An Inquisition into Bivariate Threshold Effects in The Inflation-Growth Correlation: Evaluating South Africa's Macroeconomic Objectives

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ABSTRACT: Is the SARB's inflation target of 3-6% compatible with the 6% economic growth objective set by ASGISA? Estimations of inflation-growth bivariate Threshold Vector Autoregressive with corresponding bivariate Threshold Vector Error Correction (BTVEC-BTVAR) econometric models for sub-periods coupled with the South African inflation-growth experience between 1960 and 2010; suggest on optimal inflation-growth combinations for South African data presenting a two-fold proposition. Firstly, for the performance of economic growth to improve so it coincides with the 6% target objective as defined by ASGISA, may require the sustainment of an inflation rate of below 3.08%. Secondly, given the current economic environment with inflation averages of above 3.08% and economic growth rates of below 5.58%, lower inflation rates are to be best pursued through the attainment of higher economic growth rates. Consequentially, the overall implication of the study offers support in favour of a lower, 'close-to-zero' inflation target as a means of ensuring improved macroeconomic performance within the economy, while simultaneously contending that it would prove beneficial for stabilization economic policies to be devised such that these low levels of inflation are attained through higher economic growth rates.

Keywords: Macroeconomic Policy, Economic Growth, Inflation, Thresholds, South Africa.

JEL Code: C22, E31.

1. *INTRODUCTION*

In entering a new decade, two prominent policy frameworks instituted within the South African economy are monetary policy's 'inflation-targeting' regime and fiscal policy's Accelerated and Shared Growth Initiative of South Africa (ASGISA). Implemented in 2000 and still in use to date, the inflation-target rule specifies that the South African Reserve Bank (SARB) should regulate inflation at levels of between 3-6%; whereas ASGISA's objective is towards a 6% economic growth rate intended to be achieved between 2010 and 2014. This paper is principally motivated by the absence of empirical evidence assessing the compatibility of the aforementioned policy objectives.

Over the past couple of decades, Central banks worldwide have embarked on 'price stability' economic policies with emphasis placed on the attainment of low and stable inflation rates. Despite efforts shown by monetary authorities in striving for low inflation environments, these policies strategies have not being unanimously accepted and applicable as structural macroeconomists have speculated on inflation, up to certain levels, helping to 'grease the wheels' of the economy by encouraging investment, productivity and growth in wages (Khan, Bukhari and Ahmed, 2007). The empirical works of Fischer (1993) and Bruno and Easterly (1995) were amoung the first to substantiate the structuralist argument by providing evidence on the adverse effects of inflation on economic growth differing across specified inflation bandwidths. However, the policy implications associated with the obtained results of these studies proved to be vague as these authors were unable to determine an exact optimal inflation point at which economic welfare can be maximized or similarly, the level of inflation where economic welfare losses are minimized.

This shortcoming was initially overcome by Sarel (1996) and later improved by IMF macroeconomists Khan and Senhadji (2001) who, by utilizing sample-splitting econometric techniques, estimated an exact inflation *threshold* point at which economic welfare can be deemed as being maximized. The studies of Sarel (1996) and Khan and Senhadji (2001) set a 'trend' of published articles on the subject matter and it has become a norm for panel-data studies in the literature to include South Africa in the analysis of such inflation nonlinearities. The panel-data studies include South African data amoungst a host of high inflation outlier economies and generalize on the established optimal range or level of inflation as being applicable to all observed economies (see Drukker et. al. (2005); Mi (2006); and Kremer et. al. (2009)). The estimated thresholds or optimal levels of inflation serve as a benchmark for which monetary policy should strive to preserve inflation at. In keeping the prevailing inflation rate on par with the obtained threshold level or range of inflation, as suggested in these studies, it is explicitly assumed that maximum economic growth will be realized for (amongst a host of other nations) the South African economy.

