huge importance in a banking sector like South Africa's, which is characterised by a few dominant banks and a number of smaller banks.

Although we have data available at the monthly frequency, we use annual data for two main reasons. The first is so that our estimates will be comparable with the prior literature that has typically used annual data. The second is to avoid any noise that might be present in monthly data.

We drop FinBond, GBS and VBS banks from the sample because they are mutual banks that are not subject to capital adequacy requirements that other banks are. We also drop African Bank, which experienced significant financial stress over the period and had to be bailed out and restructured. We further exclude outliers, defined as those observations with an absolute value of the capital buffer z-score greater than 3.

We compare the actual capital buffer to two proxy definitions of capital buffers. The first, $BUF1$, is measured as the difference between capital and the Basel III 8% minimum requirement (which is the common approach in the literature), and the second, $BUF2$, takes into account the Pillar 2A requirements and so is the difference between capital and the South African base minimum requirement. While the 8% minimum requirement is constant across the years we study, the Pillar 2A, and hence the South African base minimum requirements, vary across the years (see the discussion in Section 3 for details).

It is clear from Figure 2 that the banks' actual capital buffers are much lower than the calculated buffers, typically used in the literature. Without knowing the specific requirements the regulator imposes on each bank, researchers are likely to be overestimating the voluntary capital buffers by as much as two times the true capital buffers. In Figure 3, we compare the average actual buffer to the EMBI index. The two series do seem to broadly move together, although there are times where they diverge.

Table 3 provides summary statistics for the entire data set. Negative values for the capital buffer reflect that certain banks were below the regulatory requirements at specific points over the period. The high maximum values reflect the buffer of some banks that entered the market. The table also illustrates the differences between the actual capital buffer and the proxy measures. The latter have higher mean and standard deviation values.

[17] Details on the definitions and sources of all the variables can be found in the Appendix.

6 Results

Table 4 presents our main results from the estimation of equation (1). The m1 and m2 statistics give the Arellano-Bond test statistics for autocorrelation in the first-differenced standard errors. The m2 statistic is insignificant, which indicates that there is no second-order serial correlation in the first-difference residuals. The Hansen test of over-identifying restrictions confirms that the instruments are appropriate. These two conditions are required for the validity of the Arellano-Bond GMM estimates.[18]

The coefficient on EMBI is positive but not statistically significant when we look at all years. However, when looking at the period from 2013 onwards it is clear that the EMBI has a positive and statistically significant effect on banks' voluntary capital buffers. It is over this period that fiscal risks increased. The results indicate that a 100 basis point increase in the EMBI increased the capital buffer by 1.7 to 1.9 percentage points on average.

Looking at the EMBI decomposition variables, it is clear that domestic factors drive the changes in the capital buffer, both over the full sample period and from 2013 onwards. The increases in EMBI_DOM seem to drive the capital buffer responses entirely, whereas the coefficient on EMBI_INT is close to zero and not statistically significant.

Although the coefficients on the lagged buffers are not statistically significant, they are positive and relatively large, which suggests that the partial adjustment framework may still be appropriate. The size of the coefficients is close to those estimated by Fonseca and González (2010).

Of the bank-specific variables, the coefficient on SIZE is statistically significant. It shows that large banks hold smaller capital buffers, in line with our expectations and consistent with the economic literature. Large banks have implicit public guarantees, larger margins, lower adjustment costs and higher profitability.[19] These reduce the need for high capital buffers (Valencia and Bolanos 2018).

LOANS and NPL are insignificant. The proportion of loans in the total assets of a bank is a weak predictor of capital.[20] Changes to the loan portfolio relative to other asset classes have not affected the banks' capital buffers. Non-performing loans are also a weak predictor, which is expected, given that there was little variability in the NPL ratio over the period 2013 to 2019, particularly for large banks.[21]

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[18] The insignificant values of m1 in some of the estimations suggests that the errors in levels follow a random walk. This does not affect the consistency of the GM estimates in the first-difference model. See Arellano and Bond (1991).

[19] Large banks in South Africa also have large unappropriated profits, which can be appropriated if required to become capital. They can serve the role of back-up capital.

[20] The coefficients of LOANS is insignificant, with a positive sign over the entire period and a negative sign in the post-2013 period. The coefficient sign can suggest possible compositional changes to lending. For example, growth in unsecured lending slowed down significantly in the post-2013 period.

[21] The NPL ratio may reflect discretionary write-off of bad debts by banks in order to keep NPL ratios in check, which reduces variability.

