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Modeling the Long – Run Relationship Between Inflation and Economic Growth in Zimbabwe: A Bivariate Cointegration (Engle – Granger Two – Step) Approach

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Abstract

The debate on the nexus between economic growth and inflation is generally inconclusive and yet inevitably interesting. This study makes a contribution to the existing debate by empirically investigating the relationship between inflation and economic growth in the context of Zimbabwe. Using time series data spanning from 1960 up to 2017, the study employs the Engle – Granger Two Step modeling technique in order to analyze the relationship between inflation and economic growth in Zimbabwe. Our findings indicate that there is a negative and statistically significant relationship between inflation and economic growth both in the short – run and long – run. The speed of adjustment to equilibrium is approximately 62% annually when the variables wander away from their equilibrium values. Amongst other policy prescriptions, the study recommends inflation targeting policy in order to stimulate growth while maintaining price stability in Zimbabwe.

Keywords

Cointegration, Economic growth, Error Correction Mechanism (ECM), Inflation, Zimbabwe

1. Introduction & background

The relationship between economic growth and inflation rate has continued to generate series of debates among scholars; some of them confirm the existence of either a positive or negative relationship between these two major macroeconomic variables (Ihugba *et al*, 2005). Moreover, with time a general consensus evolved that low and stable inflation promotes economic growth and vice – versa (Mubarik, 2005). Inflation is broadly defined as the increase in the cost of living, generally measured in terms of a Consumer Price Index (CPI) (Siklos, 2000). Economic growth is can be defined as a sustained increase in per capita national output or net national product over a long period of time (Nyoni & Bonga, 2018).

The fundamental objective of macroeconomic policies in both developing and developed countries is to sustain high economic growth together with very low inflation (Chimobi, 2010). This is usually attributed to the fact that a high level of inflation disrupts the smooth functioning of a market economy (Krugman, 1995). Inflation also reduces a country's international competitiveness by making its exports relatively more expensive which impacts on the balance of payments (Atkinson & Milward, 1998). Hyper – inflation or run – away inflation erodes consumers' buying power thereby impoverishing them (Pindiriri, 2012) and this has already been witnessed in Zimbabwe during the period leading to the 2008 hyperinflationary era. Hyper – inflation refers to prices rising by more than 50% per month (Cagan, 1956) or when prices reach an annual rate of 100% in any one year (Capie, 1986; Fischer *et al*, 2002).

Unmanageable inflation is one of the major macroeconomic problems although moderate levels of inflation are beneficial in the form of employment creation (Blanchard & Fischer, 1989; Walsh, 1998; Sachs & Larraine, 1993; Lewis & Mizen, 2000). There is therefore need to simultaneously tame inflation at levels high enough to create employment and low enough to restore consumers' buying power (Pindiriri, 2012).

During the pre-independence period, much of the country's wealth was in the hands of the white minority under the rule of Ian Smith who served as the Prime Minister of the British colony known as Rhodesia (Munangagwa, 2011). During this era, inflation was not a problem; the economy was healthy. During the 1980 independence, for the sake of national pride, the Zimbabwean dollar (ZW$) replaced the Rhodesian dollar at the par rate, which was higher than the American dollar (US$) (Charkie, 2012) and this could have been the beginning of our woes as a nation.

As Zimbabwe was still boasting with their powerful currency, the situation quickly deteriorated in the late 1990s and saw a series of events leading to the demise of the ZW$ (Charkie, 2012). In the decade 1999 to 2008, Zimbabwe experienced one of the worst macroeconomic performances in the world (Pindiriri, 2012). Between 1998 and 2000, the country experienced increased pressure on its treasury, caused mainly by a depressed economic climate and a large liquidity shortage (Mpofu, 2015). At the time, inflation was high at 20% but soon escalated to 48% by beginning of 2001 (Games, 2005).

With ever-rising inflation, worsened by a foreign war that Zimbabwe was involved in and a badly implemented government land reform programme introduced in Zimbabwe in 2000, the economy totally lost grip (Games, 2005). The land reform programme in itself does not seem to have had many arguments against it but the implementation programme led to a massive exodus of skilled and experienced farmers, leading to many farms and farm equipment lying derelict for many years (Mpofu, 2015).

The way the land reform process was implemented increased political instability and drove away the third largest foreign currency earner, tourism. The western nations were quick to impose sanctions on Zimbabwe and that led to the drying up of yet another source of foreign currency and capital as financial aid and foreign direct investment (FDI) dried up. These activities together put pressure on the supply side of the economy, leading to further fuelling of inflation, which reached 100% in March 2001 (Games, 2005).

