Inflation and Economic Growth Nexus in the Southern African Development Community: A Panel Data Investigation

By

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Abstract

The central objective of macroeconomic policy is sustained low levels of inflation which usually creates an environment conducive to rapid economic growth. Following the literature, it is expected that a negative relationship between inflation and economic growth exists. Many studies in this field generally found that the negative relationship between these two variables tends to exist after inflation reaches a certain threshold. Furthermore, the magnitude of this inverse relationship is envisaged to be different among countries at different levels of development. Therefore, this paper employs panel data econometric techniques to examine the inflation-growth relationship in the Southern African Development Community (SADC) region based on annual data ranging from 1980 to 2008. The same analysis is also conducted using five-year averages spanning the same period. The paper uses Fixed Effects (FE), Difference and System Generalised Method of Moments (DIF-GMM and SYS-GMM) and Seemingly Unrelated Regression (SUR) estimators in examining the inflation-growth nexus. Overall, the results depict a significant inverse relationship between inflation and economic growth in the SADC region.

Keywords: Economic Growth, Endogeneity, Heterogeneity, Inflation, Panel Data and SADC

JEL Classification: C2, C3, E1, E3

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1. Introduction and Motivation

The common objective of macroeconomic policy is a low inflation rate which usually creates an environment conducive to rapid economic growth. However, macroeconomic stability, defined as a low inflation rate is a necessary but not a sufficient condition for sustained economic growth. This is evidenced by the fact that most countries have grown slowly despite low inflation, for instance, this transpired in the Franc zone during the 1980s (Fischer, 1983). Many cross-country studies suggest the existence of a negative relationship between these two variables. Furthermore, the magnitude of this relationship is envisaged to vary from region to region depending on the level of development and other factors. Although a significant body of research investigating the inflation-growth relationship exists for developed as well as developing countries, none has been conducted for African economies in particular. For instance, Ghosh and Phillips (1998) employed a large dataset covering all IMF member countries and found a negative and statistically significant relationship between inflation and economic growth. Khan and Senhadji (2000) used a large data set of 140 countries comprising both industrial and developing countries. Due to the short time span of data from developing countries, their analysis was conducted using an unbalanced panel and they found a negative relationship between inflation and economic growth. Sepehri and Moshiri (2004) compared the dataset for 24 OECD countries, 14 middle-income countries, 26 lower-middle income countries and 28 low-income countries and also found a negative relationship between the two variables.

This paper analyses the inflation-growth relationship in the Southern African Development Community (SADC)[1]. As stipulated by the SADC mission statement, the main mission of SADC is to promote sustainable and equitable economic growth and socio-economic development through efficient productive systems, deeper co-operation and integration, good governance, and durable peace and security, so that the region emerges as a competitive and effective player in international relations and the world economy (SADC, 2011). The importance of investigating the inflation-growth nexus in this region stems from the notion that the member states are striving towards common goals and therefore are likely to pursue similar macroeconomic policies.

[1] SADC comprises: Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. See Figure 1 in the Appendix for a map of the region.

The motivation for the analysis emanates not only due to the lack of any studies analysing inflation and economic growth in the SADC region, but more generally, because of the fact that this relationship may differ from the one that exists in developed countries due to the level of economic development and prudential macroeconomic policies that are being practised in those regions (Sarel, 1996). Furthermore, inflation is viewed to be one of the basic indicators of macroeconomic stability, hence it is an indicator of an ability for the government to manage the economy. Hence high levels of inflation may be indicative of a lack of sound governance by the monetary authority of a country.

The contribution of this paper to the literature is twofold: Firstly, to the best of our knowledge, this is the only study that looks into the inflation-growth relationship in the context of SADC. We restrict our sample to only include countries in the SADC region since these countries exhibit similar characteristics. Secondly, and more importantly, as far as we are aware, this is the first study, to compare both annual and five-year averages data in this region taking advantage of panel data methodologies so as to provide more robust estimates and confront the potential biases emanating from problems such as endogeneity, omitted variables bias, cross-country dependence and unobserved country-specific effects that may have affected previous empirical work on inflation-growth nexus. In addition, these new panel data methods are able to acccomodate unbalanced panels.