The INDUSTRY_ROE coefficient is positive and significant in most estimations, indicating that higher profitability is associated with higher capital buffers. This is consistent with our expectations, as retained earnings in the sector increased. Higher retained earnings translate into higher capital buffers when a bank appropriates them as capital and informs the regulator.

Over the full sample period, both measures of cyclical dynamics – GRDEV1 and GRDEV2 – are positive (and statistically significant when the EMBI decomposition is used), indicating that capital buffers are procyclical. This is in line with the findings of Valencia and Bolanos (2018). Interestingly, over the years 2013–2019 the coefficient on GRDEV1 is negative, while the coefficient on GRDEV2 is positive, although none of the estimated effects are statistically significant. It is this later period that was characterised by large supply-side shocks such as mining and manufacturing strikes, droughts in the agricultural sector and significant policy uncertainty. Estimates of potential growth were continually revised down retrospectively. Recall that GRDEV2 uses the t–1 estimate of potential growth and so it better captures the information available to banks at the time. Using this estimate shows that banks adjust their buffers in a procyclical way. Wider and more negative output gaps are associated with lower capital buffers. However, the GRDEV1 measure uses the latest estimates of historical potential GDP and demonstrates that banks' capital buffers were actually counter-cyclical as potential growth turned out to be lower than initially expected.[22]

We interact the EMBI variables with an indicator for whether a bank is systemically important, SYSIMP, to test whether the effects vary across banks. The results in Table 5 show that the effects of fiscal dynamics on the capital buffer do not differ for the six systemically important banks. The coefficients on EMBIxSYSIMP, EMBI_DOMxSYSIMP and EMBI_INTxSYSIMP are close to zero and not statistically significant, indicating that the systemically important banks do not differ in their capital buffer responses to changes in the EMBI.

We use the main specification in Table 6 to compare how the results change when using the proxy capital buffer measures used in the literature. The estimated results are very different in terms of magnitudes, indicating that the use of proxy measures in the analysis of capital buffers is likely to generate misleading results.[23] In particular, the estimated effect of the EMBI measure on capital buffers is almost twice as large when using the proxied capital buffers, BUF1 and BUF2, than when using the true capital buffer measure. Other variables have different sizes, significance levels or magnitudes.

Finally, in Table 7, we consider an alternative fiscal risk measure, GOVDEBT, defined as gross government debt as a percentage of GDP. GOVDEBT is an alternative measure for fiscal risks. The results support our main conclusion that banks' capital buffers increase with greater fiscal risks since the coefficient

[22] This finding may also indicate that commercial banks had a different view to the Reserve Bank of potential growth and the output gap.

[23] We ran regressions using the proxy measures over the entire period. The results are different in terms of magnitude but also in terms of statistical significance.

on GOVDEBT is positive and statistically significant in all estimates.[24] As expected, the coefficient is larger in the post-2013 period when concerns regarding the sustainability of government finances increased.

7 Conclusion

Our results show that higher fiscal risks are associated with higher capital buffers and empirically support the presence of a sovereign-bank nexus in South Africa. The results are consistent with the theoretical models of Borio and Zhu (2012) and Woodford (2010), which link the broader risk environment to bank capital holdings and risk taking. Other important drivers include the size of banks and the business cycle. Large banks hold smaller capital buffers, which is in line with the 'competition stability' view. The capital buffers tend to be procyclical. An important contribution of our analysis is to illustrate the limitations of proxy measures for capital buffers widely used in the literature.

There are two main implications for fiscal and macroprudential policy based on our results. The channel between fiscal risks and capital buffers, or more generally the relationship between the sovereign and the financial sector, is often ignored in the calculation of fiscal multipliers. Yet, the interlinkages between the sovereign and the financial sector can positively or negatively amplify fiscal expenditure shocks, depending on the level of government debt and the size of the output gap.[25] Internalising this channel into fiscal policy decisions will improve the assessment of fiscal sustainability and reduce crowding out effects in the economy. The second implication is that macro- and microprudential regulations need to review the role of government debt as a low-risk asset in the regulatory framework and identify interventions to reduce bank exposure to sovereign debt instruments as fiscal risks increase. This will also support more prudent fiscal policy and enhance macro-economic stability.

