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Article

Analysis of the optimal inflation rate in the economic growth process of a developing country: The case of South Africa

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Abstract: The consensus is that price stability promotes sustainable economic growth while excessive inflation harms growth. This study assesses the linkage between inflation and economic growth in South Africa to determine the optimal inflation rate threshold for the sustainable growth of the economy. Quarterly data from 1995 to 2022 was analysed through the ARDL and threshold regressions. The ARDL and threshold regressions estimate established a relationship between inflation and economic growth and computed the optimal inflation rate threshold for economic growth at 6 percent. The results also established that both the repo rate (repurchase rate) and real effective exchange rate have a negative relationship with economic growth. The Toda-Yamamoto causality test result indicated a unidirectional causality runs from inflation to economic growth. These results are crucial for the South African Reserve Bank to discharge its monetary policy functions to attain and maintain price stability. Therefore, this study offers the Bank a roadmap for targeting an inflation rate that aligns with the nation's long-term objectives for sustainable economic growth.

Keywords: inflation; economic growth; threshold; ARDL; regression

1. Introduction

In many countries, achieving high and inclusive growth and low inflation rank high among the macroeconomic policy objectives (Bodenstein et al., 2019; Stiglitz et al., 2006). Over the years, there has been a widely accepted notion in macroeconomic management circles that price stability is crucial for sustainable economic growth (Azam and Khan, 2022; Dax and Loxley, 2015; Olamide et al., 2022; Valdovinos, 2003). This notion reinforces the neo-classical school position that high inflation tends to engender the disruption of a market economy (Stockman, 1981). Such disruptions are attributed by empirical studies (Billi and Khan, 2008; Frimpong and Oteng-Abayie, 2010; Khan and Senhadji, 2001) to several negative impacts of high inflation on the economy: It hinders efficient resource allocation by shrouding the signalling role of relative price changes; it slows down the pace of financial inclusion and development, as it increases the cost of financial intermediation; it erases potential investors' and savers' confidence, as future prices become unpredictable; it burdens the society with welfare costs; and it adversely impacts a country's balance of payments, as the exports become relatively costlier, thereby diminishing the economy's international competitiveness.

In agreement with the structuralists' argument on the necessity of inflation for growth (Mallik and Chowdhury, 2001), central banks would instead pursue a target of low inflation rather than outright deflation. Moreover, macroeconomic policymakers

posit that inflation should not decline below zero as they believe deflation comes at a hefty price (Billi and Khan, 2008). Such costs may include weakening the financial system, as deflation promotes and subsidises the preference to hold money as opposed to loans and deposits (Smith, 2002). As argued by Summers (1991), another cost of deflation relates to the effect of the zero bounds on nominal interest rates in situations where the central Bank is committed to lowering interest rates in the face of slowing economic activity. From the theoretical perspective, the inflation target is expected to be congruous with the Friedman rule, which proposes a zero nominal interest rate. According to the rule, the inflation target is less than real income growth rate in life cycle economies (Freeman, 1993) or less time preference rate plus income growth adjustment in representative economies (Woodford, 1990).

Despite the preponderance of the argument that keeping inflation low is crucial to galvanising the economy's capacity for growth, there is also the argument that low inflation can exert a counter-productive impact on the economy (Vinayagathasan, 2013). As such, Central Banks face the daunting challenge of pursuing low inflation and high economic growth objectives contemporaneously, as they need to determine the appropriate level of inflation that would support attaining high economic growth (Ibarra and Trupkin, 2016). Therefore, this study focuses on how low inflation should be in South Africa. What rate of inflation maximises economic growth in the country? Should the inflation target be 5% or 8% or 10%? Furthermore, what rate of inflation inhibits economic growth in the country?

In the pursuit of its avowed commitment to always do its best to protect people's incomes from inflation, the South African Reserve Bank (SARB) raised the repo rate by 75 basis points, from 6.25 percent to 7 percent, through the Monetary Policy Committee (MPC) in November 2022. This hike in the repo rate represented a seventh consecutive increase in the rate by the SARB, which implies that the prime interest rate increased to 10.5%, with consequences on aggregate consumption, capital formation, investment and economic growth. Worldwide, both industrial and emerging nations have experienced an increase in inflation. Specifically, COVID-19 and the beginning of 2022's Russian-Ukrainian war are the causes of this growing inflation rate. These two occurrences have disrupted the world economy and global supply chain networks. Price increases have been accelerated because of consequent adverse supply-side economic effects.

Before COVID-19, the global inflation rate remained at around 3.2 percent from 2017 to early 2020. However, the rate rose to 4.7 percent in 2021 and 7.4 percent by mid-2022. The inflation monster is also appearing within the G20 group of nations. At 2.1 percent, China's inflation rate is still relatively modest compared to the other G20 nations, where rates are rising quickly. More than 8 percent inflation is present in the Eurozone and the US, more than in four decades (see **Table 1**). Inflation in South Africa has surpassed the upper band set by the SARB. Although South Africa's inflation rate is at the worldwide average, it typically lags behind that of the top trading partners and industrialised nations. By the end of 2022, the increasing trend was still prevalent globally. Lebanon, Zimbabwe, Venezuela, Turkey, and Argentina have the poorest records for controlling inflation, with 211 percent, 192 percent, 167 percent, and 61 percent, respectively (World Bank, 2022). Hyperinflation is present in these nations, which is devastating for any economy. This phrase is used when the monthly

inflation rate rises by more than 50%. The government printing of money, or the quick increase in the money supply, causes hyperinflation. Stagflation, in which output decreases but prices increase, is another form of inflation that many nations, including South Africa, are currently dealing with.

Since 2010, South Africa's inflation rate has been kept within the target range of 3% to 6%; while inflation has been kept in check, the country's economic growth has typically been subpar or negative. For 2023 and 2024, the SARB forecasted low economic growth of 1.3% and 1.4% (SARB, 2022). Interest rate differences are key in luring investment and boosting the currency. The difference in net repo rates between SA and the US is summarised in **Table 2**. The disparity has dropped since 2019, as seen in the table. Both central banks are rapidly raising interest rates. A declining gap typically causes capital to leave the nation and pressures the exchange rate. The SARB's decision to raise the repo rate is primarily motivated by this. However, these hikes are anticipated to have a disastrous impact on the economy through increased borrowing costs, depressing aggregate consumption through the negative impacts on disposable income, rising government debt payments, and declining capital investment needed to galvanise the economy.

Table 1. Annual inflation rates of selected G20 countries for the year 2022.

Country	Inflation target	Annual inflation rate (%)	Trend
China	± 3.00%	2.1	Upward trending
Saudi Arabia	-	2.2	Stable
Japan	2.00%	2.5	Upward trending
Australia	2.00%–3.00%	5.1	Upward trending
France	-	5.8	Upward trending
South Africa	**3.00%–6.00%**	**7.4**	**Upward trending**
India	4.00% ± 2.00%	7.1	Upward trending
Euro Zone	2.00%	8.6	Upward trending
US	2.00%	8.6	Upward trending
Brazil	3.75% ± 1.50%	11.7	Upward trending
Russia	4.00%	17.1	Upward trending

Source: Authors' own compilation from World Bank data and http://www.centralbanknews.info/p/inflation-targets.html.