The remainder of the paper is organised as follows: Section 2 focuses on the relevant literature, while Section 3 discusses the data and methodology. The empirical results are presented in Section 4 and finally, Section 5 concludes and highlights future research.

2. Literature review

The literature on inflation-growth relationships is quite extensive, starting with the work of De Gregorio (1993) dealing with a panel of twelve Latin American countries during the 1950-1985 period and found that these two variables are negatively related. Fischer (1993) used a spline technique regression to analyse the inflation-growth relationship and he also found that high inflation retards the growth of output by reducing investment and the rate of productivity growth.

Research at the International Monetary Fund (IMF) conducted by Sarel, Ghosh and Phillips, Khan and Senhadji, and Raphael et al.(1996, 1998, 2001 and 2010, respectively) also detected the

existence of a negative relationship between inflation and growth after inflation reaches particular threshold levels. Kalirajan and Singh (2003) looked at the inflation-growth relationship in the context of India in order to examine whether developing countries' perspective is different. They made use of annual data from 1971-1998 and found that an increase in inflation from any level has a negative effect on economic growth. Moshiri & Sepehri (2004) used a data set comprising various countries at different levels of development and also found that a negative inflation-growth relationship exists above certain optimal levels.

Mubarik (2005) examined the inflation-growth relationship for Pakistan using an annual data set from 1973 to 2000 and conclude that inflation is detrimental to economic growth above a certain threshold level. Furthermore, Pollin and Zhu (2006) looked at the inflation-growth relationship for 80 countries over the 1961 and 2000 period using middle-income and low-income countries and found that higher inflation is associated with moderate gains in gross domestic product (GDP). A study by Erbaykal and Okuyan (2008) investigated the relationship between inflation and economic growth in Turkey using quarterly data covering 1987:1 – 2006:2 and found a negative and statistically significant short-term relationship to exist.

Furuoka et al. (2009) examined the issue of the existance of threshold effects in the relationship between the inflation rate and growth rate of GDP in the context of Malaysia using annual data from 1970 to 2005 and found that inflation significantly retards growth after reaching a threshold value. Kan and Omay (2010) looked at the inflation-growth relationship using panel data from 6 industrialised countries and also found the existance of a statistically significant negative relationship between inflation and economic growth for inflation rates above the endogenously determined critical threshold level.

The above brief review of studies on the inflation-growth nexus demostrates that inflation is detrimetal to economic growth after reaching a particular inflexion point. Below this inflexion point, the relationship is generally positive or non-existant in some cases. A vast majority of previous research on inflation-growth nexus focused on cross-sectional data covering a large number of countries and also looked at averages over long periods of time (Hineline, 2007). Some researchers such as Barro (1996) used panel data in order to increase the sample size and to consider the time-dimension of inflation and economic growth.

In order to avoid business cycle influence, a conventional approach is to use five or ten-year averages. Temple (1983) mentions that one interpretation of averaging inflation and growth over several years is done so as to extract the permament component of these variables. However, as highlighted by Bruno and Easterly (1998), using higher frequency data usually strengthens the findings. Furthermore, Alexander (1997) points out that averaging over several years may obscure useful information in the data, so that studies using annual data are preferable. Therefore, our value-addition to the literature is three-fold, firstly; as far as we are aware, a panel data analysis of inflation-growth nexus has never been done for the case of SADC. Secondly, we compare the results for both higher-frequency data (annual) and lower-frequency data (five-year averages). Thirdly, we apply relatively new panel data econometric techniques that takes into account; heterogeneity, endogeneity and cross-sectional dependence.

3. Data and Methodology

3.1 The data

We use both annual and five-year averages data obtained from the World Bank Development Indicators (WDI), IMF International Financial Statistics (IFS), Penn World Tables (PWT) and Polity IV, for the period 1980 to 2008. The growth and inflation variables used in the analysis include growth in real GDP (*growth*) and inflation tax (*infltx*). Control variables include the ratio of gross fixed capital formation to real GDP (*gfcf*), ratio of imports and exports to real GDP (*open*), two measures of financial development, namely the ratio of liquid liabilities to GDP (*m2*) and ratio of private credit extension to GDP (*pvtcrd*), as well as a number of institutional variables, representing a measure of the level of political rights in the country/level of democracy (*inst*), political rights (*pr*) and freedom status (*fs*), respectively, and a measure of the size of the government (*gov*). Moreover, we interact openness with gross fixed capital formation in order to capture the notion that more open economies tend to encourage higher domestic investment within the country, which is expected to induce higher economic growth. Private sector credit extension is also interacted with level of institutional freedom to reflect that deepness of financial development is also induced by more free and independent institutions in the economy (See Table 1 for detailed variable description).