Our analysis was somewhat limited by the availability of observations after the 2013 period, when BASEL III was introduced. As more data becomes available and new entrants such as TymeBank and Discovery Bank gain market share, the analysis can be expanded to test how more specific bank characteristics affect decisions around holding capital buffers. Due to data availability, we also did not include in our analysis unappropriated (reserve) profits, which are generally large for the big six banks.[26] These can be appropriated and used as an additional buffer at times of stress. Their inclusion can improve the

[24] We also tested whether bank exposure to government debt is associated with higher capital buffers. The estimated coefficient was insignificant. We can think of two possible explanations. One is that the variable is highly correlated with other explanatory variables such as size, that is, the exposure is linked to the size of the bank. The second explanation is that the willingness of banks to hold capital buffers is not only a function of their exposure but the exposure of the entire system. The second explanation is in line with the theoretical model of Borio and Zhu (2012).

[25] See for example Makrelov et al. (2020) for analysis of how the financial sector can amplify government expenditure shocks.

[26] These profits are retained earnings that have not been appropriated as bank capital.

representation of capital buffers.

References

[1] Acharya, V, Drechsler, I and Schnabl, P. 2014. 'A pyrrhic victory? Bank bailouts and sovereign credit risk'. *Journal of Finance* 69: 2689–2739.

[2] Aiyar, S, Calomiris, C W, Hooley, H, Korniyenko, Y and Wieladek, T. 2014. 'The international transmission of bank capital requirements: evidence from the UK'. *Journal of Financial Economics* 113: 368–382.

[3] Aiyar, S, Calomiris, C W and Wieladek, T. 2016. 'How does credit supply respond to monetary policy and bank minimum capital requirements?'. *European Economic Review* 82: 142–165.

[4] Arellano, M and Bond, S. 1991. 'Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations'. *Review of Economic Studies* 58: 277–297.

[5] Atici, G and Gursoy, G. 2013. 'The determinants of capital buffer in the Turkish banking system'. *International Business Research Journal* 6: 224–234.

[6] Barro, R. 1979. 'On the determination of the public debt'. *Journal of Political Economy* 85: 940–971.

[7] Benes, J and Kumhof, M. 2015. 'Risky bank lending and countercyclical capital buffers'. *Journal of Economic Dynamics and Control* 58: 58–80.

[8] Berger, A N, Klapper, F L and Turk-Ariss, R. 2017. 'Bank competition and financial stability'. In *Handbook of Competition in Banking and Finance*, edited by J A Bikker and L Spierdijk. Edward Elgar Publishing:185–205

[9] Borio, C and Zhu, H. 2012. 'Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism?'. *Journal of Financial Stability* 8: 236–251.

[10] Bridges, J, Gregory, D, Nielsen, M, Pezzini, S, Radia, A and Spaltro, M. 2014. 'The impact of capital requirements on bank lending'. *Bank of England Working Paper Series, No. 486*.11

[11] Brunnermeier, M K, Garicano, L, Lane, P R, Pagano, M, Reis, R, Santos, T, Thesmar, D, Van Nieuwerburgh, S and Vayanos, D. 2016. 'The sovereign-bank diabolic loop and ESBies'. *American Economic Review* 106: 508–512.

[12] Burger, P and Calitz, E. 2020. 'COVID-19, economic growth and South African fiscal policy'. *Stellenbosch Working Paper Series, No. WP15/2020.*

[13] Burriel, P, Checherita-Westphal, C D, Jacquinot, P, Schön, M and Stähler, N. 2020. 'Economic consequences of high public debt: evidence from three large scale DSGE models'. *ECB Working Paper Series, No. 2450.*

[14] Carvallo, Ó A and Jiménez, L A. 2018. 'Bank capital buffers and procyclicality in Latin America'. *Monetary Policy and Financial Stability in Latin America and the Caribbean* 1(1): 133–158.

[15] Checherita-Westphal, C and Rother, P. 2012. 'The impact of high government debt on economic growth and its channels: an empirical investigation for the euro area'. *European Economic Review* 56: 1392–1405.

[16] Chen, Y, and Hsu, C. 2014. 'Are bank capital buffers cyclical? Evidence for developed and developing countries'. *Journal of Financial Studies* 22: 27–56.

[17] Corsetti, G, Kuester, K, Meier, A and Müller, G J. 2013. 'Sovereign risk, fiscal policy, and macroeconomic stability'. *Economic Journal* 123: F99–F132.

[18] Davies, R, Harris, L and Makrelov, K. 2019. 'The impact of a higher leverage ratio on the South African economy'. *SA-TIED Working Paper No. 51.*

[19] Dell'Ariccia, G, Ferreira, C, Jenkinson, N, Laeven, L, Martin, A, Minoiu, C and Popov, A. 2018. 'Managing the sovereign-bank nexus'. *European Central Bank Discussion Paper No. 2177.*

[20] Elizalde, A and Repullo, R. 2007. 'Economic and regulatory capital in banking: what is the difference?'. *International Journal of Central Banking* 10: 87–118.

