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Exploring causal interactions between macroprudential policy and financial cycles in South Africa

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ABSTRACT

This study investigated the causal interactions between macroprudential policy, measured by the Macroprudential Policy Index (MPI), and financial cycles represented by the Aggregate Financial Cycle (AFC) and the Credit and Asset Prices Financial Cycle (CAFC) in South Africa from 1970q1 to 2023q2. Additionally, the study explored the effects of macroprudential policy during different phases of financial cycles. Using the time-varying Granger-causality model, the study found that the MPI Granger-caused financial cycles during the 2003/07 credit boom in South Africa, while the AFC and CAFC Granger-caused macroprudential policy during the Covid-19-induced collapse of financial markets. The results suggest that macroprudential policy is employed more proactively during financial booms and more reactively during financial busts in South Africa. The Markov switching dynamic regression model used to assess the MPI's effects revealed that macroprudential policy's effectiveness is stronger during financial busts and weaker during financial booms in South Africa. This is because financial institutions in South Africa tend to resist stricter regulations during boom phases due to heightened optimism about future prospects. Conversely, they are more receptive to stimulatory interventions during bust phases. Based on these findings, it is recommended that the South African Reserve Bank and the Prudential Authority use macroprudential policy more assertively during financial booms to enhance its effectiveness. This could involve setting more stringent parameters upon activating macroprudential policy tools or complementing macroprudential policy with monetary policy during financial booms.

Introduction

The nexus between macroprudential policy and financial cycles is fundamental to ensuring financial stability. Financial cycles, characterized by periodic deviations in financial market behaviour from its long-term trend, serve a dual role. They encompass complete cycles of booms and busts occurring between episodes of financial distress, providing early signals of impending financial crises to macroprudential authorities (Claessens et al., 2011; Drehmann et al., 2012; Borio, 2014; Oman, 2019). Additionally, the tendency of financial cycles to amplify, propagate, and precipitate deep recessions represents a significant source of systemic risk monitored by macroprudential policy authorities (Borio et al., 2020; Das et al., 2022). Conversely, macroprudential policy employs prudential instruments to mitigate systemic risk, reduce the likelihood of financial crises, and bolster the soundness and resilience of the overall financial system (Galati & Moessner, 2018). Given that macroprudential policy aims to mitigate systemic risk and financial cycles are a primary source of such risk, this policy is crucial for monitoring financial cycle developments. Central banks and supervisory entities such as the Bank for International Settlements (BIS) and the International Monetary Fund (IMF) emphasize that the operational target of macroprudential policy should be to stabilize and smooth out financial cycles (Kockerols, 2019). Understanding the interdependence between macroprudential policy and financial cycles is therefore imperative. This comprehension carries profound implications for effectively formulating and implementing macroprudential policy to achieve financial stability. Accordingly, the primary aim of this study is to examine the causal relationship between macroprudential policy and financial cycles in South Africa, and to assess the impact of macroprudential policy on financial cycles in the country.

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The primary reason for focusing on South Africa is that financial cycles have a substantial influence on the implementation of macroprudential policy in the country. This underscores the necessity to understand the interactions between these cycles and macroprudential policy within South Africa. The South African Reserve Bank (SARB) and the Prudential Authority (PA), which are the main bodies responsible for the formulation and implementation of macroprudential policy in the country, state that to achieve financial stability at the system-wide level, they aim to utilize macroprudential policy to stabilize and smooth out financial cycles (SARB, 2024). In South Africa, the foundation for a macroprudential policy framework was laid in 2013 by the enactment of the Financial Sector Regulation Act. Subsequent institutional restructuring in 2017, which officially endorsed the Financial Sector Regulation Act, conferred the financial stability mandate and formulation of macroprudential policy measures to the South African Reserve Bank. Additionally, it established the Prudential Authority to oversee macroprudential policy implementation and endeavoured to promote coordination and collaboration among various institutions, notably by establishing the Financial System Council of Regulators. In this macroprudential policy framework in South Africa, macroprudential policy targets to limit excessive growth in credit and asset prices. These variables, i.e., credit and asset prices, are the most important ingredients in the composition of financial cycles in South Africa (*see* Borio, 2014; Farrell and Kemp, 2020). Therefore, by changing these variables' behaviour, macroprudential policy can affect financial cycle developments. At the same time, the SARB and PA regularly conduct stress tests on financial cycles to determine if there are risks in the financial system and to decide when and how they deploy macroprudential policy (Kisten, 2021). For instance, if financial cycles are in their expansionary phase, it means credit and asset markets are overheating, which can lead to policymakers applying brakes on the growth of credit and asset prices through tight macroprudential policy. Thus, it can also be expected that financial cycle developments can affect changes in macroprudential policy in South Africa.

The second reason the study focuses on South Africa is that the vast majority of studies on the effectiveness of macroprudential policy concentrate on the cross-country level and ignore the single-country context. These studies include, among others, Kim and Mehrotra (2018), Boar et al. (2017), Richter et al. (2018), Lee et al. (2016), Cerruti et al. (2017), Matos et al. (2023), Akdogan (2020), Kang et al. (2017), Avdjiev et al. (2014), and Alam et al. (2019). This focus on the cross-country level has a downside: it tends to generalize findings from different countries to individual cases and therefore ignores the uniqueness of macroprudential policy frameworks and financial sectors in each country. For instance, unlike other emerging market economies, which mostly prefer the use of borrower-based prudential tools such as the loan-to-value ratio cap (LTV cap), South Africa prefers the use of market-based tools such as the countercyclical capital buffer (CCyB), capital conservation buffer (CCB), and capital requirements (CAP) (Molise, 2020). Compared to the macroprudential policy frameworks of advanced economies, the framework in South Africa is still in its infancy, as it was recently formalized in 2017 with the adoption of the Financial Sector Regulation Act. Moreover, while South Africa is among the most resilient of emerging market economies, it is still dominated by the behaviour of a few large supply-side players, namely, the banking sector, the insurance sector, and pension funds (Goodwin, 2017). This means the behaviour of a few players tends to set the tone for the financial system in South Africa. A typical example of this tendency is the only major domestic financial crisis that occurred in South Africa in 2002 when major banks collapsed, affecting the entire South African economy and leading to the transition to flexible inflation targeting in the country. Accordingly, focusing on a country-specific case, such as South Africa, can reveal findings that would otherwise be undetected in cross-country approaches. Nevertheless, important lessons could be learned from cross-country studies. These studies often find that macroprudential policy has a strong smoothing effect on the growth of credit and asset prices. In some cases, macroprudential policy has a relocating effect, where tightening macroprudential policy in one jurisdiction shifts financial activities to another country with less stringent policies.

The third reason for focusing on South Africa is the scarcity of literature on the effectiveness of macroprudential policy in the country. Studies examining this topic, such as Patroba (2017), Liu and Molise (2019), Molise (2020), Hollander et al. (2019), and Hollander (2017), rarely include financial cycles as dependent variables and do not account for the cyclical properties of the financial variables they consider. These studies often find that macroprudential policy performs well in mitigating financial shocks but needs to be complemented by monetary policy, especially during a crisis period. On the other hand, studies focusing on financial cycles, such as Nyati et al. (2020), Pahla (2019), Magubane (2024), Farrell and Kemp (2020), De Wet and Botha (2022), and Bosch and Koch (2020), concentrate on identifying and characterizing financial cycles without examining the determinants of these cycles, such as policy variables. These gaps in the literature underscores the need for a study like the present one. The problem at hand is understanding how macroprudential policy and financial cycles interact. Hence, this study endeavoured to explore the causal interactions between macroprudential policy and financial cycles in South Africa and to assess the impact of macroprudential policy on these cycles. To address these objectives, the following econometric models were employed: a time-varying parameter model, namely, the Time-Varying Granger Causality (TVGC) model, to assess the causal relationship between macroprudential policy and financial cycles in South Africa; and a regime-switching model, the Markov Switching Dynamic Regression (MSDR), to investigate the effects of macroprudential policy during different phases of financial cycles in South Africa. The study's sample period spans from the first quarter of 1970 to the second quarter of 2023, providing a long enough period to capture changes in macroprudential policy and financial cycle variables in South Africa. The research questions of the study are: Is there a causal relationship between macroprudential policy and financial cycles in South Africa? Is the macroprudential policy and financial cycle causal link time-varying or time-invariant in South Africa? How weak or strong is the effectiveness of macroprudential policy during different phases of financial cycles in South Africa? These questions are crucial for the effective formulation and implementation of macroprudential policy.

The rest of the study is organized as follows. This current section introduces the study. Section two provides the literature review. Section three presents the data and econometric techniques used in the study. Section four presents the results of the study. Section five provides policy recommendations and concludes the study.

Literature Review

The notion of the effectiveness of macroprudential policy gained traction in the aftermath of the global financial crisis in 2007/09. How weak or strong is the impact of macroprudential policy on financial variables is crucial to formulating and implementing this policy. Accordingly, this literature review aims to briefly highlight what we have learned so far about the effectiveness of macroprudential policies.