Table 2. Net repo rate differential between SA and the US.

Date	Net interest rate difference
2019	4.25%
2020 (before COVID)	4.75%
2020 (mid-year in COVID)	3.25%
2021 (COVID)	3.25%
2022 (before the Ukrainian war)	3.25%
2022 (mid-year Ukrainian war)	3.75%
2022 (year-end prediction)	3.75%

Source: Authors' own compilation from SARB data.

Therefore, the main goal of this study is to investigate the optimal level of inflation that protects the people's income in line with the Reserve Bank's objective and maximises the country's economic growth. Understanding the optimal inflation rate for the country could be useful for the country's policymakers to combat the menace of inflation with the appropriate policy tools. For example, the SARB has used monetary policy tools over the last decade to keep inflation low, even in a cost-push inflation environment. This might explain why the economy has been trapped in a low-growth situation since 2017.

This study contributes to the literature on the inflation-economic growth nexus in South Africa in the following ways. This study makes an essential contribution by determining an optimal inflation rate, which helps to stabilise inflation expectations and results in more predictable business planning, wage negotiations and investment decisions. The resulting stability could engender a favourable atmosphere for long-run economic growth and sustainable development. Essentially, this study builds on extant studies on South Africa and, on account of the results, stresses the evolving nature of the macroeconomic conditions that shape inflation rates and the need for periodic reassessments of the optimal inflation targets.

The remaining sections of this study are as follows: Section 2 reviews both theoretical and empirical literature. Section 3 deals with the methodology, while Section 4 discusses the results of the tests and regressions. Section 5 concludes the study.

2. Literature review

2.1. Theoretical literature

Economic theories describe the relationship between inflation and economic growth from different perspectives. Considering this, we shall discuss the perspectives of a few theories: Monetarist, Neoclassical, New Keynesian and Post-Keynesian theories.

2.1.1. The monetarist theory

The monetarist theory is founded on the work of Milton Friedman (1912–2006). The theory argues that the most crucial determinant of economic growth is the change in money supply. Therefore, the movement of the business cycle is driven by the money supply. According to the theory, inflation is directly linked to the volume of money supply such that an increase in money supply over and above the growth rate of the national income leads to inflation (Totonchi, 2011). The monetarist theory is predicated on the quantity theory of money, which was developed to explain the relationship between money supply and price level. There are two variations of the quantity theory of money: The Cambridge version (or the cash balance approach) and the Fisher's version (or the transaction approach).

The Cambridge version can be described as follows:

$$\rho = \sigma \frac{Y}{M} \tag{1}$$

where ρ is the purchasing power of money, σ is a fraction of income held in the form of money, Y is the amount of real income, and M is the total money supply.

According to Equation (1), the purchasing power of money is directly related to σ or Y, while it is inversely related to M. Considering that the general price level's reciprocal is ρ (that is, $\rho = 1/P$), then Equation (1) can be written as:

$$\frac{1}{P} = \sigma \frac{Y}{M} \tag{2}$$

or

$$P = \frac{M}{\sigma} R \tag{3}$$

such that

$$\frac{dP}{dM} = \frac{1}{\sigma} Y \tag{4}$$

From Equation (4), price change directly relates to the money supply. The Fisher's version of the quantity theory of money is described as:

$$MV = PQ \tag{5}$$

where *M* is the total amount of money supply, *V* is the velocity of money circulation, *P* is the general price level, and *Q* is the real output.

Equation (5) is predicated on the assumption that the monetary authorities determine the money supply and that the economy is at full employment level. Equation (5) can be re-written as:

$$P = \frac{MV}{Q} \tag{6}$$

The implication of Equation (6) is that any changes in M initiated by the monetary authorities will directly affect *P*. By implication, Fisher's version sees inflation as a strictly monetary phenomenon. Furthermore, Equation (6) shows that the relation between the general price level and the real output is inverse, implying that inflation is negatively related to economic growth.

2.1.2. The neoclassical theory

The neoclassical growth theory also provides a fundamental theoretical underpinning for linking inflation and economic growth. As propounded by Solow (1956) and Swan (1956), the theory explains the attainment of growth through the right combination of labour capital and technology. Neoclassical growth theory emphasises the free-market system and the importance of price mechanisms for efficient resource allocation. Based on Solow (1956) and Swan (1956), the neoclassical growth model is expressed as follows:

$$y_t = f(k_t, l_t) \tag{7}$$

where y_t is output, k_t is capital, and l_t is labourDe Gregorio (1996) provides an insight into how inflation influences growth based on the neoclassical growth theory as follows:

$$y_t = \gamma f(k_t, l_t) \tag{8}$$

where y_t is output, γ is technology, k_t is the capital stock and l_t is stock of employment. By log-differentiating Equation (8), the economy's growth rate is calculated as:

$$\pi = \gamma f'(k_t, l_t) i \tag{9}$$

where π is the growth rate of output $\left(\pi = \frac{dlog(y_t)}{dt}\right)$, $\gamma f'(k_t, l_t)$ is the marginal productivity of capital and i is the investment rate.

Equation (9) implies that changes may influence growth level in marginal productivity of capital or rate of investment. On the other hand, if f is assumed as linear in k, such that f' is an increasing function of l_t, then a fall in $f'(k_t, l_t)$ engenders a fall in the growth rate as the efficiency of capital accumulation decreases. If individuals are to choose between consumption and leisure, the price of consumption goods will include an inflation rate since they have to hold money to pay for consumption goods. Therefore, an upward movement in the inflation rate will lead to a rise in the price of consumption compared to leisure. This would give rise to substitution from consumption to leisure with an attendant decline in labour supply. Consequently, a rise in inflation will result in a decline in the efficiency of investment and the growth rate.

2.1.3. The New Keynesian theory

Viewed by Post-Keynesian economists as a misnomer, the contemporary New Keynesian economic mainstream stems from the new neoclassical synthesis (Blanchard, 1991; Mankiw, 2019). This synthesis has amalgamated the neoclassical model with specific components of John Maynard Keynes's economic theory. Specifically, Keynes's assertion that nominal wages and prices frequently exhibit stickiness due to political/technical factors (such as trade unions, menu costs, etc.) is incorporated into the neoclassical model—a concept fundamentally foreign to neoclassical thinking given its assumption of atomistic competition. Therefore, inflation will only result from an "excess" amount of money injected by the central bank if it is utilised to purchase government or private sector goods and services (Mankiw, 2019). On the contrary, if the surplus money is either hoarded in bank accounts or the government abstains from executing supplementary fiscal expenditures, the extra money inflates financial assets. This does not directly impact the 'high-powered' central bank money itself, as these reserves are confined to banks' accounts at the central bank and do not circulate into the broader economy. Instead, it influences the additional credit that these reserves enable within the banking sector. As argued by Eichner and Kregel (1975), all else being equal, price shocks resulting from events like environmental disasters or oil crises ultimately diminish, and prices return to the long-run equilibrium.

