

South African Reserve Bank Working Paper Series WP/21/14

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Authorised for distribution by Konstantin Makrelov

30 July 2021



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Identifying Steady-State Growth and Inflation in the South African Economy, 1960-2020

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July 2021

Abstract

This paper employs a simple but general representation of an economy, in order to derive mutually consistent estimates of steady state growth and inflation for South Africa over the period from 1960Q1 through to 2020Q2, as well as the implied "gaps" between actual growth and inflation and their steady-state values. Analysis is under both closed and open economy frameworks. Moreover, the full sample is partitioned in sub-samples either *ex ante* by decade, or endogenously from structural breaks implied by the univariate time series characteristics of the data.

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[†]Views expressed in this paper are those of the author alone, and do not necessarily reflect those of any of the institutions with which the author is affiliated. Responsibility for the paper's contents vests solely in the author. The research assistance of Tinghua Chen, Helen Knafo, Anushka Thachil and Wei-Ting Yang is gratefully acknowledged.

1. Executive Summary

This paper employs a simple but general representation of an economy, in order to derive mutually consistent estimates of steady-state growth and inflation for South Africa over the period from 1960Q1 through to 2020Q2, as well as the implied "gaps" between actual growth and inflation and their steady-state values. Analysis is under both closed and open economy frameworks. Moreover, the full sample is partitioned in sub-samples either *ex ante* by decade, or endogenously from structural breaks implied by the univariate time series characteristics of the data.

Core findings are as follows:

- Steady-state values of growth in real output have fallen over time: by the 2010s steady-state growth lies in the 1.268% to 1.444% range under the decadal decomposition, and the -0.067% to 1.977% range under the endogenous break decomposition. Even relative to the modest full-sample steady-state growth performance of 2.808% to 3.740%, this represents a significant softening of South Africa's growth potential.
- Steady-state growth values for the open economy case are markedly higher than for the closed economy case, suggesting that globalisation is an important bulwark protecting South African growth.
- Closed economy steady-state growth values generate a preponderance of positive growth gaps, open economy steady-state growth values a preponderance of negative growth gaps. The 2010s growth gap is amongst the smallest in our sample, suggesting that the observed low growth rates are evidence of a structural incapacity to grow.
- Endogenously determined structural breaks for the South African economy have lowered the economy's steady-state growth performance, implying a declining structural competitiveness of the South African economy.
- Macroeconomic stabilisation policy has been relatively successful since the democratic transition: the volatility of both growth and inflation deviations from steady-state values has declined dramatically since the mid-1990s.
- Steady-state inflation is subject to an inverted-U shape over our sample period, rising from the 1960s through the 1980s and declining thereafter, consistent with the oil-price shock inflationary pressure during the 1970s and the adoption of monetary policy stances emphasising price stability post-2000.
- Divergence between closed and open economy steady-state inflation values is muted, suggesting that inflationary pressure in South Africa is domestic rather than imported.
- Inflation gap values consistently prove to be negative, suggesting that there remains underlying structural inflationary pressure in the South African economy.
- Endogenously derived structural breaks to the economy raise steady-state inflation prior

to 1980 and lower it thereafter, particularly for the break surrounding the year 2000. The implication is that the adoption of inflation targeting around 2000 was successful in improving price stability.

- The structural break in the economy corresponding to 2000 is important. Inflation and growth volatility declined after 2000. It is also a break point that served to raise steady-state growth and lowered steady-state inflation. The break thus corresponds not only with improved macroeconomic stability, but with an improved structural performance of the economy in the growth and inflation dimensions.

In conclusion, South Africa's macroeconomic stabilisation policy has moderated the volatility of growth and inflation gaps. However, the economy shows a worrying downward trend in its structural capacity to grow, and a lack of resilience in its growth performance to exogenous shocks. While the adoption of inflation targeting particularly around 2000 corresponds to greater price stability thereafter, inflation gaps remain negative, suggesting the presence of continued inflationary pressure in the economy, primarily due to domestic rather than imported inflation.

In short, South Africa is manifesting symptoms of stagflation.

2. Introduction

Despite a brief recovery following South Africa's democratic transition in 1994, the structural growth performance of the economy has been a perennial source of concern. Considered in a longer-term perspective, growth has been on a steady downward trajectory, with the interregnum of 1995–2008 proving an exception from the overall trend. The associated literature on South African potential output consistently underscores the downward pressure on structural growth – see Fedderke and Mengisteab (2017), Klein (2011) and Steenkamp (2018).

There are two broad approaches to estimating potential output that predominate in empirical contexts: statistical filtering and approaches based on structural models, for instance by the estimation of production functions. However, most of the literature on potential output in South Africa has employed data-filtering approaches to estimate potential output rather than structural modelling approaches, though a number of papers have employed approaches based on production functions.

Statistical filtering approaches benefit from their simplicity but prove sensitive to the filter parameterisation. Moreover, their lack of structural economic theoretical foundations makes the identification of underlying structural, and hence causal, drivers of potential output difficult. Kramer and Farrell (2013) review the limitations of statistical filters, while Fedderke and Mengisteab (2017) explore the sensitivity of potential output measures for South Africa to the use of alternative filters.

Production-function-based approaches, while having greater foundation in economic theory, in turn suffer from difficulties arising from data limitations, especially surrounding the measurement of capital, questions as to the appropriate functional form to be employed in the production function estimation, and econometric concerns surrounding identification arising from endogeneity. Other structural approaches include dynamic stochastic general equilibrium (DSGE) models, and structural vector autoregressive (SVAR) models, though these have been used relatively infrequently in identifying potential output in South Africa.

The present paper undertakes two distinct tasks.

The first is to derive a measure of the steady-state growth rate of the South African economy, from a simple but relatively general vector autoregressive (VAR) representation of a macroeconomy derived from the literature, which traces its foundations to Blanchard and Quah's (1989) identification of supply and demand shocks of an economy. The open economy extensions by Ahmed et al (1993), Ahmed and Park (1994) and Dungey and Pagan (2000) are also material. An immediate advantage of this approach is that it delivers a measure of the steady-state growth of the economy and simultaneously derives a steady-state value for inflation in the economy, such that the growth and inflation steady-state values are mutually consistent with one another. A second advantage of the approach is that the steady-state values are not based on statistical filtering, but on an (albeit simple) structural representation of the economy.

The second task of the present paper is to pay attention to the sensitivity of results to the use

of an open or a closed economy VAR. In addition, since we consider a long sample period of quarterly data, covering 1960Q1 through 2020Q2, we pay close attention to the possibility of structural breaks in the underlying data, and hence in the estimates of steady-state growth and inflation. We do so both by considering a decadal decomposition of the steady-state values, and by allowing the breaks in the data to be determined endogenously from unit root tests.

The paper is structured as follows. Section 3. provides a brief review of the South African potential output literature. Section 4. presents the simple structural representation of the economy we employ, with Sections 4.1 and 4.2 applying to the closed and open economy cases respectively. Section 5. details the data used for this study. Section 6. reports results, and Section 7. concludes.

3. Literature review

Derivation of potential output for South Africa is not new, though the simultaneous derivation of internally consistent steady-state values for both growth and inflation is more of an innovation – though see Botha and Steenkamp (2020) a partial precursor.

Studies employing statistical filters include Smit and Burrows (2002), Akinboade (2005), Ehlers et al (2013), Arora and Bhundia (2003), Du Toit et al (2006), Du Plessis et al (2008), Boshoff (2010), Kramer and Farrell (2013), Anvari et al (2014), Kemp (2015), and Fedderke and Mengisteab (2017). Starting from Anvari et al (2014), the contributions that employ the Borio et al (2013, 2014) approach of incorporating financial cycle characteristics into the estimation of potential output in a Kalman filter consistently argue for the importance of accommodating financial sector impacts. Inferences for the potential growth capacity of the South African economy range from the relatively optimistic Ehlers et al (2013) estimate of at least 3.5%, to the more muted estimates of Fedderke and Mengisteab (2017), who find that the growth deceleration post-2010 points to a structural growth rate that lies closer to 1% than 2%.

Structural approaches to potential output determination, usually based on production functions, include Smit and Burrows (2002), Akinboade (2005), Ehlers et al (2013), and Fedderke and Mengisteab (2017). More recently, a number of contributions that have the identification of supply and demand shocks in South Africa as their principal focus, derived inferences for potential growth for the economy. Thus Botha and Steenkamp (2020) employ the Quarterly Projection Model of the South African Reserve Bank, and Kuhn (2020) employs a common factor model derived from Camacho et al (2010).

4. Steady-state growth and inflation

Simultaneous derivation of steady-state values for growth and inflation that are internally consistent with one another proceeds trivially from the estimation of a simple VAR structure, for both closed and open economy contexts.

4.1 The closed economy case

We begin with a consideration of the closed economy case, consistent with the contribution of Blanchard and Quah (1989).