Table 1: Variable description

Variable	Description	Source
cpi	Consumer price index	International Financial Statistics
fs[2]	Freedom status	Freedom House
gfcf	Gross fixed capital formation as a share of GDP	World Development Indicators
gov	Government expenditure as a share of GDP	World Development Indicators
govedu	Government expenditure on education as a share of GDP	World Development Indicators
growth	Growth of real GDP	Own calculations
infl	Annual inflation rate (annual growth rate of CPI)	International Financial Statistics
infltx	Inflation tax [infl/(1+infl)]	Own calculations
inst	Institutional variable (as measured by polity2 in polity IV dataset)	Polity2
m2	M2 as a share of GDP	International Financial Statistics
open	Exports + imports as share of GDP	World Development Indicators
pr	Political rights	Freedom House
pvtcrd	Private sector credit extension as share of GDP	International Financial Statistics
rgdp	Real GDP (national currency; millions)	World Development Indicators

Data on variables such as black market exchange rate premium, corruption perception index, fiscal balance as a share of GDP, government spending on education, real GDP per capita, school enrolment ratios (for both primary and secondary school enrolments), urbanisation (share of urban population to total population), civil liberties, population size and population growth were also used as part of the explanatory variables. However, most of these were dropped from regressions due to statistical insignificance and/or lack of data for some countries in the sample. Four SADC member countries, in particular Angola, Democratic Republic of Congo, Seychelles and Zimbabwe were dropped from the analysis due to data unavailability. Therefore, the number of countries included in the sample amount to eleven.

[2] Civil liberties, political rights and freedom status (measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest)

Table 2: Correlation matrix for 11 SADC countries (1980 – 2008)

	growth	*infltx*	*fs*	*gov*	*open_gfcf*	*pvtcrd_inst*
growth	1					
infltx	-0.12**	1				
fs	0.14**	-0.55***	1			
gov	-0.02	-0.29***	0.54***	1		
open_gfcf	0.23***	-0.01	0.26***	0.06	1	
pvtcrd_inst	0.05	-0.31***	0.47***	0.19***	0.06	1

***/**/* denotes significance at 1%, 5% and 10%, respectively
All the variables are expressed in logarithm form except for institutional variable (*inst*) since it ranges from -7 to +7. The variable (*fs)* is measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest.

Table 2 depicts correlation among the variables. As expected, inflation and economic growth presents a negative and statistically significant relationship at the 5 per cent significance level. The control variables, although some being statistically insignificant, also have expected signs. Therefore this preliminary inspection of data, shows that there is indeed an existance of a negative relationship between inflation and economic growth in the SADC region as expected. Descriptive statistics are presented in Table 3.

Table 3 : Descriptive Statistics

	growth	*infltx*	*gov*	*fs*	*open_gfcf*	*pvtcrd_inst*
Mean	0.04	0.14	0.31	1.17	7.47	1.88
Median	0.04	0.10	0.19	1.00	10.25	0.07
Maximum	0.19	0.98	3.03	2.00	17.79	29.19
Minimum	-0.15	-0.01	0.07	0.00	-1.22	-2.64
Std. Dev.	0.05	0.13	0.38	0.71	6.20	5.39
Skewness	-0.17	3.06	3.81	-0.25	-0.23	3.42
Kurtosis	5.03	14.71	20.78	2.02	1.38	14.89
Jarque-Bera	57.30	2359.01	5051.65	16.26	38.19	2538.14
Probability	0.00	0.02	0.00	0.00	0.00	0.00
Observations	324	324	324	324	324	324
# countries	11	11	11	11	11	11

3.2 Methodology

3.2.1 Unit root testing

Four panel data methodologies are used and then compared in the analysis. In particular, the FE model spesification acknowledges cross-section heterogeneity and assumes a different intercept for each country included in the sample; GMM[3] deals with the endogeneity problem in the dataset and the SUR estimator deals with cross-country dependence. Before the regressions are run, unit root tests are performed in order to determine the order of integration. We use the Im, Pesaran and Shin (2003) (IPS) unit root test and find that all the variables are stationary with the exception of *gov* and *fs*. Results for unit root tests are reported in Table 4.