Thus, those shocks may impact inflation in the short term but not in the long run. This results from economic agents' rational expectations, which allow them to account for the transient effect after perceiving the short-term shock (Blanchard, 1991). According to Harcourt (2006), in this conceptual framework, sustained inflationary pressure could arise solely from an extensively depleted labour market, wherein employers engage in competitive bidding for the limited available workforce. In this situation of a labour bottleneck, the factor cost of the essential input, apart from capital, steadily rises, permeating into all prices across the economy. Therefore, a certain level of 'natural unemployment' must always exist, or, in contemporary terms, a Non-Accelerating Inflation Rate of Unemployment (NAIRU). If unemployment persists above the NAIRU for an extended period, prices are likely to decline due to a lack of labour competition and weakened bargaining power for workers. Conversely, inflation will inevitably occur if unemployment remains below the NAIRU for an extended period (Harcourt, 2006).

2.1.4. The Post-Keynesian theory

Unlike the Neoclassical and New Keynesian models, Post-Keynesian theory holds that there is not a single, stable macroeconomic equilibrium. As noted by Arestis (1996), this Post-Keynesian position immediately challenges Say's Law in that if a stable equilibrium is not assured, and markets do not necessarily reach equilibrium consistently, additional supply does not inherently create its own demand. One of the explanations for this is the fiat money itself, which is disregarded by (neo-)classical thought as ostensibly neutral. Fiat money allows households and businesses to store purchasing power for future use, thereby undermining Say's Law. Gailbraith (1997) argued that this makes the notion of NAIRU, the foundation of the New Keynesian inflation theory, outdated. If there is no long-run macroeconomic equilibrium, including a stable connection between unemployment and inflation, it is illogical to maintain unemployment at a specific level to prevent inflation. From the view of the Post-Keynesian theory, inflation is rarely caused by an excess of money or excessively low unemployment. Instead, money is endogenous to the economy, generated in response to the demand from economic agents. Inflation, therefore, arises mainly from the expectations of economic agents, especially their expectations concerning the trajectory of nominal wages disrupted by any substantial shock (Arestis, 1996).

Another Post-Keynesian perspective on inflation, which builds upon the already discussed insight, asserts that it is not a hypothetical labour market but rather the relative economic power that determines wage levels. This approach is known as the conflicting claims approach. The idea behind this approach stems from the writings of Michal Kalecki and others, who defined inflation as the result of firms' and workers' competing claims when total claims exceed national income. The intensity of these conflicts over income shares is, therefore, thought to be a measure of how much the total amount of demanded income shares outstrips the GDP (Isaac, 1999). Lastly, there is the wage-cost markup approach, introduced by Weintraub (1978). This model emphasises that the primary driver of inflation is the rise in wages relative to worker productivity. The approach proposes that to curb wage inflation and, consequently, price inflation, restrictive aggregate demand policies should be implemented. This proposition, however, comes at the expense of increased unemployment, slower growth in advanced economies, and constrained growth prospects in developing economies (Atesoglu, 1999).

2.2. Empirical literature

The theoretical perspective on the relationship between inflation and economic growth points to a negative impact of high inflation on growth. However, the empirical literature is inconclusive on the optimal level of inflation that does not impede economic growth. There are two broad categories of the empirical literature on the threshold effect of inflation rate on economic growth. One category investigates the cross-country data to determine the average inflation threshold (Abdulaqdir et al., 2019; Azam and Khan, 2022; Das and Loxley, 2015; Khan and Senhadji, 2001; Pollin and Zhu, 2006; Ndoricimpa, 2017), while the other category conducts country-specific analysis to estimate the optimal inflation rate for individual countries (Hassan and Meyer, 2020a; Leshoro, 2012; Masiyandima et al., 2018; Munir et al., 2009; Phetwe

and Molefhe, 2016; Phiri, 2018). The empirical literature also tends to explore the dichotomy between the optimal inflation rate in developing countries as opposed to that of developed economies.

In one of the most frequently cited and replicated research works, Khan and Senhadji (2001) estimated the threshold inflation using balanced panel data from 1970 to 2003 for 140 developing and industrialised countries. The study was aimed at investigating whether a threshold rate of inflation exists beyond which the impact of inflation on economic growth differs from when the rates are lower. It also sought to determine whether the inflation rate threshold is similar across the developing and the developed economies. Using the conditional least squares method, their estimate of the inflation threshold was put at 10.62%–11.38% for developing countries. On the other hand, the threshold estimate for the industrialised countries was put at a much lower range of 0.89%–1.11%. In a similar study, Pollin and Zhu (2006) investigated the inflation-economic growth nexus for 80 countries, using nonlinear regression. The results of the study suggested that higher inflation up to a threshold of approximately 15%–18% enhances economic growth.

In a study of how harmful inflation is to economic growth in South Africa, Leshoro (2012) analysed quarterly data using threshold regression for 1980–2010. The research outcome revealed that an inflation rate threshold of 4% is optimal for the economy's growth, such that economic growth is enhanced at an inflation rate of 4% and below. In comparison, there is a negative impact on economic growth for an inflation rate above 4%. In a similar study of another Southern African country, Zimbabwe, Masiyandima et al. (2018) attempted to determine the deleterious inflation level to economic growth. The study estimated a threshold model using annual data for the period 1980–1997, when the country was using its currency and using monthly data for the period 2009–2017, when the country operated a multicurrency system. The results revealed that, in both periods, the relationship between inflation and economic growth is nonlinear, such that lower inflation rates positively affect economic growth. In comparison, higher rates negatively affect economic growth. The inflation rate threshold for 1980–2017 was estimated at 8.7%, while that of 2009–2017 was estimated at 4.6%. The relationship between inflation and economic growth was also explored for Botswana by Phetwe and Molefhe (2016), who used data from 1994–2014. The research outcome revealed that the relationship between the two variables is nonlinear. The optimal inflation rate for economic growth was estimated at 6.9%, in which case any inflation level above this rate is considered inimical to economic growth.

The existence of a threshold in the linkage between inflation and economic growth was tested for Malaysia by Munir et al. (2009). The period 1970–2005 annual data was analysed using the threshold autoregressive method. The analysis estimates showed a strong negative effect of inflation on economic growth once an inflation rate threshold of 3.89% is exceeded. Abdulaqdir et al. (2019) also evaluated the optimal exchange rate policy inflation targets in 15 oil-producing economies in sub-Saharan Africa (SSA) by conducting threshold tests and regressions. The study's results revealed that the optimal inflation target impacts the exchange rate up to an optimal level of 14.47%.