Most studies on this subject are conducted at the cross-country level using panel approaches. Fewer contributions focus on a single-country context like the present study. Studies focusing on emerging market economies as a group include Bruno et al. (2017); Cerruti et al. (2017; and Lim et al. (2011); Shim et al. (2013), among others. These studies found that macroprudential policy tools such as the loan-to-value-ratio cap (LTV cap), the debt-to-income-ratio (DTI) ceilings on credit growth, and reserve requirements (RR) were successful in smoothing out credit, leverage, and property prices fluctuations in emerging market economies. However, the effectiveness of macroprudential policy differs according to which instrument is considered. In particular, the reserve requirements have a positive impact solely on property prices. Whereas LTV cap and DTI ceilings negatively affected both credit and house prices. This implies that in the context of emerging markets, LTV caps and DTI ceilings are useful tools for monitoring the housing and credit markets compared to capital requirements, which can only influence the housing market. Moreover, the LTV caps and the DTI ceilings can be used to smooth out financial cycle booms, given their negative effect, whereas RR can be useful as accommodative tools during a financial cycle bust.

Some studies have concentrated on the Latin American economies. They include Montoro and Rojas-Suarez (2012); Tovar et al. (2012); Rossini et al. (2019), and Cordella et al. (2014). A common finding in these studies is that dynamic provisions and capital requirements have an expansionary effect on credit and liquidity. This highlights that in these economies, macroprudential policy tools have been used to revamp economies during periods of economic turmoil. For example, countries such as Brazil, Colombia, and Peru resorted to easing capital requirements in the aftermath of Lehman Brothers' bankruptcy to attract more capital flows. They resorted to capital requirements because if they raised interest rates, they would attract more capital flows than required and risk pushing inflation too low (Brei and Moreno, 2019). Cordella et al. (2014) noted that capital requirements outperformed monetary policy rates in restoring order to the financial system following the Lehman Brother bankruptcy in Latin America. Some studies found a negative effect. For instance, Perez & Vega (2014) found that capital requirement and dynamic provisions have a contractionary effect on credit when it is excessively growing. These results highlight that in Latin America, macroprudential policy has a dual role: to restore the economy following a financial disruption and (ii) to prevent the emergency of financial risk associated with excessive credit growth.

Bruno et al. (2016); Kim & Mehrotra (2017); Jiang et al. (2019) have highlighted the success of macroprudential in maintaining financial stability in the Asia economies. These economies are considered to be the most frequent users of macroprudential policies. This is because economies such as China pursue exchange rate targeting. As a result, they heavily rely on foreign exchange limits, a macroprudential policy tool (Kim and Mehrotra, 2017). Bruno et al. (2016) found that macroprudential policy tools in Asia-Pacific economies have successfully brought down bank and bond flows to desired levels. Furthermore, they found that these tools were more robust when complemented with monetary policy rates. Kim and Mehrotra (2017) found that tightening macroprudential policy tools shrinks credit. In both Bruno et al. (2016) and Kim and Mehrotra (2017), an aggregate index of macroprudential policy tools was used instead of individual policy tools. Using an aggregate index, these studies demonstrated more generalized effects of macroprudential policy in the context of Asia. This leaves the question of how individual macroprudential policy tools perform in Asia open-ended.

Some studies focused on advanced economies. For instance, Turner (2016); Zhang et al. (2018); Agur & Demertzis (2018); Boar et al. (2018), and Richter et al. (2018), amongst others. These studies found that macroprudential policy in advanced economies has effectively managed financial stability and vulnerabilities. For instance, Neir and Kang (2014) found that tightening the LTV cap lowers credit growth by raising the cost of obtaining credit. By increasing the cost of credit, macroprudential policy lowers bank risk-taking, lowering credit availability and reducing the build-up of financial vulnerabilities. Kuttner & Shim (2012) found that tightening macroprudential policy tools can result in lower asset prices by discouraging the demand for housing as the cost of credit rises. These findings further imply that macroprudential policy has been a useful tool in managing the build-up of financial imbalances that build up over time, such as asset price bubbles and excessive credit growth.

Given that most studies on macroprudential policy and financial variables are cross-country studies, there is a scarcity of studies focusing on a specific case such as South Africa. In South Africa these studies include Patroba et al. (2017), Liu and Molise (2019), Liu and Molise (2020), Selialia et al. (2010), Molise (2020), Dlamini and Ngalawa (2022), Batsirai et al. (2018), Hollander and Havemann (2021), Hollander (2017). These studies use the dynamic stochastic general equilibrium (DSGE) framework to study the effectiveness of macroprudential policy, the welfare effects of the policy, and the interaction of macroprudential policy with monetary policy in South Africa. The often find that a policy framework that features a combination of monetary and macroprudential policy rules delivers a more stable economic system in terms of price and financial stability.

However, a policy framework that explicitly augments monetary policy rules to account for financial developments, combined with a typical macroprudential policy rule, leads to ambiguity about the stability of the economic system. This framework is better at attenuating the effects of financial shocks but at a much higher cost of price instability (See Liu and Molise, 2020). When the economy follows a macroprudential policy rule only, macroprudential policy performs well in mitigating adverse financial and real sector fluctuations if they originated from a financial shock. Lastly, these results suggest that macroprudential policy tends to improve economic welfare by decreasing the volatility of loan uptake and output growth (*see* Patroba et al., 2017). The use of the DSGE framework in these studies implies that their estimates are based on analyzing occasional shocks in an otherwise stable-steady state environment. The use of the TVGC and MSDR in this present study instead focuses on single form reduced regressions. It avoids having to place theoretically sound but competing restrictions within a system of equations.

Research and Methodology

This section presents the data and methodology used to accomplish the study's objectives.

Definitions and data

Macroprudential policy is commonly referred to as the use of prudential tools to enhance the resilience, soundness, and stability of a country's financial system, as well as the use of prudential tools to reduce the likelihood of the occurrence of episodes of financial crisis (Galati & Moessner 2018). Following this definition, the macroprudential policy index (MPI) collected from the International Monetary Fund (IMF) integrated macroprudential policy survey (iMaPP) is used in this study to represent macroprudential policy in South Africa. The MPI is chosen because it captures the number of times macroprudential policy tools are used within a specific timeframe. It also captures the direction (i.e., tightening or easing) of the use of macroprudential policy tools. In its original form, the MPI is a dummy variable. The study follows the rolling window procedure favoured by Kim and Mehrotra (2017) to transform the MPI into a time-series. Accordingly, when macroprudential policy tightening occurs, the index increases by one unit regardless of the type of tool used, or its intensity. Likewise, when macroprudential easing occurs, the index decreases by one unit regardless of the type of tool used or its intensity. The new value of the index is maintained until another policy action is taken. If two tightening measures occur during the same quarter and none in the direction of loosening, the index level increases by two units during the same quarter. Other scholars, such as Bruno et al. (2016) and Zdzienicka et al. (2015) have favoured this approach of accumulating the index. This study's version of the MPI is different from that of Cerruti et al. (2017), who capture the introduction of or removal of various policy measures in their index, but they do not take into consideration changes in the levels of individual policy tools over time.

Despite their popularity, financial cycles are not properly defined in the literature. The definition of a financial cycles hinges on what variables are used and which econometric is used to estimate financial cycles. Therefore, this study focuses on two financial cycles. The first is the credit and asset prices financial cycle (CAFC). This cycle comprises credit measures and asset price measures. It stems from the works of Claessen et al. (2011), Drehman et al. (2012), Gorton & Ordonez (2017), Stremmel (2015), Stremmel & Zsamboki (2015), and Oman (2019). These studies demonstrated that the movement of credit and asset price measures corresponded with changes in financial conditions in the financial system. As a result, these measures are considered to be the best proxies of the CAFC. By analyzing credit and asset price measures, Magubane (2024) and Farrel and Kemp (2017) found that based on the correlation of these variables, there is a strong co-movement of credit and asset prices underscoring the existence of the CAFC in South Africa. The second financial cycle considered in the study is the aggregate financial cycle (AFC). The AFC differs from the CAFC by including more variables representing other financial system sectors besides credit and asset prices. This is because, for economies such as South Africa, the financial system has multiple segments that credit and asset price measures may not fully capture. De Wet and Botha (2022) were the first to estimate that the AFC is South Africa and found that financial cycles in South Africa cannot be restricted to measures of three sectors.

The following variables were used to construct the CAFC. First, the credit-to-GDP ratio and the credit-to-GDP gap, both of which were collected from the Bank of International Settlements, were used to represent the credit sector. Second, the overall share price index collected from the Organization for Economic Cooperation and Development (OECD) was used to capture the equity market. Third, the house price index, price-to-rent ratio, and price-to-income ratio collected from the OECD were used to capture the housing sector. In addition to these variables, the following variables were used to construct the AFC. First, the long-term interest rates, short-interest rates, and money supply measures were used to represent the monetary sector. Specifically, broad money supply (M3) and narrow money supply (M1) were used. M3, M1, and interest rates were collected from the OECD. In addition to these variables, the yield curve, calculated in this study as the difference between long-term and short-term interest rates, was employed. Second, the real effective exchange rate collected from the OECD represents the foreign exchange market. Net private capital flows were used to capture international financial conditions. Third, to capture balance sheet conditions, the following variables were used: (i) bank assets, (ii) bank liabilities, and (iii) the financial sector balance sheet assets and accumulation account (FSBAA). All three variables were collected from the SARB. To aggregate financial variables into financial cycles, the variables mentioned above were transformed into comparable units of measurement by standardizing them with their mean and standard deviation coefficients.