Consider the following data generating process:

$$y_{it} = \alpha + \rho y_{it-1} + \varepsilon_{it} \quad (1)$$

The unit root tests were also conducted using the Levin Lin and Chu (2002) (LLC) specification which assumes a common unit root process, i.e. common ρ for all cross-sections as apposed to the IPS which assumes individual unit root processes, i.e. individual ρ_i's for cross-sections. LLC is known to suffer from heterogeneity bias, therefore IPS generally would be the preferred test. However, LLC unit root test results confirm IPS test results.

Table 4: Panel Unit Root Tests

	growth	*infltx*	*gov*	*fs*	*open_gfcf*	*pvtcrd_inst*
IPS W-stat						
Levels	-4.91***	-3.28***	0.27	-0.02	-1.62**	-0.92
[P-value]	[0.00]	[0.00]	[0.61]	[0.49]	[0.05]	[0.18]
Differences	-8.77***	-10.00***	-6.83***	-4.50***	-10.13***	-7.19***
[P-value]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
LLC t*-stat						
Levels	-2.89***	-1.98**	-0.60	-0.39	-1.39*	-1.66**
[P-value]	[0.00]	[0.02]	[0.27]	[0.35]	[0.08]	[0.05]
Differences	8.64***	-9.94***	-6.66***	-3.51***	-10.08***	-6.07
[P-value]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]

***/**/* denotes significance at 1%, 5% and 10%, respectively
[P-values] are in brackets.

[3] DIF-GMM suffers from weak instrumentation; therefore SYS-GMM augments the DIF-GMM by making an assumption that first differences of instrument variables are uncorrelated with FE. This allows for introduction of more instruments and hence improves efficiency.

All the variables are expressed in logarithm form except for an interaction variable between *pvtcrd* and *inst* since *inst* ranges from -7 to +7.

3.2.2 Fixed Effects Estimator

Consider the following two-way error component regression model:

$$y_{it} = \alpha + X'_{it}\beta + \mu_{it} \quad (2)$$

$$\mu_{it} = \mu_i + \lambda_t + \nu_{it}$$

where μ_i = unobserved individual effect

λ_t = unobserved time effect

ν_{it} =stochastic disturbance term

$i = 1, 2, \ldots, N$

$t = 1, 2, \ldots, T$

If μ_i and λ_t are assumed to be fixed parameters to be estimated and $\nu_{it} \sim IID(0, \sigma_v^2)$ then (2) represents a two-way fixed effects (FE) error component model. Note further that the X_{it} are assumed independent of the stochastic disturbance term (ν_{it}) for all i and t. However, FE are known to have problems that may lead to inconsistent and biased estimators due to the assumption that the individual specific effects are correlated with the independent variables, hence it is important to use more robust estimators.

3.2.3 Difference and System GMM Estimators

Difference and system generalised method of moments (DIF-GMM and SYS-GMM) for dynamic panels have gained much popularity in recent years. This is due to the fact that these estimators are able to circumvent several modelling concerns such as endogeneity of regressors, which may lead to inconsistent and biased results in the case of the fixed effects estimator. The most popular research papers that proposed general method of moment estimators include Holtz-Eakin, Newey and Rosen (1988), Arellano and Bond (1991), Arellano and Bover (1995); and Blundell and Bond (1998).