Consider a simple VAR representation of the domestic output and inflation (prices). Allowing y_t and π_t to denote the log of real domestic output and the domestic inflation rate respectively, and Δ the first difference operator, this allows for the VAR representation:

$$\Delta y_t = \alpha_{10} + \sum_{j=1}^k \alpha_{11,j} \Delta y_{t-j} + \sum_{j=1}^k \alpha_{12,j} \pi_{t-j} + \varepsilon_{1t} \quad (1)$$

$$\pi_t = \alpha_{20} + \sum_{j=1}^k \alpha_{21,j} \Delta y_{t-j} + \sum_{j=1}^k \alpha_{22,j} \pi_{t-j} + \varepsilon_{2t} \quad (2)$$

in which variables are differenced as appropriate in order to ensure stationarity.¹ The ε_{1t} and ε_{2t} are random disturbances in the output and inflation equations. Steady-state values of growth and inflation, under $\varepsilon_{1t} = \varepsilon_{2t} = 0$, are then:

$$\Delta y^* = \frac{\alpha_{10} \left(1 - \sum_{j=1}^k \alpha_{22,j}\right) + \alpha_{20} \sum_{j=1}^k \alpha_{12,j}}{C} \quad (3)$$

$$\pi^* = \left(\frac{\alpha_{20}}{1 - \sum_{j=1}^k \alpha_{22,j}} \right) + \left(\frac{\sum_{j=1}^k \alpha_{21,j}}{1 - \sum_{j=1}^k \alpha_{22,j}} \right) \left(\frac{\alpha_{10} \left(1 - \sum_{j=1}^k \alpha_{22,j}\right) + \alpha_{20} \sum_{j=1}^k \alpha_{12,j}}{C} \right) \quad (4)$$

$$C = \left(1 - \sum_{j=1}^k \alpha_{11,j}\right) \left(1 - \sum_{j=1}^k \alpha_{22,j}\right) - \sum_{j=1}^k \alpha_{12,j} \sum_{j=1}^k \alpha_{21,j} \quad (5)$$

Note that this implicitly defines cyclical variation in both growth and inflation as:

$$\widetilde{\Delta y}_t = \Delta y_t - \Delta y^* \quad \widetilde{\pi}_t = \pi_t - \pi^* \quad (6)$$

with Δy^* and π^* specified under 3 and 4.

4.2 The open economy case

The obvious limitation to the closed economy discussion is that it has strictly limited relevance to small open economies such as South Africa. Allowing y_t^f , y_t and π_t to denote the log of real foreign output, real domestic output, and the domestic inflation rate respectively, this allows

¹ See Sims (1980). Note that legitimate estimation under the VAR methodology depends strictly on the stationarity of all regressors to avoid inference on the basis of statistically meaningless correlations – nonsense partial correlations in the sense of Yule (1926), spurious partial correlations in the sense of Granger and Newbold (1974).

for:

$$\Delta y_t^f = \alpha_{01} + \sum_{j=1}^k \alpha_{11,j} \Delta y_{t-j}^f + \varepsilon_{1t} \quad (7)$$

$$\Delta y_t = \alpha_{02} + \sum_{j=1}^k \alpha_{21,j} \Delta y_{t-j}^f + \sum_{j=1}^k \alpha_{22,j} \Delta y_{t-j} + \sum_{j=1}^k \alpha_{23,j} \pi_{t-j} + \varepsilon_{2t} \quad (8)$$

$$\pi_t = \alpha_{03} + \sum_{j=1}^k \alpha_{31,j} \Delta y_{t-j}^f + \sum_{j=1}^k \alpha_{32,j} \Delta y_{t-j} + \sum_{j=1}^k \alpha_{33,j} \pi_{t-j} + \varepsilon_{3t} \quad (9)$$

in which variables are differenced as appropriate in order to ensure stationarity. The specification reflects the assumption that a small domestic economy will not impact foreign (world) output, but foreign output does impact both domestic output and inflation.

Steady-state values of international growth, domestic growth and inflation, under $\varepsilon_{1t} = \varepsilon_{2t} = \varepsilon_{3t} = 0$, are then:

$$\Delta y_t^{f,*} = \frac{\alpha_{01}}{1 - \sum_{j=1}^k \alpha_{11,j}} \quad (10)$$

$$\Delta y_t^* = \frac{C_1}{C_4} \quad (11)$$

$$\pi_t^* = \frac{C_4 C_5 + C_1 C_6}{C_4} \quad (12)$$

$$C_1 = \alpha_{02} + \left(\frac{\alpha_{01} \sum_{j=1}^k \alpha_{21,j}}{1 - \sum_{j=1}^k \alpha_{11,j}} \right) + \left(\frac{\left[\alpha_{01} \sum_{j=1}^k \alpha_{31,j} + \alpha_{03} \left(1 - \sum_{j=1}^k \alpha_{11,j} \right) \right] \sum_{j=1}^k \alpha_{23,j}}{\left(1 - \sum_{j=1}^k \alpha_{11,j} \right) \left(1 - \sum_{j=1}^k \alpha_{33,j} \right)} \right)$$

$$C_4 = \frac{\left(1 - \sum_{j=1}^k \alpha_{22,j} \right) \left(1 - \sum_{j=1}^k \alpha_{33,j} \right) - \sum_{j=1}^k \alpha_{23,j} \sum_{j=1}^k \alpha_{32,j}}{1 - \sum_{j=1}^k \alpha_{33,j}}$$

$$C_5 = \left(\frac{\alpha_{01} \sum_{j=1}^k \alpha_{31,j} + \alpha_{03} \left(1 - \sum_{j=1}^k \alpha_{11,j} \right)}{\left(1 - \sum_{j=1}^k \alpha_{11,j} \right) \left(1 - \sum_{j=1}^k \alpha_{33,j} \right)} \right)$$

$$C_6 = \left(\frac{\sum_{j=1}^k \alpha_{32,j}}{1 - \sum_{j=1}^k \alpha_{33,j}} \right)$$

As for the closed economy case, this then implicitly defines cyclical variation for international and domestic growth, and domestic inflation:

$$\widetilde{\Delta y_t^f} = \Delta y_t^f - \Delta y_t^{f,*} \quad \widetilde{\Delta y_t} = \Delta y_t - \Delta y_t^* \quad \widetilde{\pi_t} = \pi_t - \pi_t^* \quad (13)$$

symmetrically to the closed economy case.

5. Data

Our empirical application considers quarterly data over the 1960Q1 to 2020Q2 period. South African data for output ($\ln Y$) and inflation (π) is obtained from the South African Reserve Bank. International output data ($\ln Y^*$) employs US output derived from the St. Louis Federal Reserve.

The variables are illustrated in levels and, where appropriate, in first-difference format in Figure 1.

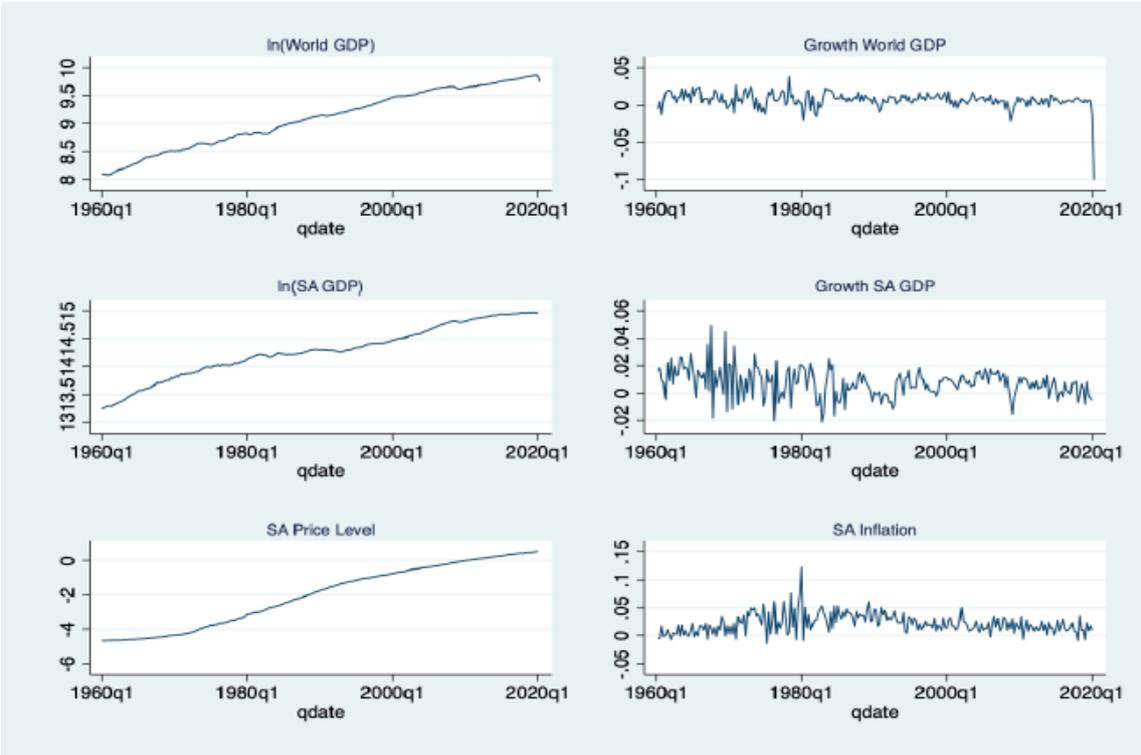


Figure 1: Variables in levels and first differences

Tests for optimal degrees of augmentation in the tests for stationarity are reported in Table 1, employing the Ng and Perron (1995) and Campbell and Perron (1991) t-test statistic, the AIC information criterion, the Ng and Perron (2001) modified AIC test statistic,² and the Schwert (1989, 2002) test statistics.