[21] Elliott, D J. 2013. 'Higher bank capital requirements would come at a price'. Brookings Institute Internet posting. Available online at http://www.brookings. edu/research/papers/2013/02/20-bank-capitalrequirements-elliott (accessed 3 May 2021).

[22] Financial Stability Board. 2020. *Peer review of South Africa.* Basel, Switzerland: Financial Stability Board.

[23] Fonseca, A R and González, F. 2010. 'How bank capital buffers vary across countries: the influence of cost of deposits, market power and bank regulation'. *Journal of Banking & Finance* 34: 892–902.

[24] García-Suaza, A F, Gómez-González, J E, Pabón, A M and Tenjo-Galarza, F. 2012. 'The cyclical behavior of bank capital buffers in an emerging economy: size does matter'. *Economic Modelling* 29: 1612–1617.

[25] Jokipii, T and Alistair Milne, A. 2008. 'The cyclical behaviour of European bank capital buffers'. *Journal of Banking & Finance* 32: 1440–1451.

[26] Kallestrup, R, Lando, D and Murgoci, A. 2016. 'Financial sector linkages and the dynamics of bank and sovereign credit spreads'. *Journal of Empirical Finance* 38: 374–393.

[27] Loewald, C, Faulkner, D and Makrelov, K. 2020. 'Time consistency and economic growth: a case study of South African macroeconomic policy'. *South African Reserve Bank Working Paper Series, No. WP/20/12.*

[28] Makrelov, K, Arndt, C, Davies, R and Harris, L. 2020. 'Balance sheet changes and the impact of financial sector risk-taking on fiscal multipliers'. *Economic Modelling* 87: 322–343.

[29] Modigliani, F and Miller, M H. 1958. 'The cost of capital, corporation finance and the theory of investment'. *American Economic Review* 48: 261–297.

[30] Moudud-Ul-Huq, S. 2019. 'Banks' capital buffers, risk, and efficiency in emerging economies: are they counter-cyclical?'. *Eurasian Economic Review* 9: 467–492.31

[31] Noss, J and Toffano, P. 2016. 'Estimating the impact of changes in aggregate bank capital requirements on lending and growth during an upswing'. *Journal of Banking & Finance* 62: 15–27.

[32] Ostry, J D, Ghosh, A R and Espinoza, R A. 2015. 'When should public debt be reduced?' *IMF Staff Discussion Note No. 15/10.*

[33] Rapapali, M and Simbanegavi, W. 2020. 'Competition in South African banking: an assessment using the Boone Indicator and Panzar-Rosse approaches.' *South African Reserve Bank Working Paper Series, No. WP/20/02.*

[34] Repullo, R and Suarez, J. 2013. 'The procyclical effects of bank capital regulation'. *Review of Financial Studies* 26: 452–490.

[35] Saadaoui, Z. 2014. 'Business cycle, market power and bank behaviour in emerging countries'. *International Economics* 139: 109–132.

[36] Schaeck, K and Cihak, M. 2012. 'Banking competition and capital ratios'. *European Financial Management* 18: 836–866.

[37] Soobyah, L and Steenkamp, D. 2020. 'A measure of South Africa's sovereign risk premium'. *South African Reserve Bank Economic Notes* OBEN/20/01.

[38] Tabak, B M, Noronha, A C and Cajueiro, D. 2011. 'Bank capital buffers, lending growth and economic cycle: empirical evidence for Brazil'. Paper prepared for the 2nd Bank for International Settlements Consultative Council for the Americas conference titled 'Monetary policy, financial stability and the business cycle', Ottawa, Canada, 12–13 May. Paper No. BIS CCA-004-2011.

[39] Valencia, O C and Alberto, O B. 2018. 'Bank capital buffers around the world: cyclical patterns and the effect of market power'. *Journal of Financial Stability* 38: 119–131.

[40] Van den Heuvel, S J. 2008. 'The welfare cost of bank capital requirements'. *Journal of Monetary Economics* 55: 298–320.

[41] Vu, Ha and Turnell, S. 2015. 'The behavior of Australian banks' capital buffers: pro-or counter-cyclical?'. *Applied Economics and Finance* 2: 110–118.

[42] Woodford, M. 2010. 'Financial intermediation and macroeconomic analysis'. *Journal of Economic Perspectives* 24: 21–44.