A recurring debate in the literature is that, in examining the relationship between inflation and growth, we are considering two endogenous variables (Temple, 2000). Therefore, to investigate this, the Hausman (1978) test for endogeneity is conducted and it confirms endogeneity in the

model, as we reject the null of exogeneity of the regressors with a χ^2 statistic of 18.57. (See Table 5). The DIF-GMM and SYS-GMM are designed to deal with the endogeneity problem, and also to fit linear models with a dynamic dependent variable, additional control variables and fixed effects (Roodman, 2009). Other studies such as Cukierman et al.(1993) uses several indicators as instruments, including central bank independence and turnover of central bank governors. However, Temple (1993) points out that a problem with using such indicators is that inflation is not correlated with the extent of central bank independence in less-developed countries. Therefore, due to the above reasoning and also due to data unavailability of such indicators in the SADC region, our DIF-GMM and SYS-GMM methods uses lagged values of *growth, infltx* and *gfcf* as instruments.

Consider the following data generating process:

$$y_{it} = \alpha y_{i,t-1} + X'_{it}\beta + \varepsilon_{it} \quad (3)$$

Where $\varepsilon_{it} = \mu_i + \upsilon_{it}$

$$E[\mu_i] = E[\nu_{it}] = E[\mu_i \nu_{it}] = 0$$

Cross-sectional units are indexed by i and time is indexed by t. A vector of control variables is represented by X and this may include lagged values for both dependent variable and controls. The fixed effects and idiosyncratic shocks are represented by μ_i and ν_{it}, respectively. The panel has $(N \times T)$ dimension and may be unbalanced. When $y_{i,t-1}$ is subtracted from both sides of (3), we get an equivalent equation of growth presented as:

$$\Delta y_{it} = (\alpha - 1) y_{i,t-1} + X'_{it}\beta + \varepsilon_{it} \quad (4)$$

In DIF-GMM, estimation occurs after the data is differenced once in order to eliminate the fixed effects, while the SYS-GMM augments the DIF-GMM by estimating both in differences and in levels (Roodman, 2009). When using these two estimators, caution needs to be exercised with respect to the number of instruments used. In particular, numerous instruments can overfit the endogenous variables and therefore the results will not be robust. Hence in this paper, we make use of Sargan (1958) test (an equivalent of Hansen (1982) test), to test for overidentification of restrictions. In our analysis; growth, inflation and investment are assumed to be endogenous, hence we instrument them with their first lags.

3.2.5 Seeminlgy Unrelated Regression (SUR) Estimator

This estimator was proposed by Zellner (1962) and this allows for cross-sectional dependence and therefore captures efficiency due to the correlation of the disturbances across country-specific equations. Unlike the FE, whose large-sample justification is based on small T and large N datasets in which $N \to \infty$, the SUR estimator is based on the large-sample properties of large T and small N datasets in which $T \to \infty$. Hoyos and Sarafidis (2009) points out that panel data sets usually exhibit cross-sectional dependence, which usually arise due to the presence of common shocks and unobserved components that become part of the error term. The reason for the interdependece emanates from the fact that over the years countries experience an increasing economic and financial integration, which implies strong interdependence among countries (Baltagi, 2005). The presense of cross-sectional dependence implies that FE estimators are still consistent although inefficient, hence the standard errors are biased.

Therefore testing for cross-sectional dependence is important in estimating the panel data models. For our sample, T = 29 and N = 11 (T > N) and the approapriate test is the Breusch-Pagan (1980) Lagrange Multiplier (LM) test. In this case the null of no cross-sectional dependence was rejected at the 1 per cent level of significance, with a Breusch-Pagan χ^2 LM statistic equal to 48.67, indicating that there is indeed cross-sectional dependence in the SADC region and this warrants the use of a SUR model (See Table A1 in the Appendix).

4. Empirical Results

4.1. Regression Results from Annual Data

This section discusses the results from the FE, DIF-GMM, SYS-GMM and SUR panel data methodologies. Results for annual data are summarised in Table 5 and the results for five-year averages data are presented in Table A2 in the Appendix.