The paper builds into the literature by addressing certain limitations allied with the existing empirical evidence, and applies remedies with reference to the exclusive experience of South African data. Firstly, the empirical analysis is conducted over differing sub-periods instituted within the data. Nell (2000) and Rangasamy (2009) have stressed the importance of incorporating structural breaks into the econometric analysis of South African data as a means of circumventing the Lucas (1976) critique. While Nell (2000) suggests break points at 1970, 1985 and 1994, the breakpoint in the study of Rangasamy (2009) is established in the year 2000. Secondly, the paper utilizes bivariate thresholds vector error correction (BTVEC) models as a means of eradicating any spurious correlations associated for the data associated with the coupled sub-periods under analysis. Finally, for the sub-periods in which significant cointegration effects exist, inflation and corresponding economic growth threshold rates are estimated. This enables the paper to assess the specific optimal economic growth rate expected as a result of the attainment of the established optimal inflation level for significantly cointegrated periods. Estimations, in this sense, are conducted within the context of bivariate threshold vector autoregressive (BTVAR) models. The BTVAR-BTVEC empirical models are specified in section 2, whilst section 3 presents an outline of the utilized data and the estimation results are presented in section 4 of the paper.

The conclusions made from the empirical study are drawn in section 5 of the paper and generally imply significant nonlinear cointegration relations between inflation and growth for data associated with the periods of 1960-1970 and 2000-2013. This of particular relevance as none of the panel data studies, which include South Africa in the data analysis, conducts their empirical analysis within the timeframe of any of these identified periods. Furthermore, the significant period of 2000-2013 represents the era in which both the inflation-targeting regime and the ASGISA programme were adopted as policy objectives. Section 5 hence draws policy conclusions by integrating the empirical findings of the study with reference to the above-mentioned policy programmes. The central contribution of the paper which is reflected in the derived conclusions, bridges two opposing contentions on policy conduct found in recent South African economic literature. On one hand, the presented evidence supports Gupta and Uwilingiye (2009) view of a lower, 'close-to-zero' inflation target as a means of minimizing welfare costs in South Africa. On the other hand, the paper simultaneously supports arguments depicted in the study of Bonga-Bonga and Kabundi

(2010), which criticizes the South African Reserve Bank's (SARB) policy intention of achieving low inflation rates through the sole manipulation of interest rates.

2. *EMPIRICAL FRAMEWORK*

In line with the study of Ahmed and Mortaza (2005) and Chowdury and Ham (2009), the paper restricts the empirical analysis of threshold effects in the inflation-growth correlation to the bivariate case. Ahmed and Mortaza (2005) investigate threshold effects in the bivariate inflation-growth correlation by estimating Hansen's (1997) threshold model whereas Chowdury and Ham (2009) opt for the use of a bivariate threshold autoregressive (BTVAR) model. Derivation of the BTVAR model is instigated through an augmentation of Hansen (1997) TAR model, which according to Chowdury and Ham (2009), is achieved by replacing the dependent and independent variables in the TAR model with vectors of bivariate endogenous variables. This paper builds on Chowdury and Ham (2009) by specifying a vector of bivariate endogenous (inflation and economic growth) threshold variables, which is directly incorporated into the BTVAR model specification. In limiting the study to a bivariate case study the paper is able to follow in pursuit Lo and Zivot (2001) in deriving an associated bivariate threshold vector error correction (BTVEC) mechanism directly from the BTVAR model. Developments by Lo and Zivot (2001) provide a unique approach into accommodating equilibrium adjustment mechanisms as a means of eliminating spurious relations which could possibly arise within the threshold vector autoregressive (TVAR) models. Our baseline BTVAR model is specified as:

$$Y_t = \psi_1(L)X_{t-p}\ I.\{\lambda \leq \lambda^*\} + \psi_2(L)X_{t-p}\ I.\{\lambda > \lambda^*\} + \varepsilon_t \qquad (1)$$