In an investigation of South Africa, Mandeya and Ho (2021) explored the inflation phenomenon in relation to economic growth. In addition to comparing the effects of inflation and inflation uncertainty on growth before and after inflation targeting, the authors also explored the combined effects of both variables. By employing quarterly data from 1961 to 2019 and the autoregressive distributed lag (ARDL) estimation technique, their research outcome revealed that whereas inflation uncertainty is a short-run phenomenon with no long-run implications in South Africa, inflation itself adversely affects growth both in the short run and in the long run. In a study to investigate the effects of inflation targeting on economic growth in South Africa, Kotsokoane and Rena (2021) used quarterly data covering the years 2000 to 2018 and the vector error-correction model (VECM). The study's results indicated the existence of a long-run relationship between inflation targeting and South Africa's economic growth. They further revealed that GDP is influenced in the short run by GDP-lagged values and inflation. In the same vein, Sekwati and Dagume (2023) investigated the impact of unemployment and inflation on South Africa's growth, using the VECM estimation approach to estimate quarterly data from 1994 to 2018. The research findings indicated that inflation and unemployment exert a negative impact on economic growth in the country.

In exploring the impact of unstable exchange rates on the linkage between inflation and economic growth in the Southern African Developing Community (SADC), Olamide et al. (2022) used estimation approaches like Generalised Methods of Moments (GMM), Pooled Mean Group (PMG) and Dynamic Fixed Effects (DFE) to estimate data for the period 2000–2018. The study's results demonstrated a negative impact of inflation and exchange rate volatility on the community's economic growth. The findings additionally demonstrated that the resultant impact of exchange rate instability on inflation negatively impacts the economic growth of the region. Specifically, a higher level of instability in the exchange rate corresponds to a more detrimental relationship between inflation and economic growth. This research is corroborated by Bittencourt et al. (2015), who utilised panel time series data to investigate the relationship between inflation and economic growth in 15 SADC countries and concluded that inflation had an adverse impact on the region's growth.

Ndoricimpa (2017) investigated non-linearities in the relationship between inflation and growth in Africa by means of a dynamic panel threshold regression of Kremer et al. (2013). The study's conclusions support the idea that inflation and economic growth in Africa have a nonlinear relationship. According to the results, the inflation threshold values are 6.7% for the entire sample, 9% for the low-income country subsample, and 6.5% for the middle-income country subsample. Additionally, the research outcomes suggest that only middle-income African countries appear to benefit from relatively lower levels of inflation in terms of stronger economic growth. In all situations, however, an inflation rate that exceeds a particular threshold is likely to be harmful to economic growth. In another study on Africa, Adeniyi (2020) investigated the impact of foreign direct investment (FDI) and inflation on economic growth in five African countries: Egypt, Kenya, Nigeria, South Africa and Tanzania. The findings of the study revealed that four of the five countries exhibited negative effects from inflation on economic growth, with the exception of Egypt.

Meanwhile, Das and Loxley (2015) explored the nonlinear linkage between inflation and growth for 54 developing economies for the years 1971 to 2010 by using the pooled OLS, random-effect and fixed-effect estimation approaches. The authors made separate estimations for three different regions in the sample: Asia, Latin America and the Caribbean and sub-Saharan Africa. The findings of the study showed that the inflation rate threshold for Asia is 11%, while those of Latin America and the Caribbean and sub-Saharan Africa are 23.5% and 23.6%, respectively. What's more, Azam and Khan (2022) investigated the impacts of thresholds in the inflation-economic growth nexus in both developing and developed economies. The authors utilised non-average inflation data from 1975 to 2018 and estimated it using the feasible generalised least squares technique. According to the empirical estimate, growth is hindered by inflation when it surpasses the turning point, which is reported to be 12.23% in developing economies and 5.36% in developed economies. Moreover, the largest adverse effects are observed in developed countries. Additionally, their results demonstrated that real exports, government spending, household spending, and gross fixed capital formation all promote economic growth, but population growth rates exert detrimental effects.

In other studies, Madurapperuma (2016) demonstrated that inflation exerts a deleterious effect on Sri Lanka's economic growth in an investigation over the period 1988–2015, while Khan and Khan (2018) reported a substantial negative linkage between the growth rate and the rate of inflation in five Asian nations between 1973 and 2016. However, according to Kryeziu and Durguti (2019), findings from a study spanning 1997–2017 show that inflation had a significant and favourable impact on the Eurozone's growth rate.

3. Data and methodology

To investigate the optimal level of inflation in South Africa, quarterly data spanning 1995Q1–2022Q3 were employed. The dependent variable is economic growth, and it was measured by the GDP growth rate. Inflation was measured by the rate of inflation (INFR). As a way of addressing the issue of variable bias omission, other drivers of economic growth are included in the model. These are the South African Repo rate (REPO) and the real effective exchange rate (REER). All the variables were obtained from the South African Reserve Bank database. The South African Reserve Bank (SARB) most frequently employs the REPO (repurchase rate) as a tool for monetary policy to combat inflation. At the same time, REER is a crucial determinant of the international trade competitiveness of the economy.

Table 3 summarises the statistical attributes of each variable in the model. The mean of INFR, REPO and REER are 5.71, 8.95 and 110.32, respectively, exceeding their respective median. This indicates that INFR, REPO and REER distribution is positively skewed. Conversely, the data distribution of GDP is negatively skewed because its mean value at 0.62 is lower than its median of 0.67. Through the study period, the average inflation rate in South Africa stands at 5.71%, with the highest rate of 12.82% recorded in 2008Q3 and the lowest rate of 0.51% recorded in 2004Q1. The highest GDP growth rate of 13.74% was attained in 2020Q3, while the worst negative growth rate of −17.09% was achieved in 2020Q2 during the Coronavirus COVID-19

lockdown. The GDP, INFR, and REPO data distributions are leptokurtic, given their respective kurtosis of 47.37, 3.79, and 3.61, which are higher than 3. On the other hand, the 2.48 kurtosis value of REER implies that a platykurtic distribution characterises the variable. The standard deviation results show that all the variables have standard deviation greater than 2. This implies that the series are more spread out from the mean.

Table 3. Descriptive statistics.

	GDP	INFR	REPO	REER
Mean	0.619810	5.707380	8.947619	110.3183
Median	0.667828	5.445545	7.000000	109.9200
Maximum	13.74146	12.82051	22.50000	133.8700
Minimum	−17.09867	0.508906	3.500000	78.78000
Std. Dev.	2.264527	2.396466	4.221297	11.33255
Kurtosis	47.36819	3.797529	3.614892	2.684076

The growth equation estimated in this study draws from the model utilised by previous studies on inflation-economic growth nexus (Pollin and Zhu, 2006; Yonus, 2015; Das and Loxley, 2015; Phetwe and Molefhe, 2016), wherein the growth of gross domestic product (GDP) serves as the dependent variable. In line with these studies, we incorporated the squared term of inflation as an explanatory variable in the growth equation, which makes the equation a second-degree polynomial. Utilising a squared term for the key variable of interest is a frequently employed method in growth literature (see for example, Das and Loxley, 2015; Hassan, 2021; Hassan and Meyer, 2020b; Hassan and Meyer, 2021; Pollin and Zhu, 2006; Rajan and Subramanian, 2008). By using this explanatory variable, the slope of the estimating equation can now vary in response variations in the inflation rate. The expression for this equation is as follows:

$$GDP_t = \beta_0 + \beta_1 INFR_t + \beta_2 INFR_t^2 + \beta_3 REPO_t + \beta_4 REER_t + \epsilon_t \quad (10)$$

where GDP is GDP growth rate, which measures economic growth, $INFR$ and $INFR^2$ are the inflation rate and its squared term, respectively, $REPO$ is Repo rate, $REER$ is real effective exchange rate, and ϵ_t is the error term. By including the inflation rate squared term in the model, we can estimate its nonlinear effect on GDP growth rate. By implication, Equation (10) is predicated on the hypothesis that the inflation rate's impact on economic growth is not necessarily negative or positive but that lower inflation rates could enhance (or dampen) economic growth before reaching a threshold beyond which it reduces (or increases) economic growth.