The first step in deriving the financial cycles is to combine financial indicators and then extract the common components which represent financial indexes. This study employs the principal component (PCA) to construct financial cycles. The chief advantage of PCA over spectral density models and structural time models is that it reduces the curse of dimensionality in the dataset and only focuses on the most relevant features describing the co-movement of variables (Stock & Watson, 2010). Moreover, unlike dynamic factor modeling, the PCA is not fragile to handling large datasets. And its correlation parameters vary over time. The study is interested in the financial variables' covariances, variances, and correlation. The information in these variances, covariances, and correlations is crucial to formulating the financial cycle. The first step is to look for a linear function $\alpha_1'x$ of the elements of $x = 3$ financial indicators having maximum variance. α_1 is a vector of p variables $\alpha_{11}, \alpha_{12}, \ldots, \alpha_{1p}$, and $'$ denotes transpose, such that:

$$a_1'x = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1p}x_p = \sum_{j=1}^{p} a_{1j}x_j. \quad (1)$$

Afterward, one can look for a linear function. $\alpha_2'x,$ uncorrelated with $\alpha_1'x,$ and having a maximum variance, such that at the kth stage, a linear function of $\alpha_k'x$ with maximum variance exists and is uncorrelated with $\alpha_1'x, a_2'x \ldots, \alpha_{k-1}x$. The kth derived variable, a_kx is one of the derived principal components (P.C.s) explaining variations in the three financial variables. There can be an m PCs; however, for the purpose of this study, we focus on the PC. with eigenvalues greater than one to extract financial cycles from financial indicators. The derived PCs will represent financial cycle indexes as in Brave & Butters (2011), which could then be used to construct the financial cycles.

This study uses the deviation cycles approach of Lucas (1976) to construct financial cycle transform PCs to financial cycles. This approach involves detrending financial indexes by separating them into a cyclical and a trend component. Voluminous filtering techniques exist in the literature, each with its own attributes. The study employs, for comparability purposes, the Hodrick-Prescott filter (HP Filter), which is widely used in the financial cycles literature (Adarov, 2017; Drehmann & Yetman, 2018; Kuper & Lestano, 2016, Bosch and Koch, 2020). The HP Filter was chosen since it is the preferred method by the Bank of International Settlements for estimating financial cycles. It performs better than other techniques is predicting financial expansions and contractions (Drehmann & Yetman, 2018). And it has yielded reliable financial cycles in the case of South Africa (see Bosch and Koch, 2020).

For the purposes of the study, assume that a financial index is:

$$y_t = c_t + \alpha_t t = 1,2 \ldots, T \quad (2)$$

Where y_t is the observed financial index, c_t and α_t is the trend component and cyclical component of the observed series, respectively. It is, moreover, assumed that the secular component is difference stationary, whereas the cyclical component is stationary at levels. An estimate of the trend is obtained by minimizing equation (4)

$$\min_{[g_t]_{t=1}^{T}} \sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=1}^{T} [(g_{t+1} - g_t) - (g_{t-1} - g)]^2 \quad (3)$$

Where c_t and g_t are the cyclical and trend components of y_t respectively. λ is the penalty parameter, which is closely related to the smoothness of the estimated trend. The penalty parameter is set to $\lambda = 400000$ for quarterly financial cycles, as Drehmann et al. (2012) and Bosch and Koch (2020) suggested. When the trend component is eliminated, then equation 3 can be written as a financial cycle equation as in:

$$fc_t = c_t \quad (4)$$

Time-varying Granger causality

The study uses the time-varying Granger causality model to investigate the relationship between macroprudential policy and financial cycles in South Africa. The chief advantage of the TVGC, amongst other models of interactions between macroeconomic variables, is that the TVGC model is not specific to a particular structural model but depends solely on the stochastic nature of variables (Baum et al., 2022). This means that no contradictory theoretical assumptions are required to identify the model. Testing for Granger causality typically involves testing joint-zero restrictions on blocks of parameters in reduced-form vector autoregression (VAR) models. Moreover, the TVGC allows for stability the stability of relationships over time, whereas static models are fragile when other time frames are considered. The TVGC has yielded reliable results in its application by Baum et al. (2022) (Output and Oil shocks); Lu et al. (2014) (Output and oil shocks); Cepni et al. (2023) (Covid-19); Ren et al. (2023) (Green energy) Shi et al. (2020) (Money and income).

The starting point of the TVGC is the bivariate VAR (m) model given by

$$y_{1t} = \emptyset_0^{(1)} + \sum_{k=1}^{m} \emptyset_{1k}^{(1)} y_{1t-k} + \sum_{k=1}^{m} \emptyset_{2k}^{(1)} y_{2t-k} + \epsilon_{1t} \quad (5)$$

$$y_{2t} = \emptyset_0^{(2)} + \sum_{k=1}^{m} \emptyset_{1k}^{(2)} y_{1t-k} + \sum_{k=1}^{m} \emptyset_{2k}^{2} y_{2t-k} + \epsilon_{2t} \quad (6)$$

Where $y_{1t} = AFC \text{ or } CAFC$, $y_{2t} = MPI$, and ϵ_{1t} and ϵ_{2t} are serially uncorrelated but possibly heteroskedastic error terms. Variable y_1 is said to Granger cause variable y_2 if the past values of y_1 have a predictive power of current values of y_2 conditional on the past behavior of y_2. Formally, the null hypothesis no Granger causality from y_1 to y_2 requires testing the joint significance of $\emptyset_{1k}^{(2)}(k = 1 \dots, m)$ with a Wald test. To illustrate, recast equations (5) and (6) into a matric notation. Let $y_t = [y_{1t} \;\; y_{2t}]'$, $x_t = [1 \;\; y'_{t-1} \;\; y'_{t-2} \;\; y'_{t-m}]'$, and $\Pi_{2x(2m+1)} = [\Phi_0 \;\; \Phi_1 \;\; \Phi_m]$ with $\Phi_0 = \left[\Phi_0^{(1)} \; \Phi_0^{(2)}\right]'$ and

$\Phi_k = \begin{bmatrix} \Phi_{1k}^{(1)} & \Phi_{2k}^{(1)} \\ \Phi_{1k}^{(2)} & \Phi_{2k}^{(2)} \end{bmatrix}$ for $k = 1, \dots, m$.

The bivariate VAR(m) can then be written very simply as

$$y_t = \Pi x_t + \epsilon_t \tag{7}$$

The null hypothesis of no Granger causality from variable y_1 to y_t is $R_{1\to 2}\pi = 0$, where $R_{1\to 2}$ is the coefficient restriction matrix that selects all coefficients on lagged y_1 in the y_2 equation and $\pi = vec(\Pi)$ using row vector. The heteroskedastic consistent Wald statistic of the null hypothesis is denoted by $W_{1\to 2}$ and is defined as

$$W_{1\to 2} = T(R_{1\to 2}\hat{\pi})'\left\{R_{1\to 2}(\hat{V}^{-1}\hat{\Sigma}\;\hat{V}\hat{V}^{-1})R'_{1\to 2}\right\}^{-1}(R_{1\to 2}\hat{\pi}) \tag{8}$$

Where $\hat{V} = I_n \otimes \hat{Q}$ and $\hat{Q} = T^{-1}\Sigma_t x_t x_t'$, and $\hat{\Sigma}_t = \hat{\xi}_t \hat{\xi}_t'$ with $\hat{\xi}_t = \hat{\epsilon}_t \otimes x_t$, and $\hat{\epsilon}_t = y_t - \hat{\Pi}\, x_t$.

Recursive estimation methods are required to allow for time variation in Granger causal orderings and date stamp changes' timing. The recursive algorithms for testing for time-varying Granger causality developed by Shi et al. (2018) and Shi et al. (2020) are employed in the study. A sequence of test statistics of Granger causality for each time period in the entire sample must be computed, and this information must be used for inference. Three algorithms generate a sequence of test statistics, namely, the forward expanding window (FE), the rolling window (RO), and the recursive evolving window (RE). Full mathematical derivations of these algorithms are presented in Shi et al. (2018) and Baum et al. (2022). In this study, we provide a narrative explanation of their work.

The forward window uses a fixed starting point for the sample data and then incrementally adds one observation at a time to the sample, making the estimation window grow larger with each step. It's like always starting from the beginning of the data and extending the window forward. Like the forward window, the recursive window uses a fixed starting point but continuously adds more data as time progresses. The distinction is often nuanced, with "recursive" emphasizing the iterative re-estimation as new observations become available. The rolling window uses a fixed sample size. As a new observation is added, the oldest observation is dropped; thus, the sample "rolls" over time. It provides a consistent sample size over the estimation period and allows for analyzing how a particular relationship might change over time.