Table 2 reports the sequence of augmented Dickey-Fuller (1979, 1981) tests (henceforth ADF) under the Perron (1988) sequence, as well as Phillips-Perron (PP) and KPSS tests (Phillips and Perron, 1988; Kwiatkowski et al, 1992). Because unit root tests suffer from poor power characteristics in the presence of structural breaks (Perron, 1989, 1994; Holden and Perman, 1994), and given the likely presence of such breaks over a 60-year period at the quarterly frequency, we test for unit roots in the presence of up to two structural breaks for variables, allowing for the structural breaks to be endogenously identified under both the Clemente et

² Note that Wu (2010), in comparing the Ng-Perron-t-test and the Ng-Perron AIC-test, found the t-test to outperform the AIC-test.

	Lag Length				Adopted Lag Length
	NP-t	AIC	NP-AIC	S	
lnY*	2	1	2	14	2
Δ lnY*	8	1	8	14	2
lnY	7	3	7	14	3
Δ lnY	6	2	14	14	2
π	11	5	11	14	14

NP-t = Ng-Perron t; AIC = Akaike; Np-AIC = Ng-Perron AIC; S = Schwert lag-length test statistic.

Table 1: Optimal lag lengths for unit root test augmentation

	ADF						PP	KPSS
	τ_τ	Φ_3	Φ_2	τ_μ	Φ_1	τ		
lnY*	-0.025	3.35	4.97**	-2.58*	7.45**	2.617	-1.130	1.26***
Δ lnY*	-5.086***	14.19**	9.58**	-4.366***	9.71**	-3.148***	-142.016***	0.0843
lnY	-2.661	6.11	9.52**	-2.704*	11.70**	3.836	-1.514	0.671***
Δ lnY	-6.195***	19.19**	12.82**	-5.730***	16.45**	-4.026***	-254.898***	0.291***
π	-2.156	3.43	2.29	-1.895	1.81	-0.614	-228.365***	0.342***

ADF = Augmented Dickey Fuller; PP = Phillips-Perron, KPSS = Kwiatkowski et al;
***, **, *, denotes significance at the 1%, 5%, 10% levels respectively.

Table 2: Univariate stationarity tests

al (1992) and Zivot and Andrews (1992) methodologies.^{3,4} We report the results in Table 3, reporting the Clemente et al (1992) test for a single (CMR1) and two (CMR2) structural breaks, and the Zivot and Andrews (1992) test for a single structural break (ZA), as well as the implied timing of the breaks.⁵ Final inferences on the univariate structure of the data are provided in Table 4.

The implication from the univariate time series properties of the data is that both SA and US real GDP are stationary in first differences ($\sim I(1)$), such that SA and US growth rates are stationary. Both PP and KPSS tests confirm this inference, thus lowering the chance that the integration properties of the data are a product of the specific power and size properties of the ADF tests. While the evidence confirms the presence of structural breaks in the data, this does not alter the inference that the two output series are difference stationary. By contrast, while for inflation ADF, PP and KPSS imply nonstationarity, once we control for the presence of structural breaks (by both the CMR and ZA methodologies), the SA inflation series proves stationary. The critical breaks are endogenously determined for the early 1970s, immediately preceding the oil price crises, and the mid-1990s, when South African monetary and fiscal policy became more firmly anti-inflationary. Thus inflation proves to be stationary ($\sim I(0)$) recognising the period of relative price instability stretching from the mid-1970s to the mid-1990s.

³ The tests allow for structural breaks in both mean and trend.

⁴ See also the discussion in Perron (1989), Holden and Perman (1994), Glynn et al (2007).

⁵ For the sake of clarity: note that structural breaks are thus determined directly from the univariate time series properties of the data, *not* the full VAR.

		Statistic	Implied Breaks
lnY*	CMR1	-2.398	1996q2
	CMR2	-2.910	1983q2, 1998q4
	ZA	-1.489	2008q1
$\Delta \ln Y^*$	CMR1	-7.951**	2017q2
	CMR2	-5.526**	1979q4, 2008q2
	ZA	-7.871***	1983q1
lnY	CMR1	-2.684	2005q2
	CMR2	-3.209	1978q2, 2004q1
	ZA	-3.354	1984q3
$\Delta \ln Y$	CMR1	-6.106**	1967q1
	CMR2	-3.846	1967q1, 1982q2
	ZA	-7.255***	1993q1
π	CMR1	-1.297	1979q3
	CMR2	-6.617**	1970q3, 1993q3
	ZA	-7.334***	1971q2

CMR1 and CMR2 = Clemente et al 1 and 2 break; ZA = Zivot-Andrews test statistics.
 ***, **, *, denotes significance at the 1%, 5%, 10% levels respectively.

Table 3: Univariate stationarity tests

	$\sim I(d)$	Trend	Drift	Breaks
lnY*	1	No	Yes	1983q2, 1996q2, 1998q4, 2008q1
$\Delta \ln Y^*$	0	-	-	1979q4, 1983q1, 2008q2, 2017q2
lnY	1	No	Yes	1978q2, 1984q3, 2004q1, 2005q2
$\Delta \ln Y$	0	-	-	1967q1, 1982q2, 1993q1
π	0	No	No	1970q3, 1971q2, 1979q3, 1993q3

Table 4: Inferred univariate time series structure of the data

6. The South African evidence on potential growth and cyclical variation

The discussion of Sections 4.1 and 4.2 allows for the identification of the implied steady-state values of growth and inflation for the closed and open economy cases, consistent with the VAR specifications of equations 1 and 2 for the closed economy case, and equations 7, 8 and 9 for the open economy case. We detail the steady-state values of South African growth in real GDP, given by equations 3 and 11 for the closed and open economy cases respectively, as well as the steady-state values for South African inflation given by equations 4 and 12 for the closed and open economy cases. In addition, we record the implied gaps between actual South African growth and the steady-state values as well as between actual South African inflation and its steady-state values, as provided by equations 6 and 13.

Given the length of time coverage in this study, an immediate concern is that the sample period covers distinct policy regimes and structural conditions that would be expected to materially influence the expected steady-state values of growth and inflation. Indeed, the diagnostics of the univariate times series properties of the time series employed for this study have already indicated that the individual time series are each subject to a series of possible structural breaks, purely in terms of the time series behaviour of the data. We deal with this concern in two distinct ways. The first is that we divide the 1960-2020 sample period, into its constituent five decades, and compute steady-state values for growth and inflation for each of the decades, in addition to the full sample period. This generates a full sample as well as individual decadal estimates for both steady-state and gap variables. Second, we estimate the closed and open economy VARs in the presence of the structural breaks implied by the univariate time series structure of the data, treating the breaks as exogenous to the system. This generates a steady-state value for growth and inflation "net" of the impact of the shocks we control for, using the parameter values obtained from the estimation of the parameter values employed in equations 3, 11, and 4, 12, obtained from the VARs estimated in the presence of the structural breaks, on which the impact of the structural breaks can then be imposed in order to generate the steady-state growth and inflation values incorporating the impact of the structural changes. In controlling for structural breaks, we include one break for all endogenously determined break points within any specifiable four-quarter period.⁶ For the closed economy case, this implies controlling for five structural breaks given by 1967Q1, 1982Q2, 1970Q3, 1979Q3 and 1993Q3. For the open economy we control for eight structural breaks: 1996Q2, 1998Q4, 2008Q2, 1967Q1, 1982Q2, 1970Q3, 1979Q3 and 1993Q3. This generates a time-varying estimate of the steady-state values, not coterminous with a decadal breakdown of the data, but corresponding to the endogenously determined timing of the structural breaks in the data.⁷

⁶ For any four-quarter rolling window applied through the sample space, where two shocks occur in the four-quarter window, only one of the two shocks is controlled for in estimation. Choice between the two breaks is on the grounds of plausibility given prior empirical findings on the SA economy, or from the trend structure of the time series.