Table 5: Regression Results for Annual data

	FE	DIF-GMM	SYS-GMM	SUR
constant	-6.62***	-	-2.58***	-3.75***
	(-6.22)		(-15.56)	(-7.04)
growth(-1)	0.08	0.82	1.95**	-
	(1.09)	(0.55)	(1.94)	
infltx	-0.49***	-0.25***	-0.05***	-0.16**
	(-3.81)	(-2.27)	(-2.09)	(-1.98)
gov	-0.55*	-0.63	0.49***	0.06
	(-2.50)	(-2.49)	(5.87)	(0.62)
fs	0.43	1.08***	-0.68***	-
	(1.28)	(3.15)	(-5.53)	
open_gfcf	0.39***	0.18***	0.04***	0.03***
	(2.51)	(3.82)	(4.61)	(4.06)
pvtcrd_inst	-0.02	-0.03	-0.03***	-0.02*
	(-1.16)	(-1.45)	(-2.56)	(-1.72)
R^2	0.44	-	-	0.06
F-stat	1.81			
[Prob > F]	[0.06]			
Hausman	18.57	-	-	-
[Prob > χ^2]	[0.01]			
Sargan	-	170.00	269.58	-
[Prob > χ^2]		[0.36]	[0.00]	
Arellano & Bond test for AR(2)	-	-1.01	-0.81	-
[Prob > z]		[0.31]	[0.42]	
# of obs.	180	170	200	282
# of countries	11	11	11	11

Dependent variable: *growth*
***/**/* denotes significance at 1%, 5% and 10%, respectively
Note: *t*-statistics in parenthesis and *p*-values in brackets.
All the variables are expressed in logarithm form except for the interaction variable between *pvtcrd* and *inst* since *inst* ranges from -7 to +7. The variable (*fs)* is measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest.

All four panel data methods used reveal that the measure of inflation which is our variable of interest, *infltx*, is negatively related to *growth* and statistically significant. This is because inflation in the economy will cause production to slow down since products are produced at higher prices. A measure of the size of the government, *gov* has a positive sign for SYS-GMM and SUR but only statistically significant for the former model. The positive sign of the gov coefficient confirms the theoretical expectations that higher government spending tends to be beneficial to economic growth. This is similar to the findings by Chen and Gupta (2006) that increase in government spending have a positive impact on economic growth because this encourages production by increasing subsidies to producers. Furthermore, increased public spending may lead to improvement in infrastructure and this is a necessary condition for improving, among others, education and living conditions, and hence ultimately economic growth.

The coefficient for freedom status (*fs*) is counterintuitive for DIF-GMM and SYS-GMM. The positive sign may be viewed to indicate that a higher level of political freedom in the region tends to encourage higher economic growth. The high degree of political freedom bodes well for investment climate and this may lead to faster economic growth. However, a high level of freedom status in the region may not necessarily encourage higher economic growth as evidenced by the SYS-GMM. The interaction variable of domestic investment (*gfcf*) and openness (*open*) has a positive sign as expected and statistically significant in all models, indicating that more open economies tend to encourage higher domestic investment and therefore leads to faster economic growth. On the other hand, an interaction variable between a measure of financial development (*pvtcrd*) and a measure of freedom of institutions (*inst*) is negative but only statistically significant for DIF-GMM and SUR models. The negative and statistically significant parameter is in contrary with our *a priori* expectations that freedom of institutions and financial development tend to encourage economic growth. Thus, contrary to expectations, our results depicts that financial deepness coupled with freedom of institutions in the SADC region negatively impacts economic growth.

4.1.1 Diagnostic Tests

The F-statistic reported for the FE methodology in Table 5 tests the null of no individual effects (H_0: $\mu_1=\mu_2=\ldots=\mu_{N-1}= 0$) against the alternative that individual effects are not all equal to zero. In this case, F=1.81 leading to a rejection of the null at the 10 per cent level of significance. Therefore, we conclude that countries in the SADC region are not homogenous and that we have to control for these differences. The implication is that the Pooled Ordinary Least Squared (POLS) estimates which omit these country-specific dummies suffer from an omission variable problem rendering them biased and inconsistent (Baltagi, 2008). The second-order serial correlation test developed by Arellano and Bond (1991) depicts that there is no second-order serial correlation present, both in DIF and SYS-GMM models. In addition, the Sargan (1958) test for over-identification of restrictions was used and the results depict that the restrictions are not over-indentified and therefore the results are robust and not weakened by many instruments for the SYS-GMM model, but not robust and weakened by many instruments for the DIF-GMM model.