Markov Switching Dynamic Regression

Financial cycles have two phases. Expansions and contractions. They transition between these two phases. Accordingly, the MSDR is used in this study to examine the effects of macroprudential policy on the different phases of financial cycles. The model is adopted here because it provides attractive transition features over a set of finite states (Buthelezi, 2023). It allows the transition process to evolve differently in each state. The transition occurs according to a Markov process. The time of transition from one state to another and the duration between changes in the state are random (Hansen, 2000). The MSDR has been applied by Nyati et al. (2020) and de Wet and Botha (2022) to study the features of financial cycles in South Africa. Assume a financial cycle can be denoted by y_t where $t = 1,2 \dots, T$ is characterized by two states, then a financial cycle can be presented in equations (9) and equation (10) as:

$$State1: y_t = \mu_1 + \epsilon_t \tag{9}$$

$$State2: y_t = \mu_2 + \epsilon_t \tag{10}$$

Where μ_1 and μ_2 are state-dependent means in $State1$ and $State2$ respectively, and ϵ_t is a white noise error with variance σ^2. The two-state model shifts in the mean term. If the timing of switches is known, the above model can be expressed as:

$$y_t = s_t\mu_1 + (1 - s_t)\mu_2 + \epsilon_t \tag{11}$$

The subscript s_t is the transition process is in state 1 and 0 otherwise. The Markov switching regression model allow the parameters to vary over the unobserved states. The MSDR model with state-dependent mean is reflected in equation (12):

$$y_t = \mu_{s_t} + \epsilon_t \tag{12}$$

Where μ_{s_t} is the parameter of interest; $\mu_{s_t} = \mu_1$ when $s_t = 1$ and $\mu_{s_t} = \mu_2$ when $s_t = 2$. The probabilities of being in each state can be estimated with transition probabilities (Buthelezi, 2023). One-step transition probabilities are given by $Ps_t, s_t + 1$. For a two-state process, p_{11} denotes the probability of stating in state 1 in the next period, given that the process is in state 1 in the current period. p_{22} denotes the probability of staying in state 2 in the next period, given the process is in state 2 in the current period. The transition probabilities from one state to another can be presented in matrix form:

$$P = \begin{pmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{pmatrix} \tag{13}$$

Then, the financial cycle depicted in equation (5) can be extended to the MSDR with a macroprudential policy component, the MPI, as reflected in equation 10:

$$\begin{bmatrix} \beta_{11} & \beta_{12}mpi_{t-1} & \beta_{13}mpi_t & \beta_{14}fc_t & \epsilon_{1,t} \\ \beta_{21} & \beta_{22}mpi_{t-1} & \beta_{23}mpi_t & \beta_{24}fc_t & \epsilon_{2,t} \end{bmatrix} \quad (14)$$

Findings and Discussion

This section presents the results of the study. It begins by discussing the properties of financial cycles and macroprudential policy. Thereafter, the main findings of the study are presented.

Data properties

This section presents the properties of financial cycles and macroprudential policy in South Africa. Table 1 below provides the descriptive statistics. The mean parameters for AFC, CAFC, and MPI are 0.01, 0.03, and 2.16, respectively. The magnitude of the mean of the CAFC is larger than the magnitude of the mean of the AFC. This finding is expected since the CAFC represents a financial cycle in the credit, housing, and equity sectors. These are the largest financial sectors in the South African financial system (Goodwin et al., 2017; Allen et al., 2011). The mean of the MPI suggests that, on average, macroprudential is used 2.16 times per quarter in South Africa.

Table 1: Properties of financial cycles and macroprudential policy

	AFC	**CAFC**	**MPI**
Mean	0,01	0,03	2,16
Median	0,01	0,01	1,00
Maximum	0,34	0,15	14,00
Minimum	-0,31	-0,11	0,00
Std. Dev.	0,12	0,05	3,61
Skewness	0,19	0,48	2,29
Kurtosis	4,48	3,71	7,03
Jarque-Bera	11,92	7,21	188,65
Probability	0,003	0,027	0,000

Source: own estimates.

Notes: AFC refers to the aggregate financial cycle; CAFC refers to the credit and asset prices financial cycle; and MPI refers to the macroprudential policy index.

The standard deviation parameters are 0.12, 0.05, and 3.61 for the AFC, CAFC, and MPI, respectively. The magnitude of the standard deviations for AFC and CAFC are less than one, indicating more stable financial cycles or financial system. However, the Aggregate Financial Cycle is more volatile than the Credit and Assets Prices Financial Cycle. Some factors contributing to an unstable AFC include high household and government debt levels, corruption in state-owned entities, steep price levels, and insufficient and unreliable electricity supply (Mothibi and Mncayi, 2019; Hollander and Van Lill, 2019). These factors cause the South African financial system to be fragile and susceptible to adverse shocks such changes in monetary policy in the United States, loadshedding, and worrying repayment rates of debt. The CAFC is more stable because the sectors represented by this cycle, are the direct target of macroprudential policy in South Africa. Their behaviour and conduct are closely monitored by macroprudential policy authorities. Hence, the CAFC is more stable when compared to the AFC. The standard deviation for the MPI is greater than three, indicating greater variations in macroprudential policy during the sample period. This is consistent with the notion that emerging markets economies such as South Africa use macroprudential policy more frequently than advanced economies (Cerruti et al., 2016; Galati & Moessner, 2018). This is because the advanced economies tend to be more averse to macroprudential policy variability because of the costs of changing macroprudential policies, whereas emerging markets such as South Africa rely on macroprudential policies to insulate themselves from unwanted financial spillovers from the advanced economies (Ghosh and Kumar, 2022; Agenor and Pereria da Silva, 2018)

The skewness parameters for the AFC, CAFC, and MPI, and 0.19, 0.48, and 2.29, respectively. The positive sign of these parameters suggests that financial cycles and macroprudential policy variables are positively skewed in South Africa. The MPI skewness parameter is far from zero suggesting that the MPI follows an abnormal distribution. In contrast, the skewness parameters for the AFC and CAFC are closer to zero, indicating that these variables are much closer to a normal distribution. Likewise, the Kurtosis parameters 4.48 and 3.71 for AFC and CAFC are close to three, which is the accepted Kurtosis value for a normal distribution. The Kurtosis value for the MPI is 7.03. A Jaque-Bera test was conducted to test the null hypothesis that the Kurtosis parameters are zero against the alternative hypothesis that these parameters are not equal to zero. The probability parameters indicate that the null hypothesis is rejected. Thus, the parameters of the Kurtosis are accepted as true for the AFC, CAFC, and MPI.

Figure 1 below plots the movements of financial cycles and macroprudential policy over time. As expected, episodes of expansions and contractions characterize financial cycles. The longest expansion occurred during 2003-2007 when economic growth was booming, inflation was stable, and the country had a major credit boom. The longest contraction occurred from the middle of the 1980s until the early 2000s. The 1980s corresponded with the imposition of economic sanctions on South Africa by the Western economies in order to force the then-current government to abandon segregation policies. There was also rising pressure from struggle parties as they began to target for bombing, mines, and other strategic economic buildings. Together, these events reduced the financial status of South Africa. This is why the ratio of credit to GDP of South Africa declined from 101 percent in the late 1970s to 78% in the early 1980s and 89% in the late 1990s (Bank of International Settlements, 2024). Likewise, the growth rate of house prices was above 100% in the 1970s but was around 70% for most part of the 1980s and 1990s. International challenges also emanated from the Asian financial crisis in the late 1980s and the collapse of the Dot.com bubble between 2000 and 2002 which affected South Africa. Amongst other things, the events mentioned above contributed to the longest contraction in financial cycles in South Africa.

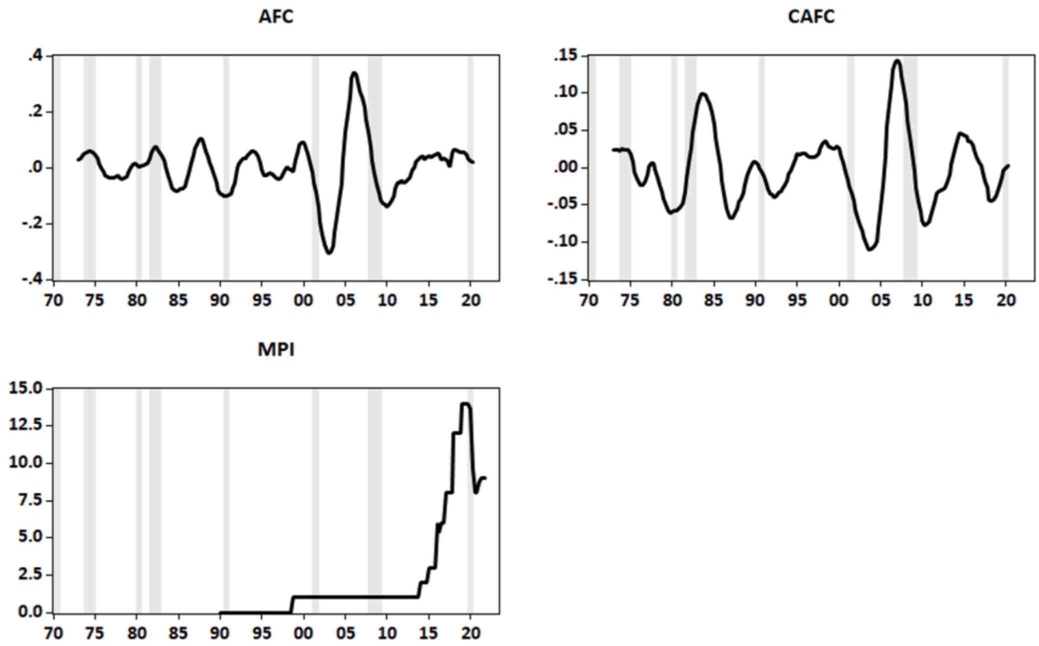

Figure 1: Evolution of financial cycles and macroprudential policy; *Source: Own estimates*