Where $Y_t = [\Delta gdp_t, \pi_t]$; $X_{t-p} = [1, \pi_{t-1},..., \pi_{t-p}, \Delta gdp_{t-1},..., \Delta gdp_{t-p}]$ with (L) being the lag operator and ψ_i being the associated coefficients of X_{t-p}. The paper specifies the vector of endogenous threshold variables as $\lambda = [\ \pi, \Delta gdp]$. Therefore equation (1) can be decomposed into two separate BTVAR estimation equations:

$$Y_t = \psi_1 X_{t-p}\ I.\{\pi \leq \pi^*\} + \psi_2 X_{t-p}\ I.\{\pi > \pi^*\} + \varepsilon_t \qquad (2)$$

$$Y_t = \psi_1 X_{t-p}\ I.\{\Delta gdp \leq \Delta gdp^*\} + \psi_2 X_{t-p}\ I.\{\Delta gdp > \Delta gdp^*\} + \varepsilon_t \qquad (3)$$

In testing for significant threshold effects, Hansen (1997) suggests the use of a likelihood ratio (LR) statistic which tests the null hypothesis of no threshold effects ($\psi_1=\psi_2$) against the alternative of threshold effects ($\psi_1\neq\psi_2$). The LR statistic is given by:

$$^{HANSEN}LR_{\lambda} = n\ [(S_{\lambda} - S_{\lambda}\text{^})/ S_{\lambda}\text{^}] \qquad (4)$$

The null hypothesis $H_0 : (\psi_1=\psi_2)$ is accepted if $^{HANSEN}LR_{\lambda} \leq c_{\zeta}\ (1- \alpha)$ and $H_1 : (\psi_1\neq\psi_2)$ is *r*ejected if $^{HANSEN}LR_{\lambda} > c_{\zeta}(1-\alpha)$, *w*here $c_{\zeta}(1- \alpha)$ are the computed bootstrapped critical values. In the case of the null hypothesis of no threshold effects being rejected, estimation of equations (2) and (3) can be conducted using Hansen's (1996) conditional least squares (CLS) method. This estimation technique entails a grid-search over a predetermined range of threshold variable estimates ($\pi_{min},\ldots, \pi_{max}$ and $gdp_{min},\ldots, gdp_{max}$) with the optimal estimates (π^*, gdp^*) chosen by minimizing the following objective functions;

$$\pi^* = argmin\ \{SSR_{\pi^*},\ \pi = \pi_{min},\ldots, \pi_{max}\} \qquad (5)$$

$$gdp^* = argmin\ \{SSR_{GDP^*},\ gdp = \Delta gdp_{min},\ldots, \Delta gdp_{max}\} \qquad (6)$$

The study employs the grid search over $\pi_{min} = 1\%$, $\pi_{max} = 16\%$ and $\Delta gdp_{min} = 0\%$, $\Delta gdp_{max} = 7\%$. Once the values of π^* and gdp* which maximize the explanatory power of regressions of (2) and (3) are estimated, Hansen (1997) proposes the use of backward substitution to estimate the corresponding slope coefficients and residual errors of equations (2) and (3).

Lo and Zivot (2001) demonstrate that if significant threshold effects are established within a BTVAR model, an associated BTVEC model can be derived as an appropriate method of modelling cointegration effects within the nonlinear framework. By taking the first differences of the BTVAR encompassing equation (1) and rearranging the terms, the following BTVEC model is specified:

$$\Delta Y = \Theta_1\, \Delta X_{t-1}\ I.\{\zeta_{\tau-1} \leq \zeta^*_{\tau-1}\} + \Theta_2\, \Delta X_{t-1}\ I.\{\zeta_{\tau-1} > \zeta^*_{\tau-1}\} + \varepsilon_t \qquad (7)$$