⁷ Note: for both sets of results we suppress the reporting of the VAR estimations for the sake of parsimony, since the coefficients do not have immediate structural interpretations, and given the number of distinct estimations involved. We note that all VARs prove to satisfy the stability conditions required of the roots of the difference equations being estimated.

From each determination of the steady-state values of growth and inflation, implied gap values emerge trivially from equations 6 and 13.

It is worth noting a priori that the decadal breakdown of the data does bear a correspondence to the structural performance of the South African economy: the high growth period of the 1960s; the oil crisis period coupled with the breakdown of the Bretton Woods system and rising political unrest of the 1970s; the period of high political unrest, uncertainty and international isolation of the 1980s; the democratic transition and reintegration of the South African into the world economy of the 1990s; the adoption of inflation targeting in the 2000s; and the reemergence of policy uncertainty in the 2010s. However, the decadal breakdown lacks the ability to determine the precise timing of breaks in the individual time series that constitute the VARs, nor does it allow for structural changes at the sub-decadal frequency. Since the estimation approach incorporating the endogenously estimated breaks allows for both, the estimation approach incorporating breaks might be expected to deliver more accurate estimations of steady-state values for growth and inflation, and hence for the gap values.

Further, we note in advance that all the derived values of steady-state growth for South Africa are consistent with the now broadly established result in the literature of the South African economy's declining structural capacity to grow – see Fedderke and Mengisteab (2017), Klein (2011) and Steenkamp (2018).

6.1 Growth

6.1.1 Decadal decomposition – growth

Results of the steady-state values for South African real GDP growth employing the decadal breakdown of the data are reported in Figure 2 and Table 5, for both the closed and open economy cases. Figure 2 records the quarter-on-quarter growth rates, while the tabulations record both the quarter-on-quarter estimates and the implied year-on-year (YoY) growth rates.

A number of inferences emerge from this evidence. First, open economy steady-state values for South African growth are higher than the closed economy estimates (for the full sample, 2.808% YoY closed economy; 3.740% YoY open economy), with the single exception of the 2010s. Second, on both estimates of steady-state growth, the period of high growth in the 1960s was followed by a collapse in the 1970s, then steadily rising growth over subsequent decades reaching a high point in the 2000s (3.389% YoY closed; 5.325% YoY open), and concluding with a dramatic reversal to low steady-state growth in the 2010s. Notably, the growth collapse of the 2010s is more pronounced for the open economy case than for the closed. Regardless of open or closed economy cases, however, steady-state growth in the 2010s was low (1.444% YoY closed; 1.268% YoY open).

The implied growth gaps from these steady-state growth values for the closed and open economy cases are reported in Figure 3 and Table 5. An immediate implication of the growth gaps, for both the closed and open economy cases, is that the growth performance of the South

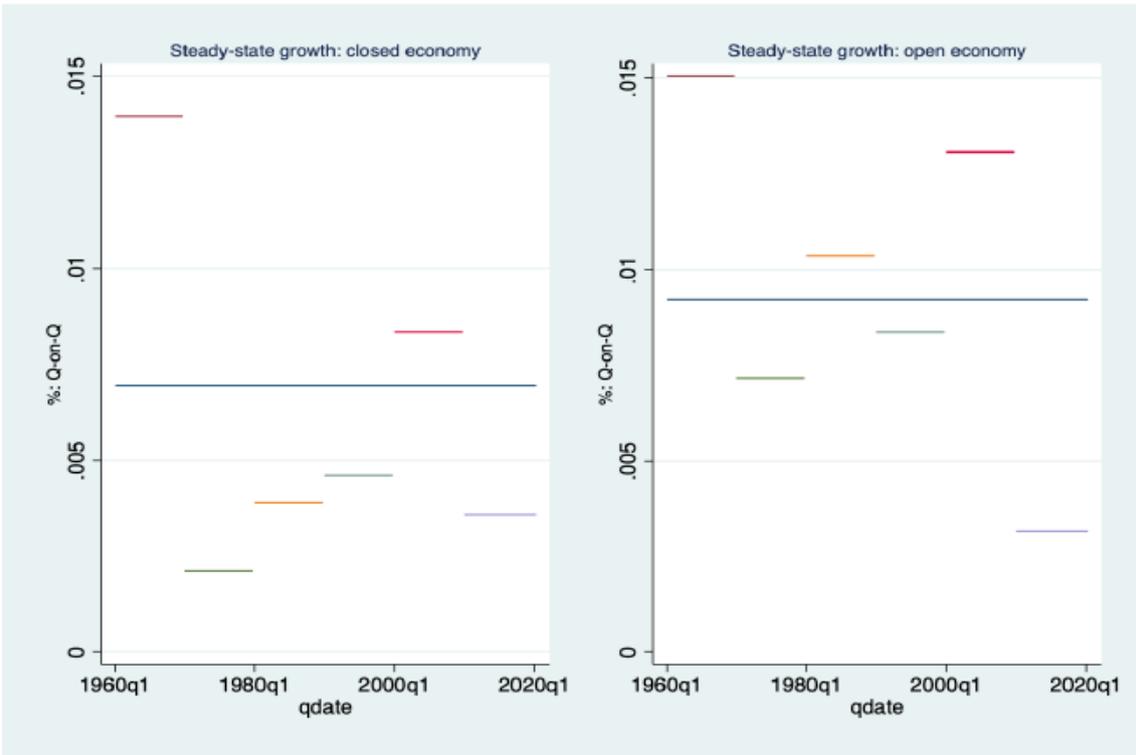


Figure 2: Steady-state growth rate: full sample and decadal values

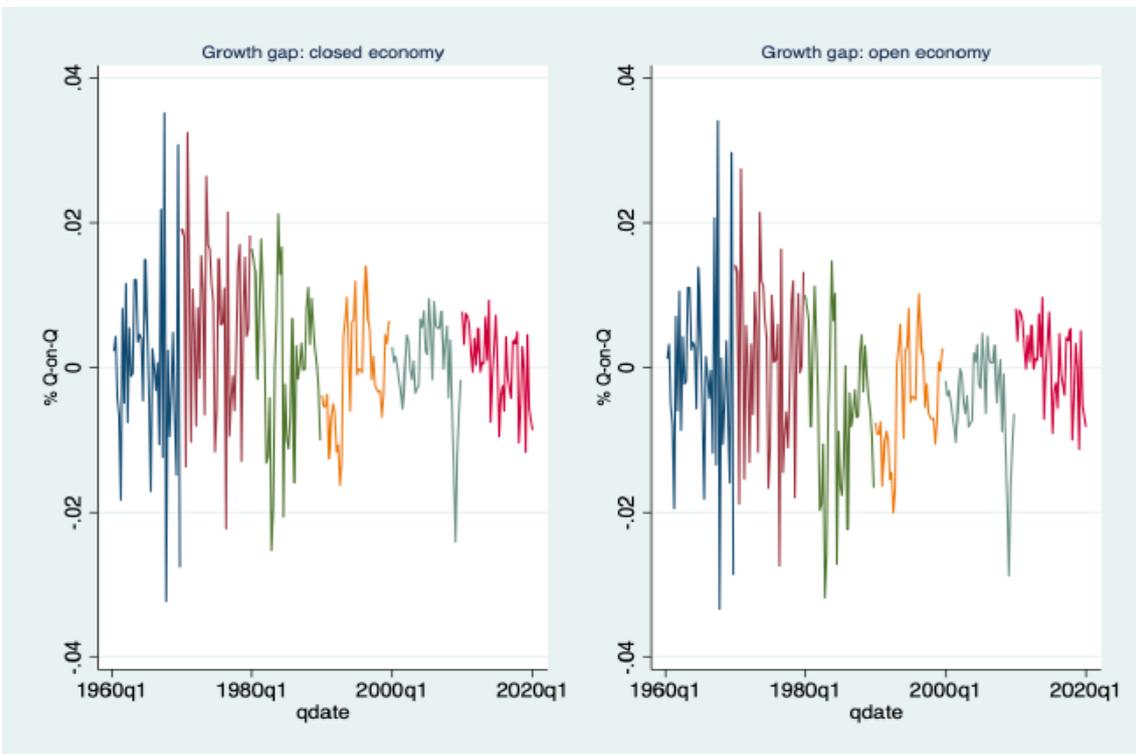


Figure 3: Growth gap: by decade

Period	Closed Economy Case				Open Economy Case			
	Steady-state Growth		Growth Gap		Steady-state Growth		Growth Gap	
	Δy_t^* %		$\Delta y_t - \Delta y_t^*$ %		Δy_t^* %		$\Delta y_t - \Delta y_t^*$ %	
	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y
Full Sample	0.695	2.808	-	-	0.922	3.740	-	-
1960s	1.394	5.694	-0.010	-0.038	1.505	6.156	-0.120	-0.480
1970s	0.212	0.852	0.606	2.445	0.717	2.898	0.101	0.406
1980s	0.389	1.565	0.095	0.379	1.038	4.216	-0.554	-2.198
1990s	0.460	1.853	-0.072	-0.288	0.839	3.399	-0.451	-1.792
2000s	0.837	3.389	0.016	0.065	1.305	5.325	-0.453	-1.798
2010s	0.359	1.444	0.017	0.068	0.316	1.268	0.060	0.242