Table 1: Structure of capital requirements

	%
Basel III minima	8
South African minima	8
Pillar 2A	0.5 to 2
South Africa base minima	8 +Pillar 2A
Pillar 2B (ICR)	no specific range
Prudential minima	8+Pillar2A+ICR
Systemically important buffer	0.5 to 2.5
Capital conservation buffer	0 to 2.5
Countercyclical buffer	0 to 2.5

Source: SARB.

Table 2: Phasing of capital regulation

%	2013	2014	2015	2016	2017	2018	2019
Total capital requirements (per Basel III)	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Pillar 2A for Total Capital	1.5	2.0	2.0	1.8	1.5	1.3	1.0
Minimum Total Capital Plus 2A	9.5	10.0	10.0	9.8	9.5	9.3	9.0
Phasing in of specified charge for systemically important banks				25	50	75	100
Capital conservation buffer				0.625	1.25	1.875	2.5
Countercyclical buffer[1]				0.625	1.25	1.875	2.5

Source: SARB.

1 The maximum for the countercyclical buffer was phased in but never activated.

Table 3: Summary statistics (2008–2019)

VARIABLES	(1) mean	(2) sd	(3) min	(4) max
BUF	6.964	12.72	-6.500	79
BUF1	13.22	15.97	1.835	138.4
BUF2	11.68	16.00	0.335	136.6
EMBI	260.3	119.2	138.6	620.5
EMBI_DOM	55.09	51.30	3.786	160.0
EMBI_INT	197.5	67.03	133.9	402.5
INDUSTRY_ROE	16.21	1.841	13.85	21.08
SIZE	16.53	2.188	12.50	21.07
LOANS	0.406	0.251	0	1.146
NPL	0.0335	0.0566	0	0.445
GRDEV1	-0.330	0.868	-3.188	0.271
GRDEV2	-1.255	1.246	-5.288	-0.0625

Note: BUF is actual capital buffer. BUF1 is defined as the difference between the bank's total capital and the 8% minimum requirement. BUF2 is defined as the difference between BUF1 and the Pillar 2A capital requirement. Source: Authors' own calculations.

Table 4: Estimation results

VARIABLES	(1) All years	(2) All years	(3) All years	(4) All years	(5) 2013+	(6) 2013+	(7) 2013+	(8) 2013+
EMBI	0.0129	0.0124			0.0170*	0.0193*		
	(0.00944)	(0.00942)			(0.0103)	(0.0102)		
EMBI_DOM			0.0202**	0.0183*			0.0166*	0.0223**
			(0.00992)	(0.0104)			(0.00983)	(0.0112)
EMBI_INT			0.00107	0.00234			0.0120	0.00808
			(0.00994)	(0.0101)			(0.0128)	(0.0118)
L.BUF	0.170	0.173	0.170	0.173	0.0583	0.0577	0.0589	0.0563
	(0.145)	(0.144)	(0.144)	(0.144)	(0.162)	(0.159)	(0.161)	(0.159)
SIZE	-5.190**	-5.222**	-5.461**	-5.405**	-9.571***	-9.607***	-9.425***	-9.649***
	(2.345)	(2.354)	(2.228)	(2.248)	(2.892)	(3.010)	(2.780)	(2.953)
LOANS	2.353	2.357	2.142	2.237	-1.726	-1.448	-1.563	-1.461
	(6.956)	(6.932)	(6.892)	(6.877)	(7.309)	(7.359)	(7.217)	(7.256)
NPL	-0.602	-1.028	-1.591	-1.784	-10.10	-9.889	-9.757	-10.18
	(9.031)	(8.959)	(8.752)	(8.741)	(8.710)	(9.297)	(8.817)	(9.144)
INDUSTRY_ROE	0.303*	0.269*	0.320**	0.273*	0.182	0.270*	0.0943	0.169
	(0.158)	(0.147)	(0.156)	(0.147)	(0.198)	(0.162)	(0.202)	(0.173)
GRDEV1	0.597		0.704*		-1.344		-1.418	
	(0.434)		(0.382)		(1.210)		(1.177)	
GRDEV2		0.432		0.469**		0.407		0.561
		(0.271)		(0.231)		(0.497)		(0.505)
Observations	271	271	271	271	193	193	193	193
Number of banks	30	30	30	30	30	30	30	30
m1	-1.950*	-1.957*	-1.875*	-1.879*	-1.542	-1.558	-1.535	-1.527
m2	0.619	0.643	0.495	0.523	0.550	0.669	0.530	0.675
Hansen	26.97	27.81	27.02	27.37	21.92	24.47	22.18	25.44

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Authors' own calculations
.