After estimating Equation (10), if both β_1 and β_2 are statistically significant and carry opposite signs, then a nonlinear relationship exists between the inflation rate and economic growth, which is suggestive of a threshold of inflation rate. If β_1 and β_2 carry negative and positive signs, the relationship is convex or U-shaped. On the other hand, if the former carries a positive sign while the latter carries a negative sign, then the INFR-GDP relationship follows an inverted U-shaped or concave pattern. The threshold of inflation rate can be determined by partially differentiating Equation (10) concerning INFR and by setting the solution to zero, which would produce Equation (11) as the threshold of INFR:

$$\frac{\partial GDP_t}{\partial INFR_t} = \frac{-\beta_1}{2\beta_2} \tag{11}$$

The autoregressive distributed lag (ARDL) or bound testing technique of Pesaran et al. (2001) estimates the model parameters. This estimation method is highly rated among researchers because of its various merits. It can generate reliable estimates in models containing variables that are entirely I(0) or I(1) processes or a combination of both I(0) and (1) processes. Also, a model's long-run and short-run parameters can be estimated simultaneously using the ARDL technique. Moreover, the endogeneity issue can be satisfactorily addressed using the method. Equation (10) is thus stated in ARDL form as follows:

$$\begin{aligned}\Delta GDP_t = \theta + \sum_{i=1}^{p} \emptyset_1 \Delta GDP_{t-i} + \sum_{i=1}^{p} \emptyset_2 \Delta INFR_{t-i} + \sum_{i=1}^{p} \emptyset_3 \Delta INFR_{t-i}^2 + \sum_{t-i}^{p} \emptyset_4 \Delta REPO_{t-i} \\ + \sum_{t-i}^{p} \emptyset_5 \Delta REER_{t-i} + \varphi_1 GDP_{t-1} + \varphi_2 INFR_{t-1} + \varphi_3 INFR_{t-1}^2 + \varphi_4 REPO_{t-1} + \varphi_5 REER_{t-1} + \varepsilon_t\end{aligned} \tag{12}$$

Within the framework of the ARDL technique, the null of no cointegration among the variables ($H_0: \emptyset_1 = \emptyset_2 = \emptyset_3 = \emptyset_4 = \emptyset_5 = 0$) is tested against the alternative hypothesis that the variables are related in the long run ($H_1: \emptyset_1 \neq \emptyset_2 \neq \emptyset_3 \neq \emptyset_4 \neq \emptyset_5 \neq 0$). The joint significance of the estimated coefficients of the lag level, from which the F-statistic is generated, is tested for the long-run relationship among the variables in Equation (12). Following that, the computed F-statistic is placed against the critical upper bound and lower bound values that Pesaran et al. (2001) provided. The null hypothesis of no long-run association between the variables is rejected if the estimated F-statistic exceeds the upper bound critical value. On the other hand, the null hypothesis that there is no long-term link between the variables cannot be rejected if the estimated F-statistic is smaller than the lower bound critical value. The calculated F-statistic is inconclusive if it lies between the lower and upper bound critical values. In this case, the result of the error correction term would determine whether there is cointegration among the variables. Prior to the implementation of the ARDL bound test procedure, the VAR lag selection criteria is utilised to select the appropriate lag length for the model. This is followed by unit root tests to enable us determine the integration properties of the data.

To check the robustness of the estimate of the inflation rate threshold, an alternative method follows a threshold regression procedure in Khan and Senhadji (2001). This approach takes changes in the regression slope into account in a consistent analysis model and has the following conditional representation:

$$GDP_t = \alpha_0 + \alpha_1 INFR_t + \alpha_2 * D_t(INFR_t - k) + \alpha_3 REER_t + e_t \tag{13}$$

In Equation (13), the variables are as earlier defined, k is the inflation rate threshold and D is a dummy variable, bound by the following conditions:

$$D_t = 1 \text{ if } INFR_t > k;\ D_t = 0 \text{ if } INFR_t \leq k \tag{14}$$

An inflation threshold (k) is needed as a priori knowledge for the regression model in Equation (13). Since this information was not directly available, a manual threshold value was simulated to match the best model test requirements and produce the most accurate regression estimation results. For South Africa, a workable threshold ranges from a rate of 4 to 9 percent. The parameter k possesses the feature that, while inflation rate is low, the relationship between it and economic growth is given by α_1, and by $\alpha_1 + \alpha_2$, while the inflation rate is high. By estimating the various values of k,

which are selected in ascending order, we can obtain the optimal value of k, as the one in the respective regression, the value of R^2 is maximised. Put differently, the optimal inflation rate threshold (k^*) is the value of k in the regression with the lowest residual sum of squares (RSS) (Ahmed and Mortaza, 2010; Frimpong and Oteng-Abayie, 2010).

4. Results and discussion

The econometric procedure starts with the determination of the appropriate lag length for the model, using the VAR Lag Order Selection Criteria. The test results are presented in **Table 4**. All the criteria agree that the appropriate lag length for the model is lag 1. Thus, the model is estimated using lag 1. In the next step, the integration properties of the variables are determined by conducting the augmented Dickey and Fuller (1975) and Phillips and Perron (1988) unit root tests. The results are displayed in **Table 5**. The results from both tests are unanimous that GDP, INFR, INF^2 (the squared term of INFR) and REER are stationary at level, while REPO becomes stationary after the first difference. These results affirm that the variables in the model are fractionally integrated between orders 0 and 1, and that there is no case of order 2 integration or higher.

Table 4. Var lag order selection criteria.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−1107.263	NA	42349.36	22.00521	22.10878	22.04714
1	−816.5239	552.6927	119.2057*	16.13046*	17.06259*	16.50781*
2	−778.5884	69.11028*	183.7628	16.56483	17.08268	16.77447
3	−765.4624	22.87309	126.6730	16.18737	17.53377	16.73243
4	−754.7635	17.79610	141.7089	16.29235	18.05302	17.00512

Note: LR = sequential modified LR statistic; FPE = final prediction error; AIC = Akaike information criterion; CS = Schwarz information criterion; HQ = Hannan-Quinn information criterion.