The depression resulted in a reduction in output, with businesses operating at about 20% of their capacity by the end of 2008, resulting in huge shortages of goods and services (Games, 2005). This is a neoclassic relationship of demand – driven inflation where a few goods are being chased by a lot of printed dollars leading to an even worse position with hyperinflation hitting the one trillion mark in 2009 (Paradza, 2011).

Since then, obviously due to the adoption of the multicurrency system; inflation in Zimbabwe has been hovering, mostly, in its negative territories. As of end of 2017, annual inflation stood at approximately 3% per annum. Such one – digit – figure inflation is thought of as conducive to growth as already put forward by many researchers, for example, Marbuah (2010) and Hasanov (2010). However, recently, starting in October 2018; inflation has spiraled to as high as 25% on a month-on-month basis and is obviously not healthy for the economy.

A number of studies have analyzed inflation in Zimbabwe, for example; Chhibber *et al* (1989), Dzvanga (1995), Sunde (1997), Makochekanwa (2007), Pindiriri & Nhavira (2011) and Pindiriri (2012) but none of them have studied, specifically, the bivariate relationship between inflation and economic growth in Zimbabwe, hence the need for this study, whose main purpose is to

analyze the bivariate nexus between inflation and economic growth in Zimbabwe over the period 1960 – 2017. The results of the study are envisaged to help policy makers in striking the balance between growing the economy and maintaining price stability. The rest of the paper is structured as follows: literature review, materials & methods, results and conclusion & recommendations, in their chronological order.

2. Literature Review

Theoretical Literature Review

The Monetarist Theory of Inflation

The monetarist school of thought, also known as the modern Quantity Theory of Money (QTM); argues that inflation is always and everywhere a monetary phenomenon which comes from rapid expansion in the quantity of money than in the expansion in the quantity of output (Nyoni & Bonga, 2018). Based on the QTM, monetarists argue that the quantity of money is the main determinant of the price level. In their analysis of the QTM, monetarists conclude that any change in the quantity of money affects only the price level, leaving the real sector of the economy totally unaffected.

The Keynesian Theory of Inflation

Keynesians oppose monetarists in some way by arguing that there is generally a positive relationship between inflation and economic growth but due to the adjustment path of Aggregate Supply (AS) and Aggregate Demand (AD) curves, this relationship may turn negative. Keynes himself argued that when the quantity of money increase, the rate of interest rate falls, resulting in an increase in investment and aggregate demand, thereby raising both output and employment. Therefore, Keynesians see a link between the real sector and the monetary sector.

The Neo – Keynesian Theory of Inflation

Rooted in the Keynesian school of thought, it basically states that there are three types of inflation; namely demand pull, cost – push and structural inflation. Demand pull inflation, also known as Philips Curve inflation, occurs when aggregate demand exceeds available supply. Cost – push inflation, also known as commodity inflation or supply shocks inflation, occurs due to sudden decrease in aggregate supply. Structural inflation occurs as a result of changes in monetary policy.

Empirical Literature Review

The following table is a summary of the reviewed previous studies:

Table 1

Author	Year	Country	Study period	Method	Key findings
Erbaykal & Okuyan	2008	Turkey	1987 – 2006	ARDL	There is a negative and statistically significant short – term relationship between inflation and economic growth
Chimobi	2010	Nigeria	1970 – 2005	VAR	There is a negative relationship between inflation and economic growth
Hussain & Malik	2011	Pakistan	1960 – 2006	ECM	Inflation is positively related with economic growth in Pakistan
Umaru & Zubairu	2012	Nigeria	1970 – 2010	Simple OLS	Inflation has a positive impact on economic growth
Ahiakpor &	2014	Ghana	1986 – 2012	ARDL	Capital, government

Akapare					expenditure, labour force and money supply have positive impact on GDP
Behera	2014	6 South Asian Countries	1980 – 2012	ECM & VAR	Long – run negative relationship between inflation and growth for Malaysia. The rest of the countries have no long – run relationship between inflation and economic growth.
Ayyoub *et al*	2014	Pakistan	1972 – 2010	Simple OLS	There is a negative and significant relationship between inflation and economic growth in Pakistan
Mohaddes & Raissi	2014	India	1989 – 2013	ARDL	There is a negative long – run relationship between inflation and economic growth in India
Ihugba *et al*	2015	Nigeria	1970 – 2013	ECM	Inflation and growth are positively related
Majumder	2016	Bangladesh	1975 – 2013	VECM	There a long – run positive relationship between inflation rate and economic growth in Bangladesh

3. Materials & Methods

The Mechanics Behind the Engle – Granger Two Step Approach (*Brief* Discussion)