Where ΔY_t = [$\Delta\Delta$gdp$_t$, $\Delta\pi_t$], $\Delta X_{t-1} = [1, \zeta_{t-1}, \Delta\pi_{t-1}, \Delta\Delta gdp_{t-1}]$; Θ_i are the coefficients of ΔX_{t-p}; ζ_{t-1} as the error correction term and ζ^*_{t-1} is its threshold estimate. To validate the presence of threshold cointegration effects, Seo (2006) proposes the use of the Supremum of the Wald statistic (SupWald) to test the null hypothesis of no cointegration (i.e. $\Theta_1 = \Theta_2 = 0$) against the alternative of threshold cointegration (i.e. $\Theta_1 \neq \Theta_2 \neq 0$. The SupWald statistic is defined as:

$$^{Seo}W_{sup} = supWald_1(\gamma) \qquad (8)$$

Seo (2006) relies on a residual-based bootstrap to approximate the asymptotic distribution of the SupWald statistic. If significant cointegration relations are established, estimation of TVEC equation (1.3) is conducted via Hansen and Seo (2002) quasi-Maximum Likelihood Estimators (q-MLE) method. This approach is prompted under the assumption of holding ε_t as an i.i.d. process which is embodied in a vector martingale difference sequence (VMDS) matrix denoted as E=E(ε_t,ε_t'). The VMDS is then incorporated into the following Gaussian likelihood function:

$$L_n(\Omega) = -n/2 \log - ½ \sum u_t(\Omega)' E^1 u_t(\Omega) \qquad (9)$$

Where:

$$\Omega = (\Theta_1, \Theta_2, E, \beta, \zeta^*_{\tau-1}) \qquad (10)$$

Hansen and Seo (2006) propose estimating the likelihood function through maximum likelihood (ML) by means of holding (Θ_1, Θ_1, E) fixed and concentrating out (β, $\zeta^*_{\tau-1}$) yields the following concentrated likelihood function:

$$L_n(\beta, \zeta^*_{\tau-1}) = -n/2 \log\left| E(\beta, \zeta^*_{\tau-1})\right| - np/2 \qquad (11)$$

The maximum likelihood estimates of the cointegration vector (β) and the threshold parameter (ζ^*_{t-1}) are obtained through a two-dimensional grid search as the values that minimize ($\log\left| E(\beta, \zeta^*_{\tau-1})\right|$) subject to the constraint:

$$n \leq n^{-1} \sum I.(x_t'\beta \leq \zeta^*_{\tau-1}) \leq 1-n \qquad (12)$$

Where 'n' denotes the trimming parameter of the data under analysis. Following Hansen and Seo (2002) n is set at 0.05 (5%). In obtaining the true values of β and ζ^*_{t-1}, backward substitution is employed to estimate the remainder of the parameters in equation (7).

3. *Data*

The data utilized in the study was retrieved from the South African Reserve Bank (SARB) website. The dataset consists of inflation in the total consumer price index (π) as well as the growth rate of real gross domestic product at market prices (Δgdp). Quarterly data for ΔGDP and π has being collected between the period of 1960:02 to 2013:02 and are given at constant prices using 2000 as a base year which is seasonally adjusted at an annual rate. The paper pursues the study of Fischer (1993) by incorporating structural breaks in the employed data. Deriving from the studies of Nell (2000) and Rangasamy (2009) structural breaks are identified at 1970, 1985, 1994 and 2000. Subsequential sub-periods are extracted by setting 1960, 1970, 1985, 1994 and 2000 as base periods for analysis. Incorporating the suggested breakpoints and extracting subsequential sub-periods associated with each of these break-periods yields a total of 15 sample periods under analysis. For instance:

- Using 1960 as a base period produces subsequent sub-periods of 1960-1970, 1960-1985, 1960-1994, 1970-2000 and 1960-2013;
- Setting 1970 as a base periods produces sub-periods 1970-1985, 1970-1994, 1970-2000 and 1970-2013;
- For 1980 the sub-periods of 1985-1994, 1985-2000 and 1985-2013 are extracted;
- For 1994; 1994-2000 and 1994-2013; and
- For the last base period of 2000, the only existing sub-period is 2000-2013.