Figure 1 shows financial cycle peaks that occurred at or around a financial crisis episode. The figure highlights several adverse events that occurred during the time of these peaks. The events include the first oil price shocks (1973), the second oil price shocks (1979), Black Monday (1988), the Asian financial crisis (1997), the Dotcom bubble bust (2002), the global financial crisis (2007/09), the Euro-debt crisis (2010), and Chinese stock market crash (2016), and the Covid-19 induced financial crisis (2019). This finding underscores that, in the case of South Africa, financial cycles can be used to predict systematic crises and ultimately influence the conduct of macroprudential policy since they are closely associated with episodes of financial upheavals. The MPI movement demonstrates an upward trend, suggesting an increase in the usage of macroprudential policy overtime. The first occurrence where macroprudential policy was used was around the longest financial expansion in South Africa. Concerned with the financial system's stability and aligning itself with Basel standards, the SARB adopted the Basel II framework and began using some of its tools. As effective January 1, 1997, the prudential limits were set for exposure per currency, and the overall foreign currency risk exposure as follows: (a) for the four dealing currencies, namely, United States dollar (USD), South African rand (ZAR), British pound (GBP), and Euro (EUR), the prescribed limit was set to 15% of unimpaired capital of a bank, per currency; (b) for all other currencies, the prescribed exposure limit was restricted to not more than 5% of a bank's unimpaired capital per currency; (c) the limit for the overall foreign exchange risk exposure was set to 30% of a bank's unimpaired capital, using the shorthand method. In addition, no bank was allowed to exceed its intraday overall foreign exchange risk position by more than 5% of the overall limit without prior approval of the Bank of Botswana. The overall foreign exchange risk exposure was set to be greater of the sum of the domestic currency equivalent of all net short or long positions in currencies in which the bank has a position.

The following year, on October 1, 1998, the authorities increased the risk weight for new mortgage loans with an LTV ratio higher than 80%. Then, between 2003-2005 capital adequacy ratios were used three times. Phasing out of Basel II took place around 2014 when Basel II non-compliant capital instruments were phased out due to phasing in of Basel III requirements. Since the phasing in Basel III, the usage of macroprudential policy has increased sharply (see Figure 1). Some of the mostly used instruments recently include the countercyclical capital buffer (CCyB), capital conservation buffer (CCB), and capital requirements (CAP). As announced on April 26, 2013, the CCyB framework was implemented on January 1, 2016. The framework covers all banks. Decisions regarding the CCyB are considered at quarterly FSC meetings and informed by a range of indicators, including the Basel Committee on Banking Supervision credit-to-GDP gap. While the CCyB framework was implemented on January 1, 2016, as announced in D5/2013, subsequent updates regarding the South African capital framework have since been broadly introduced, the latest being through D4/2020. With the transitional phase-in period for CCyB having concluded at the end of 2018, the maximum CCyB, if applied, is 2.5%. The Capital Conservation Buffer (CCB) requirements were published on December 12, 2012, and are phased in evenly at the incremental rate of 0.625% between January 1, 2016, and January 1, 2019, with a target buffer of 2.5%. The regulatory framework for the CCB in South Africa is aligned with the Basel III framework. The Capital Conservation Buffer was raised to 1.25% from 0.625% in 2017. Date: 1/1/2018. The increase in the capital conservation buffer to 1.875% from 1.25% became effective in 2018. Date: 1/1/2019. The increase in the capital conservation buffer to 2.5% from 1.875% became effective in 2019.

Estimating a TVGC and MSDR models requires knowledge of the order of integration of variables. To this end, the study employed the Laybourne (1995) and Elliot, Rothenberg, and Stock (1992) unit root tests. The former test achieves power gains over the standard Dickey and Fuller (1979) testing procedure by applying augmented Dickey-Fuller (ADF) regression to the forward and reverse realizations of time series of interest and testing for the presence of a unit root based on the maximum t-statistic. Hence, this test is commonly referred to as the ADFmax. In turn, Elliot et al. (1992) increased power over the standard Dickey-Fuller approach by applying generalized least-squares to remove the underlying mean or trend in the variable of interest. In this case, the test is often referred to as the DFGLS test. Both the ADFmax and DFGLS test the null hypothesis that the series has a unit root against the alternative hypothesis that the series is stationary. Table 2 below displays the results.

Table 2: Unit roots and stationarity

Variable		**ADFmax**				**DFGLS**			
		Levels		First difference		Levels		First difference	
		P	t-statistic	P	t-statistic	P	t-statistic	p	t-statistic
AFC	AIC	2	-7.434***	4	-5.099***	2	-7.152***	4	-4.901***
	SIC	2	-7.434***	0	3.788***	2	-7.152***	0	-3.684***
	GTS05	2	-7.434****	4	-5.099***	2	-7.152***	3	-4.511***
	GTS010	2	-7.434***	4	-5.099***	2	-7.152***	4	-4.901***
CAFC	AIC	3	-5.635***	3	-5.511***	3	-4.765***	3	-5.526***
	SIC	1	-10.121***	2	-5.107***	2	-6.197**	2	-5.122***
	GTS05	1	-10.121***	2	-5.107***	3	-4.765***	2	-5.122***
	GTS010	2	-7.164***	3	-5.511***	3	-4.765***	3	-5.526***
MPI	AIC	4	-1.214	4	-4.629***	4	-0.902	4	-4.577***
	SIC	4	-1.214	4	-4.629***	4	-0.902	4	-4.577***
	GTS05	4	-1.214	4	-4.629***	4	-0.902	4	-4.577***
	GTS010	4	-1.214	4	-4.629***	4	-0.902	4	-4.577***

Source: own estimates

Notes: *** denotes the p-values at 99% level of significance.

The information criteria put forward by Akaike (1974) and Schwarz (1978), as well as the general-to-specific algorithm developed by Campbell and Perron (1991) and Hall (1994), were used to assess the robustness of the findings presented in Table 2. In Table 2, the significance of the t-statistic implies the rejection of the null hypothesis. According to Table 2, the results reject the null hypothesis for financial cycles at both levels and the first difference. This means financial cycles are stationary at both levels and the first difference. In contrast, the results fail to reject the null hypothesis for the MPI at levels only. At first difference, the null hypothesis is rejected. Thus, the MPI is stationary at first difference. The results suggest that AFC and CAFC are I (0) variables whereas the MPI is an I(1). In order to make the MPI to be stationary and of the same order of integration with other variables, it was first-differenced.

TVGC results

This section presents the results of the TVGC used to investigate the relationship between macroprudential policy and financial cycles in South Africa. The number of lags to be included was selected using the AIC, SC, and H.Q, criteria which suggested lag one as the optimal lag. The first set of results focuses on the entire sample (1970q1-2023q2) using the FE, RO, and RE Wald t-statistics. In this full sample, the null hypothesis is that there is no evidence of Granger causality between macroprudential policy and financial cycles in the entire sample. The alternative hypothesis is that there is evidence of Granger causality between macroprudential policy and financial cycles the entire sample. Table 3 displays the results. Values without brackets or parentheses represent the Wald t-statistics. The parameters in brackets and square parentheses are the critical values at 95% and 99% significance level, respectively.

The Wald t-statistics 9.152, 47. 000, and 47.000, for the FE, RO, and RE, in the equation for the AFC are statistically significant at the 95% significance level. This is indicated by the values of the Wald t-statistics exceeding their corresponding critical values. The significance of the Wald t-statistics implies that the null hypothesis of no evidence of Granger causality from MPI to AFC is rejected in the entire sample. The Wald t-statistics 26.726, 206.526, and 649.853 for the FE, RO, and RE in the CAFC equation also exceed their corresponding critical values at 95% and 99% significance levels, respectively. Thus, the null hypothesis that macroprudential policy did not Granger cause the CAFC in the entire sample is rejected. In the macroprudential policy equations, the null hypothesis of no Granger causality from financial cycles during the entirer sample cannot be rejected in the FE window. The Wald t-statistics. 8.188 and 5.191 are smaller than their corresponding critical values, indicating that these Wald t-statistics are statically insignificant. In contrast, the RO and RE Wald t-statistics reject the null hypothesis of no Granger causality from financial cycles to macroprudential policy.