The study adopts the Engle – Granger (EG) two step approach in order to investigate whether inflation and economic growth are cointegrated. The EG methodology was initially introduced by Granger (1981), further expagorated by Engle & Granger (1987) and Engle & Yoo (1987, 1991) and used by many reputable researchers such as Phillips & Qualiaris (1990), Stock & Watson (1988), Phillips (1991) amongst others. The first step of the EG approach is to determine whether a set of data individually contain a unit root. If a set of series are integrated to order one [I (1)], then we suspect that their linear combination might be integrated to order zero [I (0)]; and in that case we say such series are cointegrated. It is at this point (the second and final step of the EG analysis) that we estimate the Error Correction Model (ECM) in order to analyze the adjustment dynamics. In order to carry out the unit root test, the study will adopt the commonly used Augmented Dickey – Fuller (ADF) test. The ADF test, in general; is estimated as follows:

$$\Delta X_t = \alpha_0+\beta_t+\alpha_1 X_{t-1}+\Sigma\lambda_1\Delta X_{t-1}+\varepsilon_t \quad \ldots\ldots (1)$$

Where Δ is the first difference operator, α_0 is the intercept (commonly known as a drift), ε_t is the disturbance term, β is the coefficient on a time trend, α_1 is the coefficient against which we evaluate the significance of the ADF test by carrying out the following hypothesis test:

H_0: $\alpha_0=1$ (X_t has a unit root)

H_1:$\alpha_1<1$ (X_t has no unit root)

If the order of integration of the series is confirmed to be I (1), then a regression of Y_t and X_t is called a cointegrating regression and can be represented as follows:

$Y_t=\beta_1 X_t+\varepsilon_t$…….. (2)

The next step is to estimate equation two and carry out the ADF test on the disturbances. The null hypothesis in the EG test is "no cointegration" while the alternative hypothesis is "cointegration is present". In this study we use the EG critical values at 5% and 10% in order to reject or fail to reject our null hypothesis. The second and last step in the EG approach is to estimate the Error Correction Model (ECM) which can be generalized as:

$\Delta Y_t=\emptyset+\omega_0\Delta X_t+\lambda\varepsilon_{t-1}+V_t$…… (3)

Where $\emptyset$, ω_0 and λ are parameter estimates, ε_{t-1} is the error correction term and V_t is the disturbance term of the ECM.

Model Specification

Our model is synonymous to the one used in Nigeria by Chimobi (2010). The model is stated in functional form as shown below:

$GDP_t=f(INFL_t)$ …….. (4)

Where GDP_t is the annual Gross Domestic Product measured in United States Dollars and $INFL_t$ is inflation as measured by annual Consumer Price Index (CPI).

The can be expressed in econometric form as shown below:

$GDP_t=\alpha_0+\alpha_1 INFL_t+\varepsilon_t$ …….. (5)

Where α_0 and α_1 are parameter estimates and ε_t is the white noise error term.

In order to put the variables on the same wave length, we rely on the logarithmic transformations as shown below:

$logGDP_t=\alpha_0+\alpha_1 logINFL_t+\varepsilon_t$ …….. (6)

Apriori Expectation: $\alpha_1<0$

After the necessary diagnostic tests (as shown in tables 2, 3 & 4), the following ECM was estimated:

$\Delta logGDP_t=\phi+\gamma_0\Delta logINFL_t+\theta\varepsilon_{t-1}+V_t$ …….. (7)

Where, Δ is the difference operator, ϕ, γ_0 and θ are parameter estimates and V_t is the white noise error term.

Apriori Expectation: $\gamma_0<0$

Data Sources

Spanning from 1960 – 2017, data employed in this study was gathered from the World Bank (online data – base).

Diagnostic Tests

Unit Root Test (Stationarity Test in Levels)

Table 2

Variable	ADF Statistic	Critical Values	Conclusion
logGDP	-2.485001	@1%: -3.55023	Not Stationary
		@5%: -2.915522	Not Stationary
		@10%: -2.595565	Not Stationary
logINFL	0.9826	@1%: -3.55023	Not Stationary
		@5%: -2.915522	Not Stationary
		@10%: -2.595565	Not Stationary

The table above indicates that the series are not stationary in levels; therefore the unit root test was done for the second time in first difference as shown in the table below:

Unit Root Test (Stationarity Test in First Difference)

Table 3

Variable	ADF Statistic	Critical Values	Conclusion
DlogGDP	-5.948432	@1%: -3.557472	Stationary
		@5%: -2.916566	Stationary
		@10%: -2.596116	Stationary
DlogINFL	-5.432522	@1%: -3.557472	Stationary
		@5%: -2.916566	Stationary
		@10%: -2.596116	Stationary

The table above shows that both series became stationary after first differencing. Therefore, both series are I (1) variables (i.e. they are integrated of order one). The next step was to test the stationarity of the disturbances as shown below:

Unit Root Test: Residuals (in Levels)

Table 4

Variable	ADF Statistic	Critical values	Conclusion
ε_t	-6.872242	@1%: -3.562669	Stationary
		@5%: -2.918778	Stationary
		@10%: -2.597285	Stationary

Since logGDP and logINFL are I (1) individually and ε_t is I (0), then equation (6) is a cointegrating long – run regression equation. Hence, the need to estimate the ECM specified in equation (7).