Table 5: Estimation results with size interaction terms

VARIABLES	(1) All years	(2) All years	(3) All years	(4) All years	(5) 2013+	(6) 2013+	(7) 2013+	(8) 2013+
EMBI	0.0104	0.00991			0.0185	0.0208*		
	(0.0103)	(0.0104)			(0.0119)	(0.0118)		
EMBI_DOM			0.0167	0.0150			0.0163	0.0221*
			(0.0110)	(0.0117)			(0.0116)	(0.0127)
EMBI_INT			0.000387	0.00138			0.0169	0.0132
			(0.0123)	(0.0125)			(0.0160)	(0.0150)
EMBIxSYSIMP	0.0102	0.0102			-0.00633	-0.00679		
	(0.0124)	(0.0124)			(0.0110)	(0.0106)		
EMBI_DOMxSYSIMP			0.0134	0.0128			0.000835	0.000409
			(0.0180)	(0.0175)			(0.0152)	(0.0148)
EMBI_INTxSYSIMP			0.00278	0.00405			-0.0224	-0.0230
			(0.0133)	(0.0136)			(0.0166)	(0.0165)
L.BUF	0.166	0.169	0.166	0.170	0.0604	0.0599	0.0645	0.0621
	(0.147)	(0.146)	(0.146)	(0.146)	(0.162)	(0.159)	(0.160)	(0.157)
SIZE	-5.195**	-5.226**	-5.421**	-5.362**	-9.506***	-9.549***	-9.307***	-9.529***
	(2.348)	(2.357)	(2.251)	(2.265)	(2.904)	(3.022)	(2.768)	(2.938)
LOANS	2.775	2.785	2.676	2.777	-1.518	-1.275	-1.353	-1.269
	(6.901)	(6.878)	(6.817)	(6.806)	(7.330)	(7.379)	(7.086)	(7.136)
NPL	-0.168	-0.589	-1.278	-1.472	-10.47	-10.27	-9.802	-10.22
	(8.863)	(8.781)	(8.542)	(8.511)	(8.522)	(9.105)	(8.836)	(9.156)
INDUSTRY_ROE	0.301*	0.266*	0.316**	0.269*	0.182	0.271*	0.0942	0.170
	(0.157)	(0.146)	(0.156)	(0.147)	(0.198)	(0.163)	(0.203)	(0.174)
GRDEV1	0.595		0.696*		-1.344		-1.429	
	(0.432)		(0.386)		(1.216)		(1.178)	
GRDEV2		0.429		0.462**		0.413		0.556
		(0.269)		(0.231)		(0.502)		(0.505)
Observations	271	271	271	271	193	193	193	193
Number of banks	30	30	30	30	30	30	30	30
m1	-1.946*	-1.953*	-1.856*	-1.861*	-1.550	-1.565	-1.545	-1.538
m2	0.572	0.596	0.433	0.462	0.570	0.689	0.511	0.665
Hansen	26.68	27.14	22.97	26.26	19.39	23.91	24.78	22.27

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Estimation results with different capital buffer measures

VARIABLES	(1) All years BUF	(5) All years BUF1	(9) All years BUF2
EMBI	0.0124	0.0234**	0.0244**
	(0.00942)	(0.0118)	(0.0119)
EMBI_DOM			
EMBI_INT			
L.BUF	0.173		
	(0.144)		
L.BUF1		0.109	
		(0.129)	
L.BUF2			0.111
			(0.128)
SIZE	-5.222**	-5.806**	-5.878**
	(2.354)	(2.627)	(2.627)
LOANS	2.357	-1.190	-1.349
	(6.932)	(8.753)	(8.720)
NPL	-1.028	-1.162	-0.546
	(8.959)	(10.09)	(10.46)
INDUSTRY_ROE	0.269*	0.216	0.203
	(0.147)	(0.181)	(0.179)
GRDEV2	0.432	0.560*	0.568*
	(0.271)	(0.302)	(0.301)
Observations	271	271	271
Number of banks	30	30	30
m1	-1.957*	-2.305**	-2.304**
m2	0.643	1.200	1.088
Hansen	27.81	27.43	27.74