Table 5: Steady-state growth and growth gaps under decadal decomposition

African economy has become considerably less volatile since the 1990s, compared to the preceding three decades, in the sense that both the mean and variance of the growth gap has consistently declined since 1990. We also note that for both the closed and open economy cases the growth gap during the 2010s proves to be positive on average (actual growth is above steady-state values), suggesting that the recent poor growth performance of the economy is not a function of a lack of stimulus to the economy, but a reflection of the declining structural capacity of the economy to grow. Related to this observation is that for the open economy case, during the 2000s the economy underperformed compared to its potential, in the sense that actual growth (despite its recovery relative to the preceding years) lay below the implied steady-state growth values for the economy, in part due to the negative shock surrounding the 2008 sub-prime crisis. We note also that through 2020Q2 the negative COVID-19 shock to the South African economy in relative terms has not yet proved as strong as the 2008 crisis, though this in turn reflects the already very poor capacity of the economy to grow, and the size of the COVID-19 impact may also increase in magnitude over time.

6.1.2 Decomposition with endogenous structural breaks – growth

Repeating the derivation of steady-state growth and the implied growth gaps by controlling for the endogenously determined structural breaks from Section 5., while providing broadly consistent conclusions to those obtained from the decadal approach, provides some important additional insights into South Africa's growth performance. The implied steady-state growth values are reported in Figure 4 and Table 6, providing both the direct quarter-on-quarter and the implied year-on-year growth rates in the tabular results. Note that the steady-state values for growth show a range of distinct values reflecting the impact of the structural breaks, though these no longer correspond to straightforward decadal time frames. Nonetheless, for the purposes of comparison with the decadal decomposition, in Table 6 we record averages for each of the five decades in our sample.

The most striking feature of the evidence incorporating endogenous structural breaks is that

the impact of most of the breaks has been negative for South African steady-state growth, often strongly so. The only exceptions are the two breaks timed late 1979-early 1980, and the period around 2000 (on the open economy estimate). Cumulatively, the impact of the structural breaks on the South African economy has thus been to lower its structural capacity to grow.

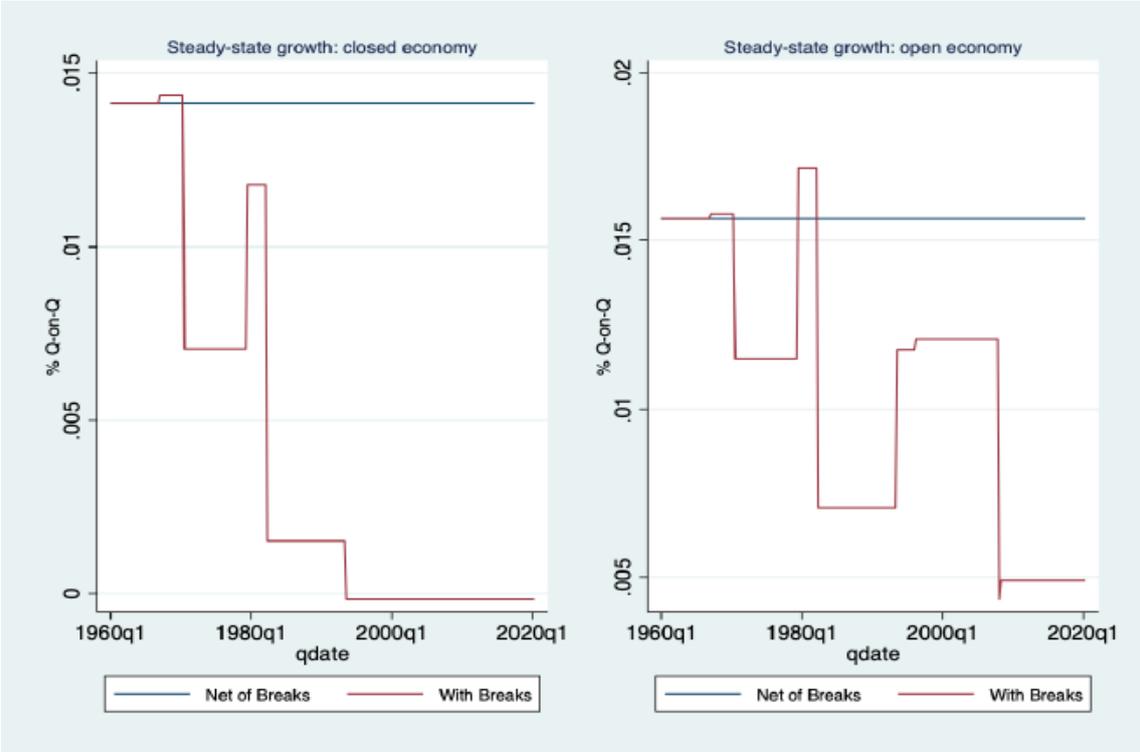


Figure 4: Steady-state growth rate: impact of endogenously determined structural breaks

Results for the steady-state estimates of South African growth mirror the decadal decompositions insofar as open economy estimates of steady-state growth are higher for the open economy decomposition than for the closed economy decomposition (for the full sample, 1.715% YoY closed economy; 4.236% YoY open economy case), though in contrast with the decadal decomposition there is no exception to this rule for the 2010s.

While both the closed and open economy estimates of steady-state growth show a decline off the highs implied for the 1960s in subsequent decades, for the closed economy case the decline is both persistent and strong, finally reaching a marginally negative steady-state growth rate by the 2000s and 2010s (-0.067% YoY). For the open economy case, there is a decline from the 1960s, though the 1970-2010 period reports steady-state growth values distributed about 4% YoY, and then halving to approximately 2% YoY in the 2010s.

As such, the implication of the estimations, controlling for structural breaks, confirms that the South African economy has a declining structural capacity for growth, already noted for the decadal decompositions. In the case of the closed economy estimates the decline is more dramatic than for the decadal decomposition, implying a negative or at best zero steady-state growth by the 2010s as opposed to the 1.2-1.4% steady-state growth of the decadal decomposition. By contrast, the open economy estimates with structural breaks offer a more optimistic