Table 3: TVGC main results

	FE	RO	RE
$MPI\ \overrightarrow{GC}\ AFC$	9.152	47.000	47.000
	(8.854)	(9.439)	(9.776)
	[13.157]	[13.091]	[13.326]
$MPI\ \overrightarrow{GC}\ CAFC$	26.726	206.526	649.853
	(9.328)	(9.522)	(9.898)
	[15.495]	[15.438]	[16.293]
$AFC\ \overrightarrow{GC}\ MPI$	8.188	309.618	309.618
	(8.884)	(9.313)	(9.653)
	[13.897]	[13.897]	[13.919]
$CAFC\ \overrightarrow{GC}$ MPI	5.191	22.375	22.375
	(8.807)	(9.477)	(9.882)
	(13.783)	(13.394)	(13.845)

Source: own estimates

The study's findings indicate that in most cases, the null hypothesis is rejected in favour of the alternative hypothesis. The results provide evidence of a bi-directional causal relationship between macroprudential policy and financial cycles in South Africa. This crucial finding implies that in the case of South Africa, the conduct of macroprudential policies affects financial cycles, and financial cycle developments affect the conduct of macroprudential policies. According to the South African macroprudential policy framework, this policy, macroprudential policy aims to stabilize and smooth financial cycles. In contrast, financial cycles are a tool used by macroprudential policy authorities to monitor systemic risk over time in South Africa (Nyati et al. 2020). Hence, changes in macroprudential policy can lead to changes in financial cycles and *vice versa.* Two channels capture this symbiotic relationship. These are asset prices and credit extensions. According to the SARB, excessive growth in asset prices and credit during a boom causes exuberant behavior in investments into riskier assets, over-borrowing, and over-supplying credit (Rungcharoenkitkul et al., 2019). During a bust, riskier investments turn into huge losses, debts into high default rates, and banks are under leveraged, both precipitating a financial crisis. Accordingly, the SARB and PA tightens macroprudential policy when there is excessive asset price and credit growth to mitigate imprudent behavior. In turn, macroprudential policy is eased during a crisis to ensure that banks are adequately leveraged to continue their activities and the whole system functions (Nyati et al., 2023). When the SARB and PA, tightens macroprudential policy, the costs of obtaining and supplying credit increase, lowering the rate at which credit grows and the rate of investments into assets.

A sequence of Wald t-statistics from the FE, RO, and RE are now graphically examined to investigate how the causal relationship between macroprudential policy and financial cycles changed over time. Figure 1A in the appendix plots these statistics for each algorithm together with the 90th and 95th percentiles of the empirical distribution in the AFC and CAFC equations. Panel a of Figure 1A tests the null hypothesis of no Granger causality from macroprudential policy to the AFC at any point during the entire period. Panel b tests the null hypothesis of no Granger causality from macroprudential policy to the CAFC at any point during the entire period. The solid lines are the Wald t-statistics, whereas the dashed dark lines are the 90th percentile, and the light dots are the 95th percentile. The null hypothesis is rejected whenever the Wald t-statistics is above either of these percentiles.

Figure 1A shows evidence of Granger causality from macroprudential policy to financial cycles in two distinct periods in South Africa. The first period is between 2002 and 2007. The second period is between 2014 and 2018. The first period coincided with a significant credit boom in South Africa between 2003 and 2007. In contrast, the second period coincided with institutionalizing macroprudential policy and introducing new macroprudential policy tools in the country. In panel a, in can be seen that the Wald t-statistics of the FE, RO, and RE were clearly above the 90th and 95th percentiles during these periods. In panel b, FE graph, the Wald t-statistics was only above the percentiles between 2001 and 2004. In contrast, in the RO, it was significant in 2006/2007, just before the international financial crisis in 2007-09. In contrast, the RE Wald t-statistics were above the percentiles for the extended period running from 2005 until 2013. However, compared to other algorithms, there is strong evidence of Granger causality from 2003 until 2007. The second period where the macroprudential policy Granger caused financial cycles is between 2014 and 2018. This period is marked by the RE and RO Wald t-statistics in panels a and b being above the 90th and 95th percentiles. Figure 2A in the appendix displays the results of the null hypothesis that financial cycles granger caused macroprudential policy at least once during the entire sample. In panel a of Figure 2A, the null hypothesis is rejected in the RO and RE only for the period 2002 – 2007. However, in panel b, the null hypothesis is rejected in the RO and RE only for the period 2015-2018 and 2019 until 2022. This means that, in panel a, the Aggregate Financial Cycle Granger caused macroprudential policy in 2002-2007, whereas the Credit and Asset Price Cycle Granger caused macroprudential policy in 2015-2020. 2015 -2020 is significant because it ended after the beginning of the COVID-19-induced financial crisis.

The findings that macroprudential policy Granger caused financial cycles during a financial boom and that financial cycles Granger caused macroprudential policies during a financial crisis have a profound implication for the use of macroprudential policies in South Africa. These findings imply that macroprudential policies are used more proactively during a financial boom and more reactively during a financial crisis. During 2002 – 2007, South Africa's credit extension by banks accelerated to 19.2% on average yearly. As a result, the credit growth rate, which was almost 0% in the late 1990s, was 15% by the end of 2007 (Hollander and Haveman, 2022). During the same period, economic conditions were conducive to credit growth. Output expanded by 4.5% on average yearly while inflation remained within the target of 3% and 6%. The SARB, which housed macroprudential policy during this time, became concerned that the rapid acceleration of credit growth could trigger risk-taking behavior, such as high indebtedness and over supply of risky financial assets, and thus, precipitate another financial crisis, such as the banking crisis that occurred in 2002 in South Africa. As a result, they began to make stricter changes in the required capital ratios. The Bank Supervision Circular 8/2003 made changes to the treatment of preference shares and narrowed the definition of regulatory capital. The Bank Supervision Circular 1/2004 made it compulsory for banks to maintain a level of capital consistent with Basel II requirements. Then, the Bank Supervision Circular 19/2004 stated that at least 60% of minim required capital should consist of primary share capital, without any reliance on hybrid debt instruments. The overall effect of these circulars was that overall required capital adequacy levels rose from 11.96 in March 2003 to 13.67% in March 2005.

South Africa was introduced to Covid-19 in early March 2019. However, macroprudential policy responses were delated until 2020. Initially, the pandemic was considered a health crisis, and the SARB governor did not foresee the pandemic having severe financial stability implications for South Africa (De Villiers et al. 2020). By 2020, it was clear to policymakers that the death toll from COVID-19 coupled with lockdown regulations could have adverse ripple effects on systematically important financial institutions, and they may not be able to continue to provide financial activities and support the resilience of the economy to COVID-19 shocks (Herbst, 2023). Consequently, macroprudential policy was eased in order to provide buffers to these institutions. For instance, at the beginning of 2020, the CCyB was decreased to 0% from 2.5%. This meant that banks' credit in reserves was now available to banks to lend to the economy. Another example is that in 2020, the Prudential Authority allowed banks to utilize the capital conserved during normal times by releasing CCB as specified in Regulation 38(8)(e)(iv)(D) of the Regulations. The PA made two similar concessions to capital requirements. In April 2020, it reduced the Pillar 2A minimum capital requirement as set out in regulation 38(8)(e)(ii) of the Regulations temporarily reduced to 0—that is, banks were allowed to conduct business with a zero percent Pillar 2A capital requirement. Then, in line with the BCBS statement of March 2020, the Prudential Authority delayed the implementation of the following Basel III standards: (1) Standardized Approach to Counterparty Credit Risk (from October 1, 2020, to January 1, 2021); (2) Capital requirements for bank exposures to central counterparties (from October 1, 2020, to January 1, 2021); (3) Capital requirements for banks' equity investments in funds (from October 1, 2020, to January 1, 2021); (4) Revisions to the securitization framework (from January 1, 2021, to April 1, 2021); (5) Total Loss Absorbing Capacity Holdings (from January 1, 2021, to April 1, 2021); (6) Large exposures framework (from January 1, 2021, to April 1, 2021); and (7) Output floor: 50%—from January 1, 2022, to January 1, 2023; 55%—from January 1, 2023, to January 1, 2024; 60%—from January 1, 2024, to January 1, 2025; 65%—from January 1, 2025, to January 1, 2026; 70%—from January 1, 2026, to January 1, 2027; and 72.5%—from January 1, 2027, to January 1, 2028. The purpose of these delays was to further ensure that banks had enough capital to continue provide financial activities in the economy during the Covid-19 pandemic. Moreover, the delays in policy implementation also supports the notion that the SARB and the PA tend to use macroprudential policies in a reactive manner during a crisis episode.

The fact macroprudential policies were used more aggressively during 2002-07 before the international financial crisis in 2007 is the one that underscores that macroprudential policies were used more proactively during this period in order to reduce the risk of a financial crisis occurring. Indeed, studies have provided evidence that because of the policy interventions made before the international crisis, South Africa behaved relatively well compared to other emerging market economies and advanced economies during the international crisis in 2007-09 (Maredza and Sylvanus, 2013; Rena and Msoni, 2014). In contrast, the fact that the SARB and PA waited until a year later before implementing lenient macroprudential policies during Covid-19 supports the notion that these policies were used more reactively during a financial crisis. Besides these findings, the study also found a bi-directional Granger causality relationship between macroprudential policies and financial cycles between 2015 and 2018. Between 2015 and 2018, South Africa was in the process of formalizing its institutional frameworks for macroprudential policy. In 2015, the South African Reserve laid out the 'twin peak' model, which guides the implementation of macroprudential policy in S.A. Then, in 2017, the Financial Sector

Regulation act was finally put in place. Several prudential requirements were introduced during this period, affecting the South African financial sector. In April 2016, the countercyclical capital buffer, which requires all banks to put aside some capital to be used as buffers, was implemented. The capital conservation buffer, initially introduced in 2012, began to be phased evenly at an incremental rate of 0.625% between January 2015 and December 2019 with a target buffer of 2%. These changes meant banks were expected to hold additional capital requirements, thereby reducing the amount of credit they could supply.