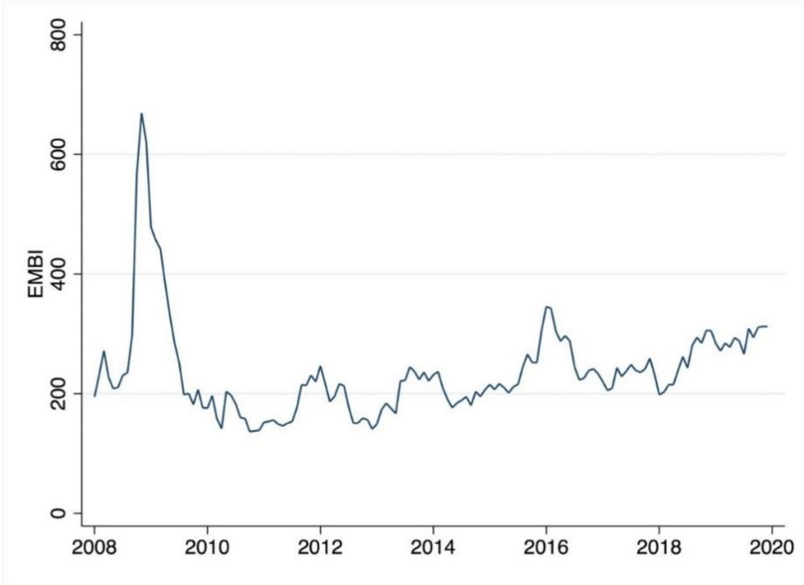
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Estimation results with different fiscal risk measure

VARIABLES	(1) All years	(2) All years	(3) 2013+	(4) 2013+
GOVDEBT	0.201*	0.198*	0.250*	0.231*
	(0.104)	(0.104)	(0.136)	(0.118)
L.BUF	0.153	0.156	0.0550	0.0552
	(0.144)	(0.144)	(0.162)	(0.162)
SIZE	-7.362**	-7.270**	-10.59***	-10.56***
	(2.925)	(2.911)	(3.333)	(3.312)
LOANS	-0.293	-0.167	-2.608	-2.633
	(7.043)	(7.055)	(7.509)	(7.600)
NPL	-9.299	-9.305	-14.93	-14.79
	(8.509)	(8.553)	(9.089)	(9.068)
INDUSTRY_ROE	0.374**	0.354**	0.376*	0.314*
	(0.164)	(0.155)	(0.210)	(0.168)
GRDEV1	0.332		0.574	
	(0.403)		(1.274)	
GRDEV2		0.193		0.199
		(0.249)		(0.475)
Observations	271	271	193	193
Number of banks	30	30	30	30
m1	-1.777*	-1.785*	-1.438	-1.431
m2	0.513	0.521	0.483	0.476
Hansen	20.59	23.29	23.97	23.53

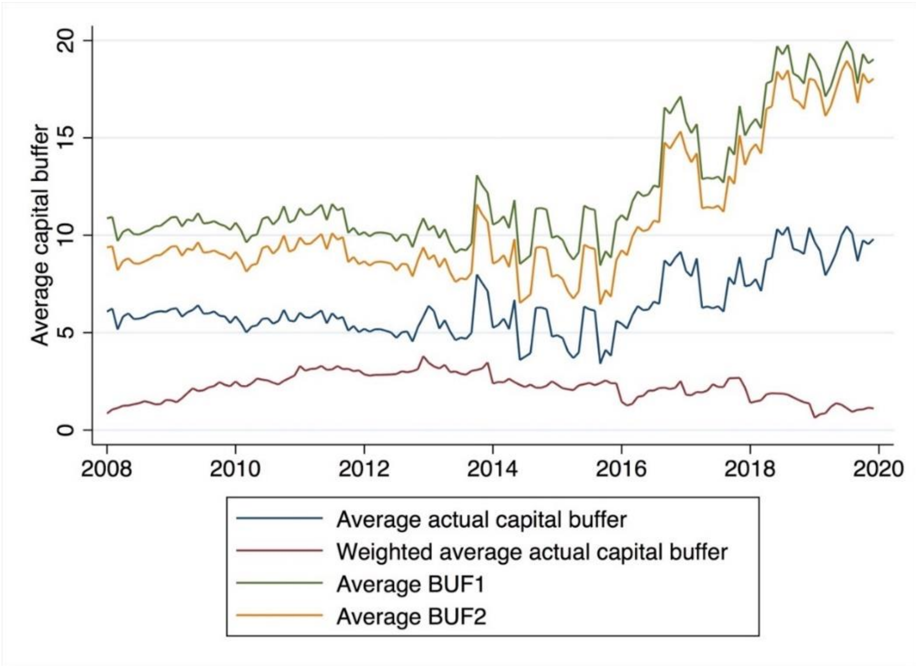
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figure 1: South Africa's risk measure (EMBI+ spread)