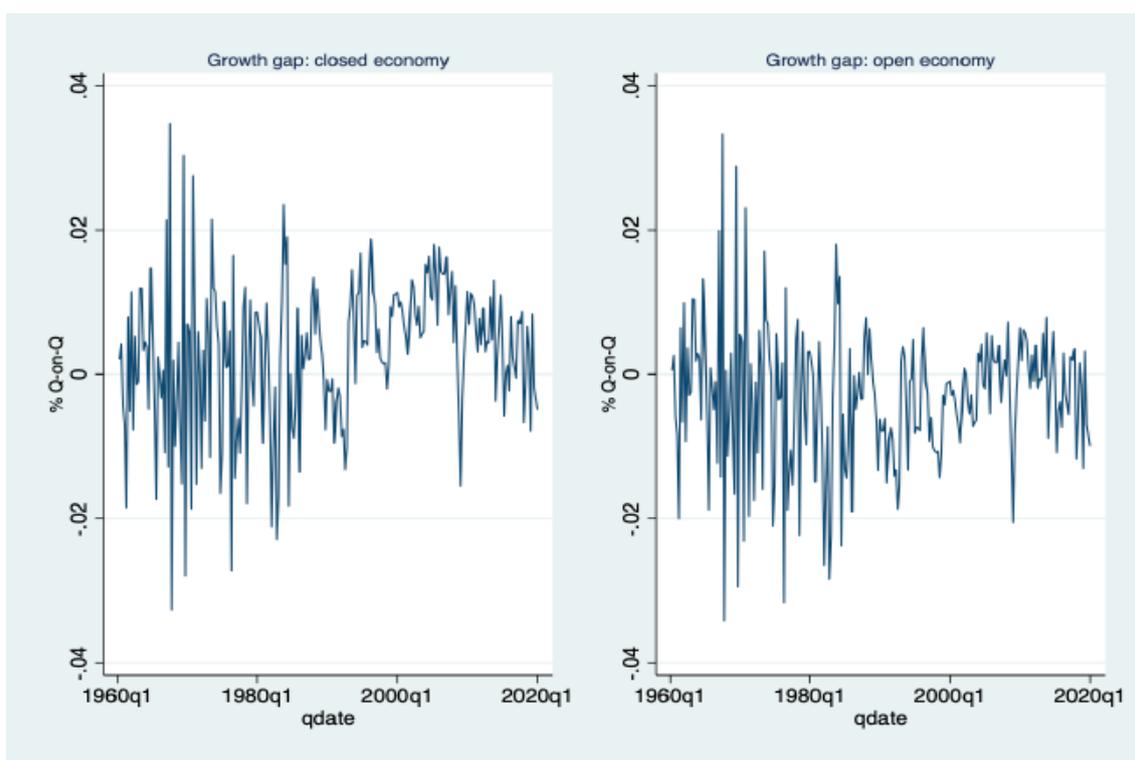


Figure 5: Growth gap: controlling for structural breaks

Period	Closed Economy Case						Open Economy Case					
	Steady-state Growth Δy_t^* %				Growth Gap $\Delta y_t - \Delta y_t^*$ %		Steady-state Growth Δy_t^* %				Growth Gap $\Delta y_t - \Delta y_t^*$ %	
	Structural Break						Structural Break					
	No		Yes		Yes		No		Yes		Yes	
	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y
Full Sample	1.412	5.770	0.425	1.715	0.289	1.163	1.566	6.411	1.043	4.236	-0.330	-1.312
1960s	-	-	1.419	5.799	-0.035	-0.140	-	-	1.567	6.428	-0.185	-0.739
1970s	-	-	0.767	3.102	0.052	0.207	-	-	1.200	4.887	-0.382	-1.518
1980s	-	-	0.383	1.540	0.101	0.405	-	-	0.933	3.785	-0.449	-1.785
1990s	-	-	0.042	0.170	0.346	1.390	-	-	1.025	4.163	-0.637	-2.523
2000s	-	-	-0.017	-0.067	0.869	3.524	-	-	1.065	4.329	-0.212	-0.847
2010s	-	-	-0.017	-0.067	0.393	1.580	-	-	0.491	1.977	-0.115	-0.458

Table 6: Steady-state growth and growth gaps under estimation with structural breaks

prognosis of a 1.98% steady-state growth rate.

One reading of the evidence is thus that the two estimations of steady-state growth controlling for structural breaks provide lower (closed economy) and upper (open economy) bound values for the structural capacity of the South African economy to grow, with the decadal decomposition providing intermediate values.

In Figure 5 and Table 6 we also report the gap between actual and steady-state growth implied by the estimations controlling for structural breaks. As for the decadal decompositions, the implication is again of a declining volatility of growth over the sample period. Given the low steady-state values of growth emerging from the closed economy model, it is not surprising to find that the implied growth gaps are consistently positive – with the sole exception of the 1960s. Conversely, given the considerably more optimistic values for steady-state growth associated with the open economy model, the implication is of a consistently negative growth gap, suggesting that the South African economy consistently fails to realise its growth potential.

6.1.3 Final remarks – growth

Our results suggest a number of fundamental implications for South African growth.

First, consistent with a broad set of findings, steady-state growth in South Africa has been in long-term structural decline. Our findings imply that this decline is more severe than much of the literature suggests.

Second, South Africa's integration into the world economy appears to have shored up steady-state growth.

Third, since the 1990s, but particularly since 2000, the volatility of deviations of actual from steady-state growth has diminished in both the first and second moments.

Fourth, while we present both closed and open economy derivations of steady-state growth and growth gaps, on a priori grounds, the open economy case for an economy such as South Africa has to constitute the preferred framework, given South Africa's status as a small open economy.

Finally, while the decadal and the endogenous break decompositions provide broadly consistent results, the endogenous break results are likely preferable, both because the identification of the breaks is emergent from the data itself, and because it allows for breaks at frequencies both above and below the decadal frequency, as is consistent with the data.

6.2 Inflation

6.2.1 Decadal decomposition – inflation

Results of the steady-state values for South African inflation employing the decadal breakdown of the data is reported in Figure 6 and Tables 7, for the closed and open economy cases. Figure

Period	Closed Economy Case				Open Economy Case			
	Steady-state Inflation		Inflation Gap		Steady-state Inflation		Inflation Gap	
	π_t^* %		$\pi_t - \pi_t^*$ %		π_t^* %		$\pi_t - \pi_t^*$ %	
	Q on Q	Y on Y						
Full Sample	2.195	9.075	-	-	2.235	9.245		
1960s	0.858	3.477	0.002	0.006	0.739	2.989	0.050	0.198
1970s	2.618	10.890	0.228	0.914	4.615	19.778	-1.769	-6.892
1980s	3.597	15.183	-0.021	-0.082	3.122	13.086	0.454	1.829
1990s	2.445	10.144	0.087	0.348	1.383	5.646	1.149	4.677
2000s	1.873	7.706	-0.013	-0.052	1.789	7.350	0.071	0.285
2010s	1.353	5.524	-0.019	-0.076	1.437	5.873	-0.103	-0.411

Table 7: Steady-state inflation and inflation gaps under decadal decomposition

6 records the quarter-on-quarter inflation rates, while the tabulations record both the quarter-on-quarter estimates and the implied year-on-year inflation rates. Open economy steady-state values for South African inflation are broadly similar to those for the closed economy estimates (for the full sample, 9.075% YoY closed economy; 9.245% YoY open economy case), though the open economy estimates of steady-state inflation for the 1970s are considerably higher than the closed economy case (19.778% YoY open; 10.890% YoY closed), and lower for the 1990s (5.646% YoY open; 10.144% YoY closed). Both sets of estimates indicate a strong moderation of steady-state inflation rates from the 1970s and 1980s, to the 2000s and 2010s, with both open and closed economy estimates settling at a 5.5-6% steady-state inflation rate for the 2010s. These steady-state values for inflation remain relatively high in international comparative terms.

The implied inflation gaps from these steady-state growth values for the closed and open cases are reported in Figure 7 and Table 7. Symmetrically to the evidence on growth gaps, the immediate implication for both the closed and open economy cases is that South African inflation has become considerably less volatile since the 1990s, compared to the preceding three decades, in the sense that both the mean and variance of the inflation gap has consistently declined since 1990, and even more markedly since 2000. Notably, deviation from steady-state values of inflation is much more constrained than prior to 2000. On the closed economy estimates, actual inflation has on average fallen below steady-state values of inflation for both the 2000s and 2010s decades, while for the open economy estimates actual inflation on average exceeded steady-state values for the 2000s, and fell below steady-state values during the 2010s.

The implication is that monetary policy has been relatively successful in terms of its price moderation mandate during the 2000s and 2010s, in the sense that actual inflation has fallen below the steady-state value of inflation on a number of the reported estimates. However, this indicator of success needs to be qualified by noting again that the steady-state inflation reference value is high by international standards, thereby also qualifying the extent of monetary policy success.