4.2 Regression results for five year averages data

The regression results for five-year averages data are presented in Table A2 in the Appendix. Similar to the case of the annual data, all the methods still reveal that *infltx*, is negatively related to *growth* but in this case, statistically insignificant. An interaction variable between *gfcf* and *open* still has a positive sign as expected and statistically significant for FE, DIF-GMM and SYS-GMM. The interaction variable between *pvtcrd* and *inst* still has a negative sign and statistically significant, except for the DIF-GMM estimation result.

The F-test reported for the FE methodology tests whether the country-specific effects are all equal to zero and in this case F=2.01, leading to a rejection of the null of no individual effects. The second-order serial correlation test depicts that there is no second-order serial correlation both in DIF-GMM and SYS-GMM models. The test for over-identification of restrictions, the Sargan test, shows that the DIF-GMM results are not robust and they are weakened by many instruments and therefore these results cannot be relied upon. In general, the results derived by using five-year averages are not as robust and meaningful as the results derived using annual data.

5. Conclusion and Future Research

This paper investigates the inflation-growth relationship in the SADC region using panel data methodology. The vast majority of previous research in this field has found that a negative relationship between these two variables exists, although the magnitude of the correlation varies from one region to another depending on the level of economic development. Based on available annual and five-year average data covering the period of 1980 to 2008, we found an inverse relationship between these two variables of interest. The size of the government was found to have a positive and statistically significant impact on economic growth using SYS-GMM methodology. The interaction variable between opennes and domestic investment depicts a strong positive impact on economic growth. However, there is no evidence that financial deepness coupled with free and independent institutions encourages economic growth.

To the best of our knowledge, this is the only study that looks into the inflation-growth relationship in the context of SADC since these countries exhibit similar characteristics; second, as far as we are aware, this is the first study, to compare both annual and five-year averages data in this region taking advantage of panel data methodologies so as to provide more robust estimates, implying that these relatively new panel data econometric procedures confronts the potential biases emanating from problems such as endogeneity, omitted variables bias, unobserved country-specific effects and cross-sectional dependence that may have affected previous empirical work on inflation-growth nexus.

The paper made use of the FE, DIF-GMM, SYS-GMM and SUR, and all four methodologies confirmed that there is indeed a negative relationship between inflation and economic growth in the SADC context as discovered by other studies in other regions of the world. Many researches in this field have found that at low levels of inflation, there is a positive relationship between inflation and economic growth, but at higher levels of inflation, the sign switches and becomes negative, meaning that at higher levels of inflation, there is a negative relationship between inflation and economic growth. This implies that the inflation-growth relationship is non-linear. It is therefore in this conjecture that future research on this topic would be to investigate the optimal level/threshold level of inflation in the SADC region, above which inflation may be detrimental to economic growth, below which inflation may not have an effect on economic growth and below which inflation may be beneficial to economic growth. Therefore, it is necessary to examine the inflation-growth non-linearities in the SADC context.

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Appendix

Table A1: Seemingly Unrelated Regressions (Dependent Variable: *growth*)

	gov	*infltx*	*open_gfcf*	*pvtcrd_inst*
Botswana	-1.97*	-0.94***	-0.35***	-2.87***
Lesotho	-0.35	1.46***	3.82***	0.30***
Madagascar	2.10***	0.06	0.26***	-838.10***
Mozambique	0.04	-0.12	-0.97	-2.28***
Mauritius	-0.73	1.20***	-0.03	0.05***
Malawi	1.37***	0.19	-0.04	0.18
Namibia	0.05	0.97***	-1.31***	-0.33
South Africa	1.79***	-0.88**	-0.86**	-0.35***
Swaziland	2.07***	0.29	-0.05	-0.54
Tanzania	0.26	-0.29	3.02***	623.24

Breusch-Pagan test of independence: $\chi^2_{(45)} = 48.67$, [P=value = 0.33]

Zambia excluded due to SUR model limitation (only 10 countries can be included)
fs excluded due to insufficient observations across countries
***/**/* denotes significance at 1%, 5% and 10% significance level, respectively