Residual Diagnostic Test (The White Test):

Table 5

F-statistic	0.400382	Probability	0.7671
Obs*R-squared	6.82682	Probability	0.6911

Since the p-value of the F statistic [0.7671] is insignificant, we reject the null hypothesis of heteroskedasticity and conclude that equation (7) does not violate the homoscedasticity assumption.

4. Results: Presentation, Interpretation & Discussion

Results of the long run cointegrating equation:

Table 6

Variable	Coefficient	Std Error	T-Stat	Significance
C	9.064270	0.052920	171.2818	0.0000
logINFL	-0.399236	0.016563	-24.10468	0.0000

[R^2=0.814965; Adjusted R^2=0.803391][1]; {DW=1.807430}[2]

The coefficient of inflation is negative and statistically significant at 1% level of significance. The results imply that for a 1% increase in inflation, in the long – run; there is approximately 0.4% decrease in economic growth. While these results differ from previous studies such as Umaru & Zubairu (2012), they are consistent with a number of other previous studies such as Chimobi (2010), Ayyoub *et al* (2014) and Mohaddes & Raissi (2014).

Results of the short – run ECM

Table 7

Variable	Coefficient	Std Error	T-Stat	Significance
C	0.033862	0.006590	5.138319	0.0000
ΔlogINFL	-0.221076	0.006358755	-34.7671832	0.0000
ε_{t-1}	-0.62493	0.141660423	-4.411465	0.0016

[R^2=0.740839; Adjusted R^2=0.732473][3]; {DW=1.633304}[4]

The coefficient of the explanatory variable (ΔlogINFL) is negative and statistically significant at 1% level of significance. This reveals that for a 1% increase in inflation, in the short – run; there is approximately 0.22% decrease in economic growth. The coefficient of the error correction

[1] The long – run model has high value of R^2 (that is, 81%), implying the correct specification of the model and the relevance of inflation in the economic growth debate. An adjusted R^2 of nearly 80% confirms that stability of our long – run model.

[2] Since the value of the Durbin – Watson statistic is quite close to 2 (that is, 1.8), we conclude that our long – run model is not suffering from autocorrelation.

[3] Our short – run model also carries a reasonably high value of R^2 (that is, 74%), implying the correct specification of the model and relevance of the explanatory variable (inflation) in explaining economic growth in Zimbabwe. An adjusted R^2 of approximately 73% confirms the stability of our short – run model.

[4] Since the value of the Durbin – Watson statistic is above 1.5 (that is, 1.6), we simply conclude that it is closer to 2 and therefore, our short – run model, just like our long – run model; does not suffer from autocorrelation.

term (ε_{t-1}) is negative and statistically significant at 1% level of significance, implying that if economic growth is above its long – run relationship with inflation, it will decrease to return to equilibrium and the speed of adjustment is approximately 62%. The implication is that GDP and inflation series tend to converge to long – run equilibrium; and it shows that any deviations from this equilibrium relationship due to shocks will be corrected over time. Since ε_{t-1} tends to one, it suggests that the speed of adjustment to equilibrium is quite fast. The results of the ECM actually confirm the long – run relationship between inflation and economic growth in Zimbabwe over the period 1960 – 2017. Our results differ from previous studies such as Hussain & Malik (2011), Ahiakpor & Akapare (2014), Ihugba *et al* (2016) Majumder (2016) and Nyoni & Bonga (2017) who found a short – run positive relationship between inflation and economic growth. However, on the other hand; our results are consistent with a number of previous studies such as Erbaykal & Okuyan (2008) and Behera (2014) who found that there is a short – run and statistically significant relationship between inflation and economic growth.

5. Conclusion & Recommendations

The relationship between inflation and economic growth was analyzed using cointegration and error correction techniques in order to empirically examine both long – run and short – run dynamics for Zimbabwe using annual data from 1960 – 2017. The main purpose was to determine whether a relationship exists between inflation and economic growth, and if so, how? The study concludes that inflation and economic growth are negatively related and that any increase in inflation will harm economic growth in Zimbabwe. To boost economic growth in Zimbabwe, we recommend inflation targeting as the most suitable monetary policy measure. Other policies to fight inflation in Zimbabwe may include wage and price controls, although these ones have been vainly applied in the past and actually proved to be very unsuccessful.

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