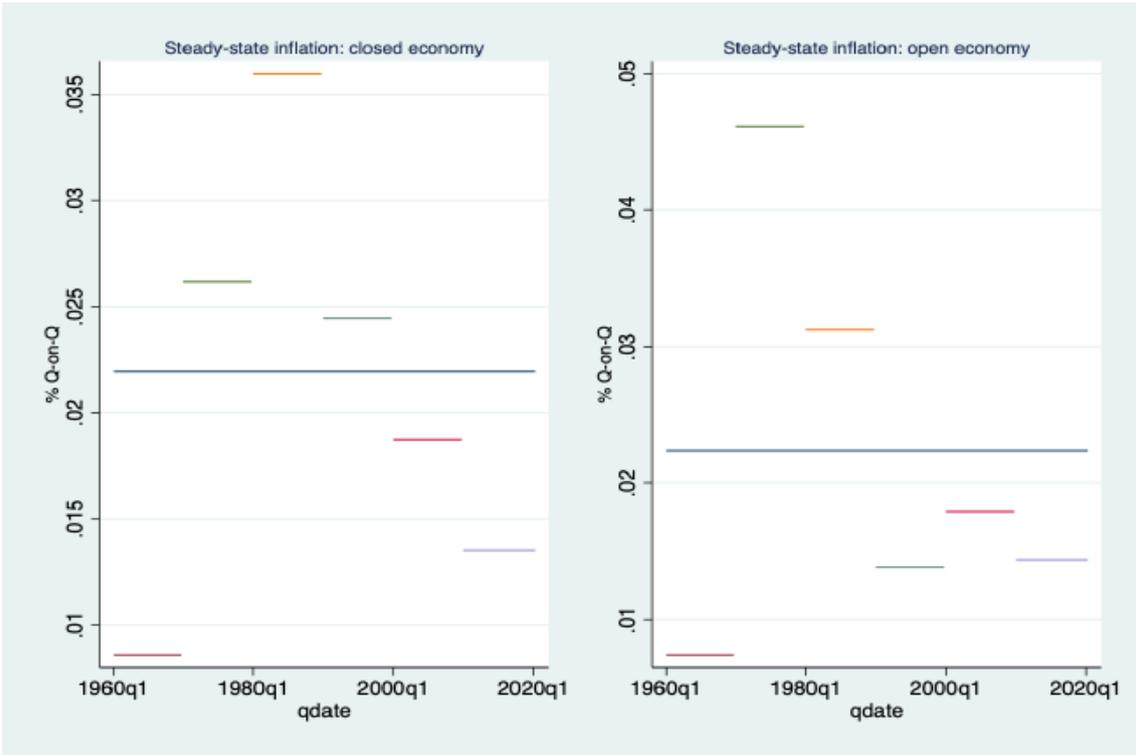


Figure 6: Steady-state inflation: full sample and decadal values

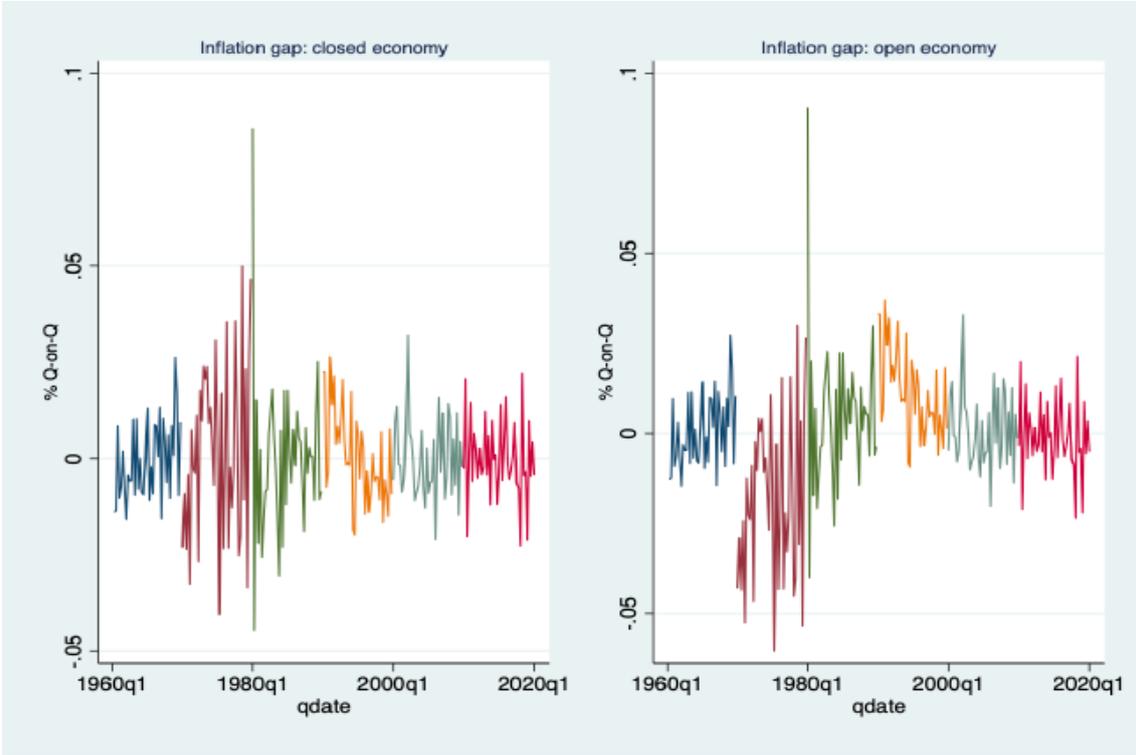


Figure 7: Inflation gap: by decade

6.2.2 Decomposition with endogenous structural breaks – inflation

Steady-state inflation and the implied inflation gaps obtained by controlling for the endogenously determined structural breaks from Section 5. are reported in Figures 8–9 and Table 8, providing both the direct quarter-on-quarter and the implied year-on-year growth rates in the tabular results.

While steady-state estimates showed that structural breaks served to lower the ability of the South African economy to grow, by contrast the impact of the breaks on steady-state inflation has raised the steady-state value of inflation. However, while the structural breaks around 2000 served to raise the growth rate of the economy, the evidence suggests a lowering of the steady-state values of inflation corresponding to these break points.

As for the decadal decomposition, the estimates of steady-state inflation in the presence of structural breaks demonstrate an increase from the 1960s through the 1980s, and a steady decrease thereafter. Open economy estimates suggest lower steady-state inflation rates than do closed economy estimates, and a more dramatic decrease in the steady-state inflation rate particularly in the 2010s. Despite the decline in the estimated steady-state inflation values, both closed (9.197% YoY) and open (5.762% YoY) economy estimates of steady-state inflation remain high in international comparative terms even during the 2010s.

The implied inflation gaps from these steady-state growth values for the closed and open cases, symmetrically to the preceding evidence on growth and inflation gaps, continue to imply less price volatility after 1990, but particularly after 2000. Both the mean and variance of the inflation gap has consistently declined after 1990, and even more markedly since 2000, with deviations from steady-state values of inflation more constrained than prior to 2000. On the closed economy estimates, actual inflation has on average fallen below steady-state values of inflation, while for the open economy estimates actual inflation on average exceeded steady-state values for the 2000s, and fell below steady-state values during the 2010s.

The implication is again that monetary policy has been relatively successful in terms of its price moderation mandate, particularly during the 2000s and 2010s, in the sense that actual inflation has fallen below the steady-state value of inflation on a number of the reported estimates. However, as for the decadal decomposition, this indicator of success continues to be accompanied by the caveat that the steady-state inflation reference value is high by international standards, thereby also qualifying the extent of monetary policy success.

6.2.3 Final remarks – inflation

Our results suggest a number of fundamental implications for South African inflation.

First, steady-state inflation in South Africa, after peaking in the 1970s and 1980s, has been in long-term structural decline, most markedly since 2000.

Second, South Africa's integration into the world economy appears to have moderated inflation,

Period	Closed Economy Case						Open Economy Case					
	Steady-state Inflation			Inflation Gap			Steady-state Inflation			Inflation Gap		
	π_t^*			$\pi_t - \pi_t^*$			π_t^*			$\pi_t - \pi_t^*$		
	%			%			%			%		
	Structural Break											
No		Yes		Yes		No		Yes		Yes		
Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y	Q on Q	Y on Y	
Full Sample	1.218	4.960	2.741	11.423	-0.591	-2.344	0.701	2.834	2.189	9.047	-0.040	-0.159
1960s	-	-	1.383	5.647	-0.598	-2.372	-	-	0.852	3.450	-0.067	-0.267
1970s	-	-	3.380	14.221	-0.534	-2.121	-	-	2.780	11.594	0.066	0.261
1980s	-	-	4.330	18.480	-0.754	-2.982	-	-	3.696	15.624	-0.120	-0.478
1990s	-	-	2.931	12.248	-0.399	-1.586	-	-	2.614	10.872	-0.082	-0.327
2000s	-	-	2.224	9.197	-0.364	-1.448	-	-	1.820	7.480	0.040	0.161
2010s	-	-	2.224	9.197	-0.890	-3.512	-	-	1.410	5.762	-0.076	-0.305

Table 8: Steady-state inflation and inflation gaps under estimation with structural breaks

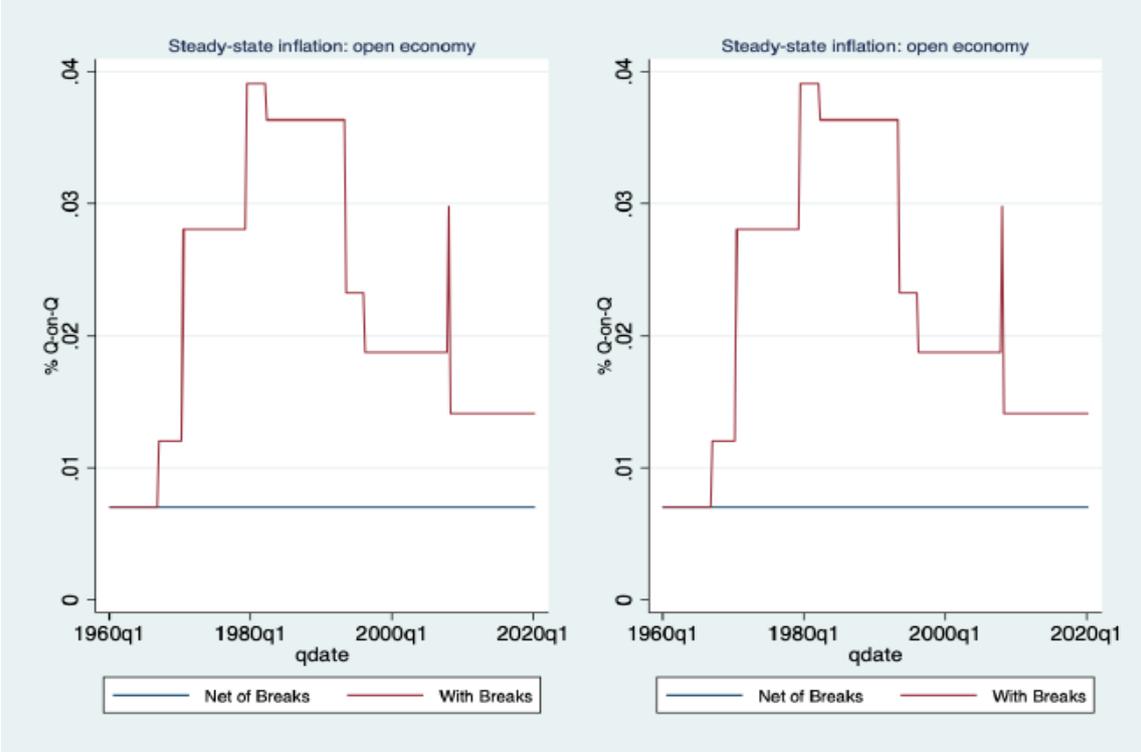


Figure 8: Steady-state inflation: impact of endogenously determined structural breaks