Table 5. Unit root test results.

	Augmented Dickey-Fuller		Phillips-Perron	
	Level	1st Diff.	Level	1st Diff.
GDP	−14.46***	−6.951***	−15.494***	−74.368***
INFR	−3.131**	−8.727***	−2.701*	−13.016***
$INFR^2$	−4.883***	−8.02***	−2.625*	−11.068***
REPO	−1.696	−6.833***	−1.446	−4.487***
REER	−10.654***	−8.976***	−10.644***	−73.938***

Note: ***, ** and * indicate 1%, 5% and 10% levels of significance, respectively.

The outcome of the unit root tests indicates a possibility of applying the bound test for cointegration based on the integration attributes of the series. The result of the bound test is reported in **Table 6**. From the results, the computed F-statistics stands at 7.86, which is higher than the upper bound critical value of 5.06 and lower bound critical value of 3.74. This indicates that the null hypothesis that the variables in the model (GDP, INFR, $INFR^2$ REPO and REER) do not have a long-run relationship is

rejected. Therefore, the alternative hypothesis of long-run association among the variables is accepted.

Table 6. Bounds test results.

Statistic	Value
F-statistic	7.861***
Lower bound critical value	3.74
Upper bound critical value	5.06

Note: *** indicates 1% level of significance.

Following the estimation of Equation (12), the estimates of both the long-run and short-run parameters are displayed in **Table 7**. The results of the long-run estimates show that both INFR and $INFR^2$ are statistically significant at 1% and 5% respectively. Additionally, while INFR carries a positive sign, $INFR^2$ carries a negative sign. This indicates that the linkage of inflation and economic growth is inverted U-shaped and that the inflation rate affects economic growth differently as it changes in value. Specifically, this result implies that in the long run, when the inflation rate is low, its impact on economic growth is beneficial, but when it increases beyond a certain threshold, its effect on economic growth is negative. This result aligns with the position of neoclassical growth model that an increase in the inflation rate would eventually lead to a decline in the supply of labour and in the economy's growth rate (De Gregorio, 1996). The result is also consistent with Masiyandima et al. (2018) and Phetwe and Molefhe (2016), who investigated other Southern African economies and concluded that the relationship between inflation and economic growth is nonlinear and inverted U-shaped. It also corroborates previous studies on South Africa by Leshoro (2012) and Phiri (2018) who found that inflation-economic growth nexus in South Africa is nonlinear and inverted U-shaped.

Table 7. ARDL results.

Variable	Coefficient	Std. Error	*t*-Stat	*p*-value
Long-run results:				
INFR	0.08983***	0.01262	7.118	0.000
$INFR^2$	−0.00748**	0.00351	−2.131	0.037
REPO	−0.00455**	0.00219	−2.078	0.011
REER	−0.08179***	0.01395	−5.863	0.004
Short-run results:				
ECT	−0.71026***	0.06670	−10.649	0.000
D(INFR)	−0.86872**	0.41505	−2.093	0.043
D($INFR^2$)	0.04277	0.03276	1.306	0.195
D(REPO)	−0.00125*	0.00069	−1.811	0.074
D(REER)	−0.00157**	0.00063	−2.493	0.015

Note: ***, ** and * indicate 1%, 5% and 10% levels of significance, respectively.

The threshold that changes the direction of the linkage between inflation and economic growth in the long run can be determined by estimating the coefficients in

Equation (11) as the basis for optimisation. Therefore, the optimum inflation rate is reached when Equation (11) equals zero. Solving the equation means an inflation rate threshold of 6 percent (0.08983/2(0.00748) = 6.00). This research outcome implies that economic growth is positively impacted when the rate of inflation is below 6 percent. However, as soon as the inflation rate crosses the 6 percent threshold, economic growth is negatively impacted. This result indicates that in the long run, the optimal rate of inflation safe for economic growth in South Africa is 6 percent. Monetary authorities should endeavour to work with this rate for the healthy growth of the economy. This study builds on previous research efforts which have proposed inflation thresholds for South Africa's economic growth. These studies include Leshoro (2012) who proposed a 4% inflation threshold and Phiri (2018) who suggested a 5.3% inflation threshold.

Furthermore, we know that deflation, or a price drop, is a possibility in an economy if there is no inflation, which engenders reduced outputs and wage cuts. Achieving the threshold inflation rate will be a reliable deterrent to these negative possibilities. Therefore, inflation will support a steady economic growth rate if its annual growth rate does not outstrip 6 percent. On the contrary, if its growth rate does outstrip 6 percent, inflation tends to become detrimental, sharply slowing the growth of the South African economy. This result corroborates previous studies which argued that an inflation rate beyond a certain threshold tends to inhibit the growth of the economy (Abdulaqdir et al., 2019; Khan and Senhadji, 2001; Leshoro, 2012; Masiyandima et al., 2018; Munir et al., 2009; Phetwe and Molefhe, 2016; Phiri, 2018).

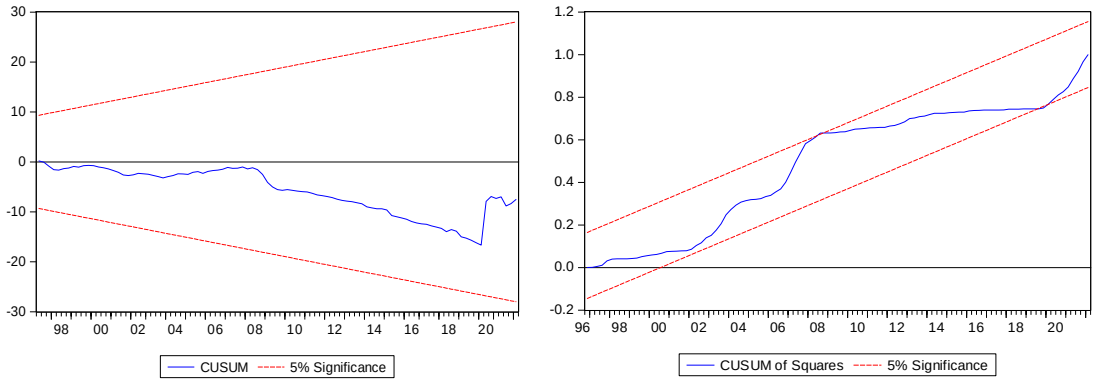
The long-run coefficient of REPO is negative and significant at 5%. This indicates that the repurchase rate (REPO), which SARB most often uses to control inflation, has an inverse relationship with economic growth and should be applied cautiously by SARB not to inhibit economic growth. This result corroborates that of Habanabakize and Meyer (2018), which showed a negative long-run relationship between REPO and economic growth in South Africa. Furthermore, REER has a negative and significant coefficient at the 1% level. This implies that in the long-run, high REER is associated with declining economic growth in South Africa. Intuitively, a higher REER tends to make an economy lose its international trade competitiveness and could deteriorate the balance of trade. This result is in line with previous studies on South Africa (for example, Mudenda et al., 2014; Precious et al., 2014; Sibanda et al., 2013), which concluded that REER has a negative relationship with economic growth. On the other hand, the result contradicts Tarawalie (2010), who reported a positive linkage between REER and economic growth in Sierra Leone.