4. *Empirical Analysis*

In view of drawing possible 'spurious' conclusions from the estimates of the BTVAR-BTVEC specifications, Hansen (1997) LR test for threshold effects and Seo (2006) threshold cointegration tests are, as a preliminary step, employed on the data for the sub-periods under analysis. The asymptotic p-values for the employed threshold tests are obtained by using 1000 bootstrapped replications with the results being displayed in Table 1.

Table 1: Hansen's LR test for threshold Effects

start year	*end year*	${}^{HANSEN}LR_{\lambda}$ *equation (2)*	${}^{HANSEN}LR_{\lambda}$ *equation (3)*	${}^{SEO}W_{SUP}$ *equation (7)*	*decision*
	1970	*245.76 (0.00)****	*245.76 (0.00)****	*253.91 (0.00)****	*significant correlations*
1960	*1985*	*111.13 (0.00)****	*111.13 (0.00)****	*89.49 (1.00)*	*no significant correlations*
	1994	*66.667 (0.30)**	*73.789 (0.06)**	*92.18 (1.00)*	*no significant correlations*
	2000	*73.300 (0.04)**	*74.660 (0.06)**	*72.42 (1.00)*	*no significant correlations*
	2013	*71.831 (0.09)**	*65.350 (0.260)**	*79.00 (1.00)*	*no significant correlations*
	1985	*230.14 (0.00)****	*189.21 (0.00)****	*99.37 (1.00)*	*significant correlations*
1970	*1994*	*88.272 (0.10)**	*90.219 (0.04)***	*135.60 (1.00)*	*no significant correlations*
	2000	*68.301 (0.30)**	*87.175 (0.00)****	*110.74 (1.00)*	*no significant correlations*
	2013	*61.268 (0.58)*	*56.216 (0.640)*	*213.74 (1.00)*	*no significant correlations*
	1994	*152.52 (0.00)****	*51.902 (0.00)****	*334.42 (0.00)****	*significant correlations*
1985	*2000*	*189.19 (0.00)****	*164.53 (0.00)****	*322,36 (1.00)*	*no significant correlations*
	2013	*117.63 (0.00)****	*82.650 (0.10)***	*290.60 (1.00)*	*no significant correlations*
1994	*2000*	*185.33 (0.00)****	*130.94 (0.00)****	*110.55 (1.00)*	*no significant correlations*
	2013	*185.46 (0.00)****	*187.76 (0.00)****	*110.55 (1.00)*	*no significant correlations*
2000	*2013*	*185.33 (0.00)****	*187.76 (0.00)****	*587.97 (0.00)****	*significant correlations*

Significance Level Codes:"***", "**' and '*' denote the 1%, 5% and 10% significance levels respectively. Asymptotic bootstrapped p-values are reported in parentheses.

The results indicate that with the exception of the period of 1970-2013, Hansen's (1999) LR test fails to reject the alternative hypothesis of threshold effects present in regressions (2) and (3) for all remaining sub-periods. However, based on the results of Seo's (2006) cointegration test, significant nonlinear cointegration effects are present for periods of 1960-1970, 1985-1994 and 2000-2013. Following the above analysis, the next sub-section conducts BTVAR-BTVEC model estimations for the identified significant nonlinear cointegrated periods. Having identified periods in which inflation and growth are significantly nonlinearly cointegrated for South African data, estimations of BTVAR-BTVEC equations (2), (3) and (7) are conducted for each of these periods. For 1960-1970, the results are given in Table 3, for 1985-1994 in Table 4 and for 1999-2013 in Table 5. The BTVAR model specifications (2) and (3) are estimated using Hansen's (1999) conditional lest squares

(CLS) method with the lag order of the regressions being selected on the basis of minimizing the AIC. The coefficients and threshold values for the BTVEC model (7) are estimated using Hansen and Seo (2002) q-MLE method.