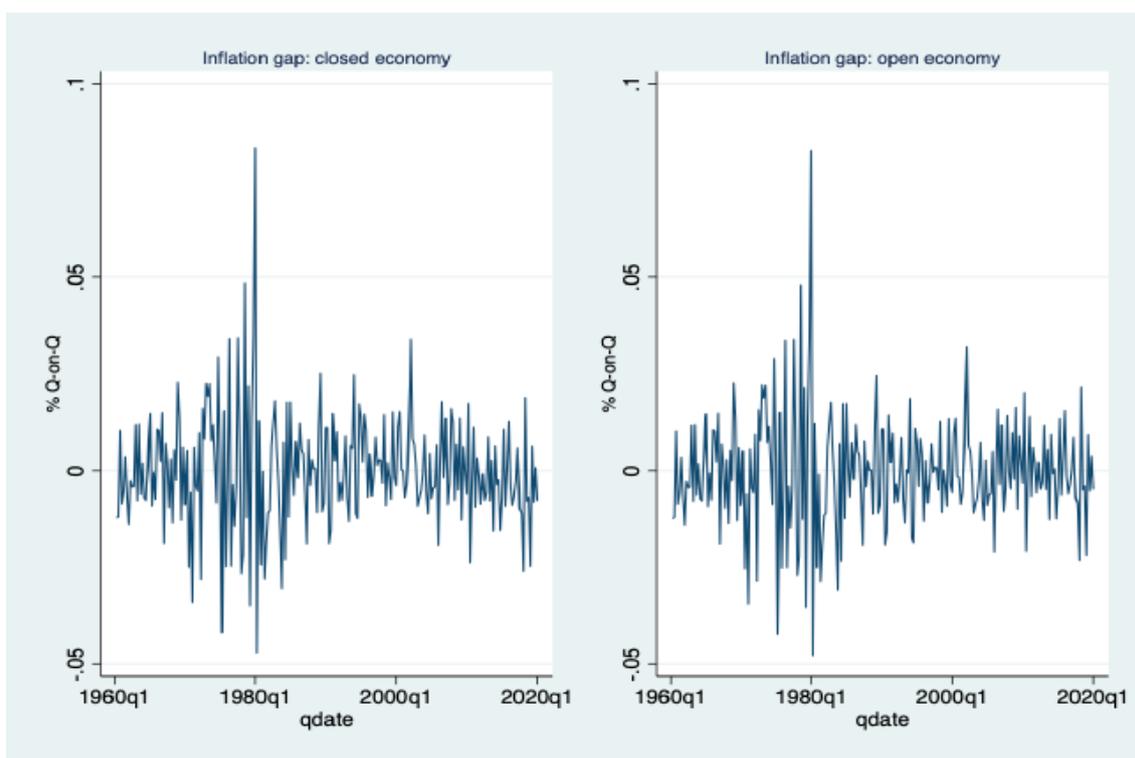


Figure 9: Inflation gap: controlling for structural breaks

suggesting that inflationary pressure in South Africa is domestic rather than imported.

Third, since the 1990s, but particularly since 2000, the volatility of deviations of actual from steady-state inflation has diminished in both the first and second moments.

Fourth, while we present both closed and open economy derivations of steady-state inflation and inflation gaps, on a priori grounds, the open economy case for an economy such as South Africa's has to constitute the preferred framework.

Finally, while the decadal and the endogenous break decompositions provide broadly consistent results, the endogenous break results are likely preferable, both since the identification of the breaks is emergent from the data itself, and since it allows for breaks at frequencies both above and below the decadal frequency, as is consistent with the data.

7. Conclusion

In this paper we employ a simple but relatively general representation of an economy, in order to derive mutually consistent estimates of steady-state growth and inflation for South Africa over the 1960Q1 through 2020Q2 period. Steady-state values in turn imply "gaps" between actual growth and inflation and their steady-state values. The analysis is performed both under closed and open economy assumptions, and over sub-samples of the data determined either *ex ante* as decadal partitions or endogenously by structural breaks implied by the univariate time series characteristics of the data.

A number of general implications flow from our analysis.

Unsurprisingly, the pervasive finding of a declining structural capacity of the economy to grow is confirmed by the present study. Steady-state values of growth in real output have been falling over time. Under the decadal decomposition, year-on-year growth of the economy by the 2010s had fallen to the 1.268% (open economy) to 1.444% (closed economy) range, while for the endogenous break decomposition growth was in the -0.067% (closed economy) to 1.977% (open economy) range. Relative even to the modest full sample steady-state growth performance of 2.808% (closed economy) or 3.740% (open economy), this represents a significant softening of the welfare improving capacity of the economy. What is more, even under the best steady-state prognosis of 1.977% year-on-year growth, this is still 4.434% below the implied steady-state growth in the absence of the impact of structural breaks over the 1960–2020 period.

There are further important nuances to emerge from the steady-state growth values. Most immediate is that steady-state growth values for the open economy case are markedly higher than for the closed economy case. One interpretation of this evidence is that the integration of South Africa into the world economy is an important bulwark protecting South African growth.

By way of a corollary of the preceding inference, closed economy steady-state growth values generate a preponderance of positive growth gaps (actual above steady-state growth), open economy steady-state growth values generate a preponderance of negative growth gaps (actual below steady-state growth). For the 2010s, growth gaps values are amongst the smallest in our sample, suggesting that the observed low growth rates are not evidence of negative output shocks (whatever their source), but of a structural incapacity to grow.

With the sole exception of a break around 1980 (corresponding to the adoption of market rather than administrative determination of interest rates), and the break surrounding 2000 (corresponding to the international commodities boom and the adoption of inflation targeting), every endogenously determined structural break for the South African economy has lowered the economy's steady-state growth performance. An immediate inference is that over time, the structural competitiveness of the South African economy, and its ability to weather shocks, appears to have declined.

One positive implication of our results is that the volatility of both growth and inflation deviations from steady-state values has declined dramatically since the mid-1990s. This is true irrespective of whether the gap is computed for the closed or open economy case, and irrespective of whether the sample is partitioned by decade or by endogenously determined structural break. The inference is that macroeconomic stabilisation policy has been relatively successful since the democratic transition.

For steady-state inflation, our findings are of an inverted-U shape over our sample period, rising from the 1960s through the 1980s, declining thereafter. This is consistent with both the inflationary pressure of the oil-price shock period of the 1970s and the adoption of monetary policy stances emphasising price stability post-2000.

In contrast with the results for steady-state growth, the divergence between closed and open

economy steady-state inflation values is much more muted. One interpretation is that inflationary pressure in South Africa is domestic rather than imported.

Note also that the inflation gap values implied under the decompositions consistently prove to be negative (actual below steady-state inflation). The implication is thus that there remains underlying structural inflationary pressure in the South African economy.

Again in contrast to the findings for steady-state growth, endogenously derived structural breaks to the economy raise steady-state inflation prior to 1980 and lower it thereafter, particularly the break surrounding the year 2000. The implication is that the adoption of inflation targeting around 2000 was successful in improving price stability, though in international comparative terms South African inflation remains high. Note also that the 2008 financial crisis generated upward inflationary pressure.

One might go further in commenting on the structural break around 2000. It is not only that price and growth volatility declined after 2000. It was also a break point that served to raise steady-state growth and lower steady-state inflation. The break thus corresponds not only with improved macroeconomic stability, but with an improved structural performance of the economy in the growth and inflation dimensions.

A final concluding synoptic inference from these conclusions is that in South Africa macroeconomic stabilisation policy has moderated the volatility of growth and inflation gaps. However, the economy shows a worrying downward trend in its structural capacity to grow, and a lack of resilience to shocks in its growth performance. In addition, while the adoption of inflation targeting around 2000 corresponds to greater price stability thereafter, inflation gaps remain negative, suggesting the presence of continued inflationary pressure in the economy, primarily due to domestic rather than imported inflation. In short, South Africa is now manifesting symptoms of stagflation.

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