Table A2: Regression results for the five-year averages

Dependent variable: *growth*

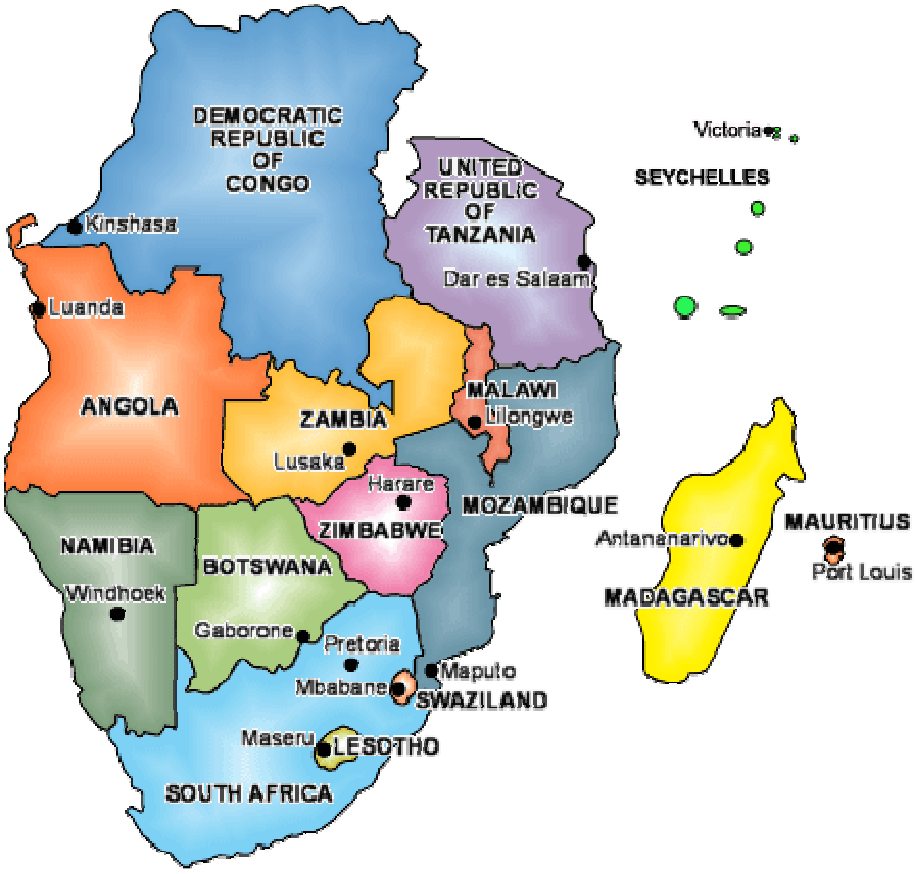
	FE	DIF-GMM	SYS-GMM	SUR
constant	-7.55***		-3.96***	-3.67***
	(-5.53)		(-6.08)	(-4.37)
growth(-1)	-0.26	-4.97	5.19**	-
	(-1.81)	(-1.18)	(1.94)	
infltx	-0.37	-0.35	-0.12	-0.11
	(-1.25)	(-1.07)	(-0.52)	(-0.45)
gov	-0.84*	-0.88*	-0.06	-0.09
	(-1.89)	(-1.87)	(-0.32)	(-0.43)
fs	0.52*	0.60	0.44*	-
	(1.68)	(1.70)	(1.93)	
open_gfcf	0.16*	0.20*	0.01***	0.02
	(1.79)	(1.75)	(0.59)	(1.11)
pvtcrd_inst	-0.04***	-0.04	-0.06***	-0.06***
	(-1.44)	(-1.43)	(-2.48)	(-2.74)
R^2	0.05	-	-	0.23
F-stat	2.01			
[Prob > F]	[0.06]			
Sargan		44.00	69.57	
[Prob > χ^2]		[0.23]	[0.08]	
Arellano & Bond test for AR(2)			0.81	
[Prob > z]		0.93 [0.35]	[0.42]	
# of obs.	55	44	58	58
# of countries	11	11	11	11

***/**/* denotes significance at 1%, 5% and 10%, respectively.

Note: *t*-statistics and *p*-values in parenthesis and brackets, respectively.

All the variables are expressed in logarithm except for an interaction variable between *pvtcrd* and *inst* since *inst* ranges from -7 to +7. The variable *(fs)* is measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest

Figure 1: SADC Map



Source: http://www.winne.com/division/events/fair/2004/mauritius_summit/images/sadc_map.gif