Table 2: BTVAR-BTVEC model estimates for 1960-1970

π^*	*3.04%*					
Δgdp^*	*5.59%*					
ζ^*_{t-1}	*0.033*					
β	*-0.44*					
	equation (2)		*equation (3)*		*equation (7)*	
ssr	*0.00011*		*0.00013*		*0.0547*	
aic	*-1081.76*		*-1073.26*		*-1365.20*	
below threshold						
regressor→ *regressand* ↓	π	Δgdp	π	Δgdp	$\Delta\pi$	$\Delta\Delta gdp$
constant	*-0.07 (0.007)****	*0.05 (0.01)****	*0.01 (0.03)*	*-0.06 (0.06)*	*0.05 (0.00)****	*-0.09 (0.00)*
π_{t-1}					*-0.004 (0.80)*	*-0.25 (0.00)****
$\Delta\pi_{t-1}$					*-0.72 (0.00)****	*-0.14 (0.14)*
$\Delta\Delta gdp_{t-1}$					*-0.19 (0.01)***	*-0.85 (0.00)****
π_{t-1}	*2.33 (0.03)****	*-0.76 (0.06)****	*2.18 (0.03)****	*-0.06 (0.05)*		
π_{t-2}	*-1.26 (0.03)****	*0.69 (0.05)****	*-1.20 (0.03)****	*0.07 (0.06)*		
Δgdp_{t-1}	*0.39 (0.02)****	*1.68 (0.03)****	*-0.20 (0.02)****	*2.07 (0.03)****		
Δgdp_{t-2}	*-0.40 (0.02)****	*-0.65 (0.03)****	*0.20 (0.02)****	*-1.06 (0.03)****		
above threshold						
constant	*0.34 (0.09)****	*0.45 (0.17)**	*-0.08 (0.01)****	*0.15 (0.02)****	*0.01 (0.21)*	*-0.08 (0.00)****
π_{t-1}					*0.11 (0.00)****	*-0.01 (0.06)**
$\Delta\pi_{t-1}$					*-1.04 (0.00)****	*0.02 (0.75)*
$\Delta\Delta gdp_{t-1}$					*0.12 (0.27)*	*-0.98 (0.00)****
π_{t-1}	*1.96 (0.09)****	*-0.35 (0.15)**	*2.36 (0.02)****	*-0.50 (0.04)****		
π_{t-2}	*-0.98 (0.09)****	*0.35 (0.16)**	*-1.28 (0.02)****	*0.44 (0.04)****		
Δgdp_{t-1}	*-0.21 (0.11)**	*1.78 (0.20)****	*0.43 (0.02)****	*1.69 (0.03)****		
Δgdp_{t-2}	*0.16 (0.12)*	*-0.87 (0.22)****	*-0.45 (0.02)****	*-0.68 (0.03)****		

Significance Level Codes: '***', "**" and '*' denote the 1%, 5% and 10% significance levels respectively. P-values are reported in parentheses

For the period of 1960-1970 inflation thresholds of 3.04% and economic growth thresholds of 5.59% are estimated. Given a positive error correction threshold estimate (ζ^*_{t-1}) for equation (5), the upper regime of the BTVEC model is in continuous disequilibrium while equilibrium can only exist in the lower regime. Since the only significant adjustment parameter (ζ_{t-1}) is found for the growth equation in the lower regime of the BTVEC model, inflation can be considered as the driving trend in the system, causing economic growth in the granger sense, being weakly exogenous. The larger absolute lagged inflation coefficients of the economic growth regressors in the lower regime for equation (2) and the upper regime for equation (3), points to economic growth being more responsive to a change in inflation when the combination of inflation rates are below 3.04% and economic growth rates above 5.59% are simultaneously realized. The cointegration vector (β) further provides a measure of the inflation-growth elasticity in equilibrium (Risso and Sanchez-Carrera, 2009). The -0.44 elasticity estimate associated with the data interprets to a 1% increase in the inflation rate producing a decrease in economic growth levels of 0.44%.