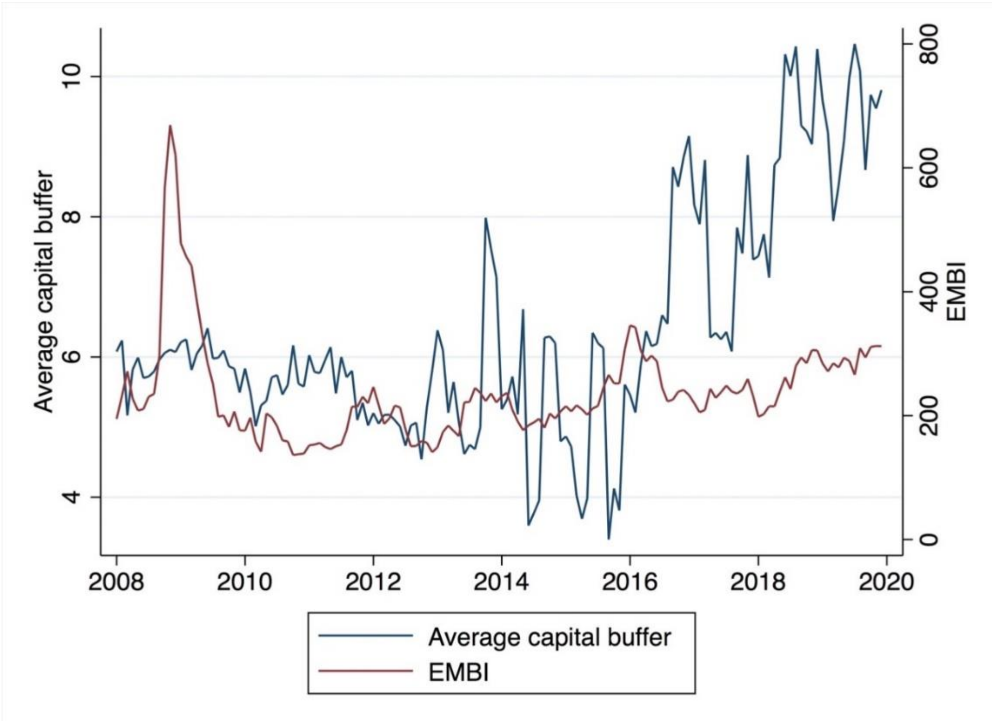
Source: JP Morgan

Figure 2: Actual versus inferred capital buffers



Note: BUF1 is defined as the difference between the bank's total capital and the 8% minimum requirement. BUF2 is defined as the difference between BUF1 and the Pillar 2A capital requirement. The weighted average is weighted by bank assets. Source: SARB, authors' own calculations.

Figure 3: Capital buffers and the EMBI



Source: SARB, authors' own calculations.

Appendix

Variable	Definition	Source
BUF	Actual capital buffer = surplus capital held by bank in excess of requirement	South African Prudential Authority
BUF1	Proxy for capital buffer = bank total capital ratio – 8% minimum requirement	Calculated by authors based on South African Prudential Authority data
BUF2	Proxy for capital buffer = BUF1 – Pillar2A requirement	Calculated by authors based on South African Prudential Authority data
EMBI	JP Morgan Emerging Market Bond Index spread	Bloomberg
EMBI_DOM EMBI_INT	EMBI decomposition into domestic and international factors	Soobyah and Steenkamp (2020)
INDUSTRY_ROE	Return on equity	South African Reserve Bank (Quarterly Bulletin)
SIZE	Total bank assets, log	South African Reserve Bank (BA900)
LOANS	Total loans over total assets	South African Reserve Bank (BA900)
NPL	Ratio of non-performing loans to total loans	South African Reserve Bank (BA900)
GOVDEBT	Gross government debt as a percentage of GDP	South African Reserve Bank (Quarterly Bulletin)
GRDEV1	Deviation of annual GDP growth from potential growth (current estimate)	Calculated by authors based on South African Reserve Bank data
GRDEV2	Deviation of annual GDP growth from potential growth (one year ahead estimate)	Calculated by authors based on South African Reserve Bank data
SYSIMP	Systemically important bank, indicator (=1 for Absa, Capitec, FirstRand, Investec, Nedbank and Standard Bank)	Calculated by authors