MSDR results

This section presents the results of the MSDR estimation. The MSDR was applied in the study to investigate the effects of macroprudential policy during different phases of financial cycles. Table 4 displays the results. In the AFC column, the parameter $\mu_1 = -0.02$ is less than the parameter μ_2 =0.10. In the CAFC column, the parameter μ_1=-0.05 is less than $\mu_2 = 0.03$. μ_1 and μ_2 are state-dependent means at state one and state two, respectively. Since $\mu_2 > \mu_1$This suggests that the first state refers to the phases of the financial cycle busts, whereas the second state refers to the phases of the financial cycle boom. After identifying which state is which, the parameters σ_1 and σ_2 the variances in state one and state two are discussed. In the AFC and CAFC columns $\sigma_1 > \sigma_2$. This demonstrates that the variance of financial cycles during a financial boom is less than it is during a financial cycle bust. This is because financial cycle busts have often coincided with financial crises (*see* Farrel and Kemp, 2017; Drehmann et al., 2012). In some cases, financial cycle busts can coincide with recessions, which also causes instability in the overall economy (Claessens et al., 2011).

According to Table 4, $d_1 = 38$ whereas $d_2 = 33$ in the AFC equation. In the CAFC equation $d_1 = 95$ and $d_2 = 36$. The values in d_1/d_2 are a number of quarters describing the duration of each financial cycle phase. A typical AFC bust phase lasts up to 9.5 years, whereas an AFC boom phase lasts up to 8.25 years. A complete AFC is, therefore, 17.75 years. A CAFC bust lasts up to 23.5 years, whereas a boom last up to 9 years. A complete CAFC is 32.5. These findings are similar to existing studies that found that the length of financial cycles in South Africa can range from 10 to 30 years (De Wet and Botha, 2022; Bosch and Koch, 2020). For the AFC, p_{11} = 0.97*,* and for the CAFC $p_{11} = 0.99$. In contrast, $p_{22} = 0.97$ for both AFC and CAFC respectively. The parameters suggest that if financial cycles are in a bust or boom phase, there is a high probability that they will remain in that phase instead of transitioning to another phase.

Table 4: MSDR results

	AFC	**CAFC**
$\boldsymbol{\mu_1}$	-0.02	-0.05***
$\boldsymbol{\mu_2}$	0.10***	0.03***
$\boldsymbol{\sigma_1}$	0.09***	0.03***
$\boldsymbol{\sigma_2}$	0.07***	0.02***
$\boldsymbol{d_1}$	38	95
$\boldsymbol{d_2}$	33	36
$\boldsymbol{p_{11}}$	0.97	0.99
$\boldsymbol{p_{12}}$	0.03	0.01
$\boldsymbol{p_{21}}$	0.03	0.03
$\boldsymbol{p_{22}}$	0.97	0.97
$\boldsymbol{mpi_1}$	0.11***	0.12**
$\boldsymbol{mpi_2}$	-0.05**	-0.01

Source: own estimates

The properties of financial cycles presented above reveal some similarities and differences in financial cycles that can affect the effectiveness of macroprudential policy. The similarities are that (i) financial cycle busts are more volatile compared to financial cycle booms; (ii) financial cycle busts have a longer duration compared to financial cycle booms; and (iii) financial cycle phases can be characterized by a high level of persistence a described by transition probabilities p_{11} and p_{22}. The difference is that the CAFC has a longer financial cycle than the AFC. Moreover, the AFC has more volatility compared to the CAFC.

Table 1 shows that in the case of busts in the AFC, the corresponding MPi_1 parameter is 0.11. In case of a boom, the corresponding MPI_2 parameter is -0.05. In the CAFC column, the MPI_1 and MPI_2 parameters are 0.12 and -0.01 in the bust and boom phase, respectively. The signs of the parameters mentioned above indicate that macroprudential policies have an expansionary effect in the bust phase of financial cycles. In contrast, macroprudential policy has a contractionary effect during the boom phases, indicated by the negative sign. This is expected. Macroprudential policies are tightened during a financial cycle boom to slow down excessive growth in credit and asset prices. During a bust phase, macroprudential policies are eased. The magnitude of MPI_1 is greater than the magnitude of the MPI_2 parameters. Moreover, MPI_1 are more statistically significant compared to MPI_2 parameters (see Table 4). The parameters' magnitude and statistical significance imply that macroprudential policy effects are stronger during financial cycle bust phases and weaker during financial cycle boom phases.

The first reason the effects of macroprudential policy are weaker during a financial cycle boom is that during this phase of the financial cycle, financial actors can resist macroprudential policy. During a financial cycle boom, banks profit more from lending, households have access to more debt, and investments into riskier assets provide short-term gains. Ultimately, this causes financial actors to be euphoric about future prospects, causing them to want to borrow more, lend more, and even more into riskier assets. Consequently, financial actors can resist financial regulations that require them to act more prudently during a financial cycle boom (Kane, 1999; Spendzharova, 2016). An example of resistant behavior towards financial regulations is the banking collusions in South Africa. The Competition Commission alleges that big banks such as Standard Bank and ABSA agreed from at least 2007 to collude with each other on prices for bids, offers, and bid-offer spread for spot trades concerning currency trading involving the U.S. dollar and rand currency pairing (Mlambo & Ncube, 2011). By doing so, these institutions were contravening the South African Competition Act, which prohibits direct or indirect price fixing between competitors and information exchange, giving rise to anticompetitive conduct (Ngonyama & Simatele, 2017). The main motivation for colluding was South Africa's capital pool; therefore, available capital is not always sufficient to support lending activities. Then, tightening financial regulations such as macroprudential policy implies that the smaller pool of capital is further reduced, and banks can receive smaller revenues and profits as their ability to lend exuberantly is limited. Ultimately, banking collusions imply these financial institutions circumvent regulations targeted towards them, rendering these regulations less effective. In contrast, the behavior of financial actors and macroprudential policy authorities are more aligned during a financial boom, especially those that coincide with a financial crisis, such as the one during COVID-19. Both financial actors and authorities are concerned with preventing huge losses from the crisis and ensuring that financial institutions continue their activities without disruptions (Shikwane et al., 2020). As a result, during a bust phase, financial institutions receive more stimulatory interventions from the SARB and the P.A.

The second reason behind weaker macroprudential policies during a financial cycle boom is that the corresponding switching of capital buffers occurs in smaller incremental changes overtime. These smaller changes may not be strong enough to restrain a financial cycle boom. For instance, during the 2003/07 credit boom, capital adequacy ratios increased three times, once in 2003, once in 2004, and once again in 2005. However, the credit-boom continued until it was put to an end by the international financial crisis in 2007/09, which was an external shock to South Africa originating from the U.S. Indeed, Figure 1 demonstrated that there were long financial booms between 2003 and 2007 which only reached their peaks at the beginning of the global financial crisis. Another example is the CCB. The capital conservation buffer was initially introduced in 2012. However, it began to be phased evenly at an incremental rate of 0.625% between January 2015 and December 2019, with a target buffer of 2%. Existing studies provide evidence that between 2015 and 2019, financial cycles were in a financial boom phase in South Africa. These boom phases ended with the collapse of financial markets in the early stages of Covid-19. Thus, it can be said that financial cycles did not show responsiveness to the tightening of the CCB. During a financial cycle boom, such as the one triggered by Covid-19, capital buffers were switched off completely without following the process of decremental changes. The CCyB decreased from 2.5 to 0% immediately. The CCB decreased from 2% to 0% immediately. The resulting effect is that South African banks had immediate access to capital stored up during normal times; as a result, they could be more resilient to the Covid-19 shock. This explains why the effects of macroprudential policy are stronger during financial cycle booms.

Conclusions

This study aimed to investigate the intricate relationship between macroprudential policy and South Africa's financial cycles from 1970 to 2023. The study successfully addressed these aims by employing the time-varying granger causality model and the Markov switching dynamic regression, and it provided valuable insights into the dynamics of macroprudential policy and financial cycles in the South African context. The study's main findings reveal a strong bidirectional relationship between macroprudential policy and financial cycles. It was observed that macroprudential policies are utilized more proactively during periods of financial booms, such as the credit boom between 2002 and 2007, and more reactively during financial crises, exemplified by the COVID-19-induced financial turmoil. Furthermore, the study highlighted the effectiveness of macroprudential policies, indicating that they tend to be more impactful during financial bust phases compared to boom phases.

The findings of the study make a substantial contribution to the literature on macroprudential policies and financial variables. Most studies have identified a unidirectional link where macroprudential policy negatively affects credit and asset prices (Kim and Mehrotra, 2018; Boar et al., 2017; Richter et al., 2018; Lee et al., 2016; Cerruti et al., 2017; Matos et al., 2023; Akdogan, 2020; Kang et al., 2017; Avdjiev et al., 2014; Alam et al., 2019; Patroba, 2017; Liu and Molise, 2019; Molise, 2020; Hollander et al., 2019; Hollander, 2017). In contrast, this present study establishes a bidirectional relationship between macroprudential policy and financial variables. This indicates that the actions of prudential authorities influence the financial system, while the behaviour of financial markets, in turn, affects the decisions of prudential authorities. Additionally, the study reveals asymmetries in the effectiveness of macroprudential policy. Unlike Bruno et al. (2017), Cerruti et al. (2017), and Lim et al. (2011), who found that different policy tools have varying strengths, this study finds that macroprudential policy is more effective when employed during episodes of financial expansions. This goes to show that the effectiveness of macroprudential policy varies depending on the phases of financial cycles.