Table 3: BTVAR-BTVEC model estimates for 1985-1994

π*	*15.01%*					
Δgdp*	*1.15%*					
$\zeta^*_{\tau-1}$	*1.18*					
β	*-9.36*					
	equation (2)		*equation (3)*		*equation (7)*	
ssr	*0.0543*		*0.1874*		*0.8162*	
aic	*-549.93*		*-449.31*		*-805.89*	
below threshold						
regressor→ regressand ↓	π	Δgdp	π	Δgdp	$\Delta\pi$	$\Delta\Delta gdp$
constant	-1.12 (0.06)***	1.18 (0.07)***	-1.23 (0.18)***	1.39 (0.12)***	-0.33 (0.00)***	0.20 (0.00)***
$\zeta_{\tau-1}$					-0.01 (0.27)	0.004 (0.28)
$\Delta\pi_{t-1}$					-1.24 (0.57)	0.69 (0.63)
$\Delta\Delta gdp_{t-1}$					-0.47 (0.90)	0.20 (0.93)
π_{t-1}	1.06 (0.004)***	-0.08 (0.005)***	1.07 (0.01)***	-0.10 (0.01)***		
Δgdp_{t-1}	0.12 (0.01)***	0.91 (0.02)***	0.09 (0.05)	0.98 (0.04)***		
above threshold						
constant	0.24 (0.56)	-3.33 (0.68)***	-0.61 (0.21)***	0.70 (0.15)***	0.01 (0.77)	0.001 (0.96)
ζ_{t-1}					-0.02 (0.00)***	-0.001 (0.76)
$\Delta\pi_{t-1}$					-0.51 (0.00)***	-0.02 (0.08)
$\Delta\Delta gdp_{t-1}$					-0.40 (0.05)*	-0.01 (0.91)
π_{t-1}	1.04 (0.04)***	0.23 (0.04)***	1.05 (0.01)***	-0.04 (0.01)***		
Δgdp_{t-1}	-0.69 (0.06)***	0.85 (0.07)***	-0.07 (0.08)	0.91 (0.05)***		

Significance Level Codes: '***', "**' and '*' denote the 1%, 5% and 10% significance levels respectively. P-values are reported in parentheses

For 1985-1994 data, the error correction threshold estimate is insignificantly positive. Thus only the regression coefficient estimates of the lower regime in BTVEC equation (5) are taken into consideration. Based on insignificant error correction terms being estimated for both inflation and growth regressions, it is deduced that no functional significant cointegration can be extracted from the data associated with this sub-period.

Table 4: BTVAR-BTVEC model estimates for 2000-2013

π^*	6.08%					
Δgdp^*	3.12%					
$\zeta^*_{\tau-1}$	1.88					
β	-1.65					
	equation (2)		*equation (3)*		*equation (7)*	
SSR	0.00044		0.00044		1.573	
AIC	-549.93		-449.31		-805.89	
Below threshold						
regressor→ regressand ↓	π	Δgdp	π	Δgdp	$\Delta\pi$	$\Delta\Delta gdp$
constant	1.53 (0.09)***	-0.21 (0.04)***	-2.19 (0.62)**	0.81 (0.22)***	0.03 (0.1)	0.01 (0.25)
$\zeta_{\tau-1}$					-0.02 (0.06)*	-0.01 (0.35)
$\Delta\pi_{t-1}$					-0.48 (0.07)*	-0.19 (0.28)
$\Delta\Delta gdp_{t-1}$					-0.79 (0.06)*	-0.31 (0.27)
π_{t-1}	1.82 (0.03)***	-.003 (0.02)*	2.15 (0.06)***	-0.20 (0.02)***		
π_{t-2}	-1.01 (0.03)***	0.05 (0.01)***	-0.88 (0.08)***	0.10 (0.03)***		
Δgdp_{t-1}	-1.27 (0.11)***	2.22 (0.05)***	1.73 (0.45)***	1.31 (0.16)***		
Δgdp_{t-2}	1.16 (0.10)***	-1.21 (0.04)***	-1.58 (0.40)***	-0.37 (0.14)*		
Above threshold						
constant	1.12 (0.27)***	0.33 (0.12)*	1.22 (0.10)***	-0.07 (0.03)*	0.40 (0.0002)***	-0.35 (0.00)***
$\zeta_{\tau-1}$					-0.02 (0.20)	-0.01 (0.61)
$\Delta\pi_{t-1}$					-0.93 (0.18)	0.21 (0.65)
$\Delta\Delta gdp_{t-1}$					0.003 (1.00)	-0.86 (0.02)*
π_{t-1}	2.25 (0.05)***	-0.18 (0.02)***	1.92 (0.02)***	-0.05 (0.01)***		
π_{t-2}	-1.37 (0.04)***	0.14 (0.02)***	-1.07 (0.02)***	0.06 (0.01)***		
Δgdp_{t-1}	-0.37 (0.22)	1.65 (0.10)***	-0.91 (0.08)***	2.09 (0.03)***		
Δgdp_{t-2}	1.16 (0.10)***	-1.21 (0.04)***	-1.07 (0.02)***	0.06 (0.01)***		