Turning to the short-run results, the coefficient of INFR is negative and significant at 5%, while that of $INFR^2$ is statistically insignificant. This implies that the linkage of inflation and economic growth is linear in the short run. It also implies that in the short run, an increase in INFR is associated with a decline in the economy's growth. This result is in line with Manamperi (2014) and Mandeya and Ho (2021), who argued that inflation has a negative impact on economic growth in the short run. Similar to their long-run results, both REPO and REER also negatively impact economic growth in the short run, which indicates that an increase in REPO and REER tends to lead to a decline in economic growth in the short run.

The results of the various diagnostic tests for our model are displayed in **Table 8**. The probability values of each of the tests exceed the 5% level. This indicates that the model possesses a normal distribution attribute and does not suffer from the problem of either heteroscedasticity or serial correlation. Furthermore, as Brown et al. (1975) suggested, stability tests were conducted on the model, and the results are reported in **Figure 1**. The figures show that the CUSUM and CUSUMSQ plots fall within the 95% confidence level. This confirms that the estimates in the model are stable.

Table 8. Diagnostic test results.

Test	Probability
Normality	0.375
Residual heteroscedasticity	0.182
Serial correlation (LM)	0.617



(a) **(b)**

Figure 1. CUSUM and CUSUM of squares plots of recursive residuals: **(a)** CUSUM; **(b)** CUSUM of squares.

As an alternative to the ARDL estimation, a threshold regression was also conducted on Equation (13) by ordinary least squares (OLS), in line with the procedure in Khan and Senhadji (2001). The regression results are presented in Table 9. The inflation rate threshold for South Africa was conducted within 9 percent ±4 percent band. Through Equation (13), specific inflation rate thresholds are stated, the impact of each threshold level on economic growth is assessed, and the coefficient of determination (R^2) for each threshold is computed. As stated earlier, the optimal threshold of inflation is the one that maximises the R^2.

We can observe from the results that at lower inflation rate thresholds ($k < 6\%$), the coefficient of α_2 (which denotes the inflation rate threshold dummy) is not statistically significant. This implies that the relationship between the inflation rate threshold dummy and economic growth is insignificant for threshold levels of 4% and 5%. By implication, the relationship between inflation rate and economic growth at threshold levels 4% and 5% is accounted for by only α_1. However, α_2 becomes significant as k increases from 6% to 9%. In other words, the relationship between inflation rate threshold dummy and economic growth is significant for inflation threshold levels 6% to 9% ($k \geq 6\%$), and at these inflation rate thresholds, the linkage between inflation and economic growth is accounted for by $(\alpha_1 + \alpha_2)$. Consequently,

the results, as displayed in **Table 9**, imply that for an inflation rate below 6 percent, an increase in the rate of inflation is associated with a decline in economic growth by the coefficient of INFR. On the other hand, if the inflation rate is 6% or higher, an increase in inflation rate is associated with a decline in economic growth by the combined coefficients of INFR and (INFR-k).

As shown in **Table 9**, between threshold levels of 6 percent to 9 percent, the coefficient of determination is maximised at 6 percent. Thus, the optimal inflation rate for South Africa is 6 percent, which is consistent with the result in the ARDL estimation. Therefore, inflation will help maintain a stable economic growth rate if the annual inflation rate does not exceed 6 percent. On the other hand, inflation tends to become detrimental and considerably slow the growth of the South African economy if the yearly inflation rate exceeds 6 percent.

Table 9. Results of inflation threshold model estimation.

k	Variable	Coefficient	Std. Error	Probability	*R*-squared
4%	C	0.0255***	0.0027	0.000	0.51381
	INFR	−0.0136**	0.0064	0.018	
	D(INFR-k)	−0.0104	0.0065	0.142	
	REER	−0.1381***	0.0245	0.000	
5%	C	0.1924***	0.0128	0.000	0.50212
	INFR	−0.0151***	0.0038	0.000	
	D(INFR-k)	−0.0217	0.0143	0.137	
	REER	−0.0931**	0.0456	0.031	
6%	C	0.0648***	0.0218	0.006	0.53196*
	INFR	−0.0129**	0.0064	0.022	
	D(INFR-k)	−0.0274***	0.0087	0.000	
	REER	−0.1782*	0.0963	0.062	
7%	C	0.0752**	0.0316	0.015	0.51281
	INFR	−0.0116***	0.0019	0.000	
	D(INFR-k)	−0.0259***	0.0051	0.001	
	REER	−0.1132**	0.0539	0.034	
8%	C	0.1093***	0.0091	0.000	0.52192
	INFR	−0.0130**	0.0060	0.041	
	D(INFR-k)	−0.0266*	0.0145	0.053	
	REER	−0.0818***	0.0205	0.000	
9%	C	0.0913***	0.0114	0.000	0.52127
	INFR	−0.0124**	0.0052	0.038	
	D(INFR-k)	−0.0271**	0.0130	0.014	
	REER	−0.0904***	0.0129	0.000	

Note: ***, ** and * indicate 1%, 5% and 10% levels of significance, respectively.

When series on inflation and economic growth have high frequency, the causality may follow a different path from inflation to growth but rather the reverse. If this is the situation, the estimated impact of inflation on growth is likely biased. Furthermore,

REER could be endogenous to the model. If the traditional OLS is applied in these situations, estimates may differ. To address these issues and assess the estimates' robustness, it was decided to reassess the threshold model using the Two-Stage Least Square (TSLS) estimation method. The collection of instruments included first lags of GDP, INFR and REER. The estimates of the TSLS regression, as reported in **Table 10**, also indicate the optimal inflation rate threshold as 6 percent. Furthermore, the TSLS regression estimates are generally similar to those of the main regression in **Table 9**.

Table 10. Results of inflation threshold model estimation (TSLS).

k	Variable	Coefficient	Std. Error	Probability	*R*-squared
4%	C	0.0815***	0.0272	0.000	0.49731
	INFR	−0.0951***	0.0338	0.003	
	D(INFR-k)	−0.0252	0.0184	0.218	
	REER	−0.0811*	0.0443	0.062	
5%	C	0.1915***	0.0213	0.000	0.48312
	INFR	−0.0781**	0.0372	0.022	
	D(INFR-k)	−0.0355	0.0222	0.469	
	REER	−0.0538***	0.0135	0.000	
6%	C	0.0763***	0.0064	0.000	0.51936*
	INFR	−0.1021***	0.0204	0.000	
	D(INFR-k)	−0.0628**	0.0299	0.021	
	REER	−0.0311*	0.0164	0.068	
7%	C	0.1015**	0.0508	0.033	0.50215
	INFR	−0.0913***	0.0114	0.000	
	D(INFR-k)	−0.0435***	0.0087	0.002	
	REER	−0.0188	0.0157	0.294	
8%	C	0.0772**	0.0386	0.031	0.49492
	INFR	−0.0971***	0.0162	0.000	
	D(INFR-k)	−0.0601***	0.0086	0.000	
	REER	−0.0418*	0.0228	0.074	
9%	C	0.1136***	0.0142	0.000	0.50837
	INFR	−0.0617**	0.0295	0.014	
	D(INFR-k)	−0.0392***	0.0098	0.001	
	REER	−0.0827**	0.0394	0.016	

Note: ***, ** and * indicate 1%, 5% and 10% levels of significance, respectively.