The findings of the study carry significant implications for policymakers and financial regulators in South Africa. It is recommended that macroprudential policies be deployed more assertively during financial booms to enhance their effectiveness in mitigating systemic risks and stabilizing the financial system. This could involve setting more stringent parameters upon activating macroprudential policy tools. Additionally, policymakers may consider supplementing macroprudential policies with monetary policy measures during periods of economic expansion to ensure comprehensive and robust financial regulation. However, it is essential to acknowledge the limitations of this study. One limitation lies in the scope of the analysis, which focuses solely on the South African context. Future research could explore similar relationships in other emerging markets or compare the findings with those of advanced economies to provide broader insights into macroprudential policy effectiveness. Furthermore, while the study provides valuable insights into the dynamics between macroprudential policy and financial cycles, it may not capture all relevant factors influencing these relationships. Future research could incorporate additional variables or refine methodologies to deepen our understanding of these complex dynamics.

In conclusion, this study makes a significant contribution to the literature on macroprudential policy and financial cycles in South Africa. By elucidating the bidirectional relationship between these phenomena and highlighting the implications for policy, the study offers valuable guidance for policymakers and regulators striving to maintain financial stability and resilience in dynamic economic environments.

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Appendix

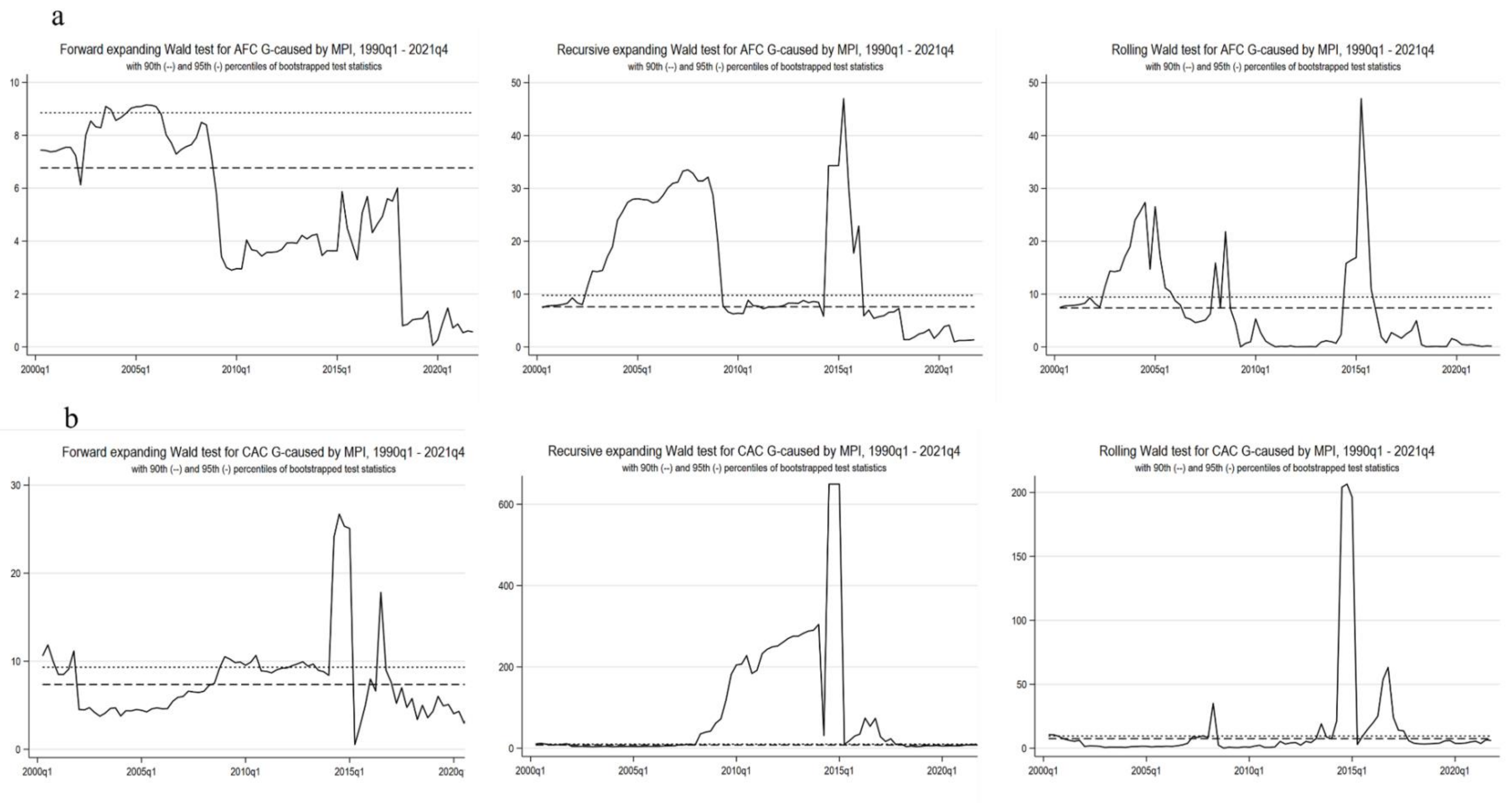

Figure 1A: TVGC datestamp of MPI causes AFC and CAFC Source: Own estimates

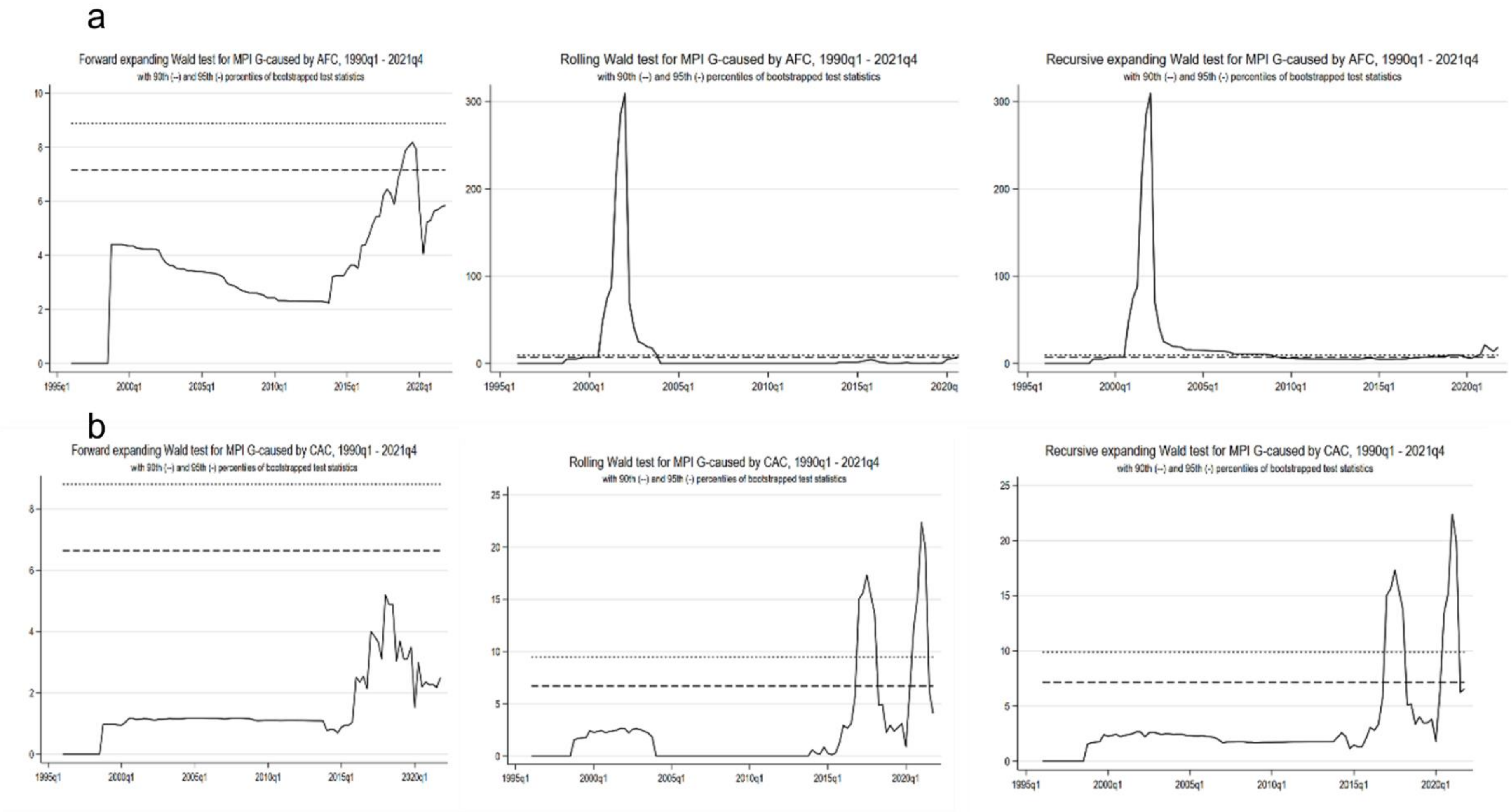

Figure 2A: TVGC datestamp of AFC and CAFC causes MPI Source: own estimates