Significance Level Codes: '***', "**' and '*' denote the 1%, 5% and 10% significance levels respectively
P-values are reported in parentheses

Between 2000 and 2013, inflation thresholds of 6.08% with associated economic growth thresholds of 3.12% are obtained. Given a positive error correction threshold estimate (ζ^*_{t-1}) for equation (5), the upper regime of the BTVEC model is in disequilibrium while equilibrium can only be established in the lower regime. The only significant negative error correction term estimate (ζ_{t-1}) in equation (5) is obtained for the inflation equation in the lower regime. This result suggests on causality being driven from economic growth to inflation for data associated with this sub-period. The larger absolute lagged growth coefficients of the inflation regressors in the lower regime for equations (2), implies on inflation being more responsive to changes in economic growth when inflation rates are below 6.08%. The elasticity for inflation-growth (as measured by β) is -1.65 which means that a unit increase in the inflation rate for the observed data is associated with a decrease in economic growth of 1.65%.

5. CONCLUSION

Is the SARB's currently utilized inflation-target regime of 3-6% suitable for the attainment of the 6% percent economic growth rate objective defined by ASGISA? By estimating BTVAR-BTVEC econometric models for sub-periods between 1960-2010 in which inflation-and growth are significantly correlated, this paper sought to shed light on this policy question. Exploitations of BTVEC models imply significant nonlinear correlations between the macroeconomic variables only occur for the data associated with sub-periods of 1960-1970 and 2000-2013. Of primary interest is the period of 2000-2013 which represents the era in which both the inflation-targeting regime and the ASGISA programme were adopted. Estimates of BTVAR models for data associated with this period indicate optimal inflation levels of 6.08% with corresponding optimal economic growth rates of 3.12%.

Given that the currently obtainable optimal economic growth rate is below ASGISA's set objective, what then is the level of inflation required to attain the 6% economic growth objective? Based on the overall findings, inflation rates of below 3.04% are associated with the attainment of optimal economic growth rates above 5.59%. However, caution is prescribed when interpreting these findings as causality between the data is established to run from inflation to economic growth at inflation levels of below 3.04%, whereas at higher levels of inflation (between 3.04%- 6.08%), causality runs from economic growth to inflation. Therefore, pursuing a *strict* inflation targeting regime can only efficiently support ASGISA's objective once the realization of inflation levels below 3% are accompanied with economic growth levels above 5.59%. Until such circumstances materialize, the study concludes that macroeconomic policy strategies need to be directed at channeling improved economic growth as a means of lowering inflation rates. Future research can thus be concerned with identifying appropriate channels through which such a disinflationary policy strategy can be worked through by taking into consideration other important structural economic factors such as investment.

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