The Toda-Yamamoto test for causality is performed as the final step in the econometric analysis, and the findings are shown in **Table 11**. Policies aimed at optimising the inflation rate for sustainable economic growth can be made more effective through access to information about the causal relationships between the variables being studied. It might also shed light on how INFR, REER and REPO shaped South Africa's GDP growth. The results suggest a unidirectional causality between inflation and economic growth, with the causality moving from inflation to

economic growth. This result corroborates Sahnoun and Abdennadher (2019), who found unidirectional causality from inflation to economic growth in North African countries. Similarly, REER and GDP have unidirectional causality from REER to GDP. This result supports Anyanwu et al. (2017), who report causality from the exchange rate to growth in Nigeria. Other significant causality results are unidirectional causalities from REER to INFR and from REPO to INFR. These results indicate that the exchange rate and repo rate are crucial to the inflation rate in South Africa, in line with Olamide (2022), who found that a higher level of instability in the exchange rate is associated with a more detrimental relationship between inflation and economic growth.

Table 11. Toda-Yamamoto causality test.

Null Hypothesis	M-Wald Stat	Probability	Causality
INFR → GDP	3.479	0.035	Yes
GDP → INFR	0.242	0.785	No
REER → GDP	4.418	0.006	Yes
GDP → REER	0.683	0.507	No
REPO → GDP	0.147	0.863	No
GDP → REPO	0.294	0.746	No
REER → INFR	5.743	0.000	Yes
INFR → REER	0.354	0.701	No
REPO → INFR	12.529	0.000	Yes
INFR → REPO	1.369	0.259	No
REPO → REER	1.880	0.158	No
REER → REPO	1.484	0.232	No

5. Conclusion

The potential for long-run growth is the most compelling reason why governments and central banks worldwide might desire to attain price stability. Economies generally worry about the inflation rate for sustainable economic growth because if it goes above the optimal inflation threshold, it could result in slower GDP growth. In this paper, the nature of the relationship between inflation and economic growth was assessed for South Africa to determine the optimal threshold of inflation rate for sustainable growth of the economy. Quarterly data over the period 1995–2022 was assessed using the ARDL and threshold regression procedures. In addition, the Toda-Yamamoto causality test was also used to assess causality among the variables in the study.

The ARDL estimates demonstrated that the relationship between inflation and economic growth is nonlinear and inverted U-shaped in the long run. However, the relationship is linear and inverse in the short run. This indicates that an increase in the inflation rate hampers economic growth in the short run. In the long run, lower inflation rates help to maintain economic growth on the upward path, while at high inflation rates beyond the threshold of 6 percent, economic growth is hampered. The long-run result is corroborated by the OLS and TSLS threshold regressions, which

also computed the inflation rate threshold at 6 percent. Furthermore, the effects of both repurchase and real effective exchange rates on economic growth were negative. The Toda-Yamamoto causality test results also revealed unidirectional casualties from inflation to economic growth, from exchange rate to economic growth, from exchange rate to inflation and from repo rate to inflation.

These research outcomes imply that to achieve long-term economic growth and sustainable development. It is crucial to strike the right balance between inflation and economic growth. As future inflation expectations are a critical factor in economic decision-making, this study makes an essential contribution by determining an optimal inflation rate, which helps to stabilise inflation expectations and results in more predictable business planning, wage negotiations and investment decisions. This resulting stability engenders a favourable atmosphere for long-run economic growth and sustainable development. Furthermore, these research outcomes are crucial for the South African Reserve Bank (SARB) in the discharge of its monetary policy functions with the overarching objective of attaining and maintaining price stability. In summary, this study provides backing for maintaining an optimal inflation level within the existing target range of 3%–6%, as set by SARB. Therefore, this study offers the SARB a roadmap for targeting an inflation rate that aligns with the nation's long-term objectives for sustainable economic growth.

Furthermore, structural reforms should be implemented to tackle the underlying supply-side issues and increase the economy's capacity for productivity rather than overstretching the inflation target beyond the 6% threshold, which could negatively affect growth. These reforms should focus on reducing inefficiencies in the labour market, driving competition, spending on education and skill development and improving the business climate.

This research builds on the existing literature and contributes by refining the suggested inflation thresholds. Previous studies on South Africa by Leshoro (2012) and Phiri (2018) had proposed inflation thresholds of 4% and 5.3%, respectively. The estimation of the inflation threshold at 6% by the current study indicates that it is crucial to acknowledge the evolving nature of macroeconomic conditions in South Africa and the need for periodic reassessment of optimal inflation targets by SARB.

Moreover, the negative impact of real effective exchange rate and repo rate on economic growth has policy implications. First, policymakers should carefully consider the potential negative impact of repo rate on economic growth and explore alternative tools for inflation control. Tools like supply-side policies aimed at addressing structural issues in the economy can be implemented as they can have a more lasting impact on inflation. Wage and price interventionist controls can also be carefully considered. Second, policymakers should be cautious about allowing the REER to rise too high, as it may harm international trade competitiveness and the balance of trade. The need to control these two macroeconomic variables is further reinforced by the results of unidirectional causalities from repo rate and REER to inflation. For example, findings of Olamide (2022) revealed how exchange rate instability engendered adverse impact of inflation on economic growth.

Additionally, to offer clear and consistent direction on its inflation targets and policy decisions, the SARB needs to improve its communication approach. This is because transparency promotes trust and enables people and businesses to make

informed decisions based on the trajectory of anticipated inflation. Finally, it is crucial to regularly monitor and assess the optimal inflation rate and how it affects economic growth. Given the dynamic nature of economic conditions, it is recommended that ongoing monitoring and research be conducted to reassess optimal inflation targets and the impact of monetary policy tools on economic growth. Important macroeconomic indicators like GDP growth, investment trends, employment levels and inflation expectations should be regularly analysed. If the economic environment significantly changes because of this, modifications to the inflation target should be considered.

A major limitation of this study is the inability to incorporate other variables that explain economic growth in the growth model. This was because of inaccessibility of quarterly data for these variables. This study has contributed by establishing the optimal inflation rate for South Africa, which is crucial for promoting economic growth and determining appropriate real interest rates. Future research can include more important variables as explanatory variables. Furthermore, future studies can undertake a comparative analysis of optimal inflation rates in major sub-Saharan African economies.

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