A Granger-Causality and Cointegration Analysis of Consumption Effects on Zimbabwe's Hyperinflation and GDP Growth

Eric J. Nasution
Adventist International Institute of Advanced Studies, Philippines
nasution@aiias.edu

Brian Mahaso
Solusi University, Zimbabwe
mahasobrian@gmail.com

Abstract: The importance of understanding behavioral economics for consumers is immense nowadays. According to the Keynesian economic theory, consumption depends on GDPGR or national income growth (elasticity of income) and CPI (purchasing power). The study on Zimbabwe's GDPMPC effects, particularly on inflation in general and the 796 million % hyperinflation in particular, seemed to attract many to learn the case. It sought to observe the interaction pattern of the country's consumption using a co-integration and Granger-causality analysis, which sought to answer the research questions and hypotheses. They led to answer the trends direction and stationarity of the economic indicators, Granger-causality relationship and the effects of GDPMPC as a model for long-range equilibrium. The analysis of the 39-year economic panel data demonstrated a significant time series co-integration of the GDPMPC effects, which had indicated a clear direction on the GDPGR and CPI, which triggered the hyperinflation with the following model: CEt-1 = 1.000 GDPMPC (consumption) t-1 + 0.554 GDPGR (national income) t-1 + 0.167 CPI (hyperinflation) t-1 + et.

Keywords: *ADF or Augmented Dickey-Fuller test, CPI or consumers price index, GDPGR or GDP growth, GDPMPC or Gross Domestic Product marginal propensity to consume, RBZ or reserve bank of Zimbabwe, VAR or vector autoregressive.*

Introduction

After the signing of the Lancaster House Agreement on December 21, 1979, and independence of Rhodesia, which was proclaimed as Zimbabwe in 1980, the country began its economic affairs with agriculture, manufacturing and mining as the main business sectors in the country, which represented some 14.0%, 24.9%, and 8.8% of the GDP, respectively. Zimbabwe is known as a model of shrinking economy with around 70% of its people under poverty line and the highest hyperinflation rate of 79.6 billion % in 2008, i.e. cost of a loaf of bread of Z$ 500 million (see Figure 1). Ersado et al. (2005) stated that the people of Zimbabwe's propensity to consume as indicated by the rate of more than 100% was mainly due to the additional income of the people stemming from cash transfer, food aid and remittances from the extended family members in foreign countries.

Figure 1. Image of Zimbabwe's Value of Money for A Loaf of Bread

An interesting experience to learn from Zimbabwe's case on hyperinflation (79.6 billion % in 2008): How a loaf of bread can cost some Z$ 10 million (USD 0.42) (Baldauf, S., 2008)

The UN World Food Programme (WFP) officially released report confirming that the country was seriously experiencing food insecurity. Maize and other milling agricultural produces were distributed to large farmers and direct crowded population areas by the UN. Other

empirical study conducted by Zhou et al. (2003) reported that diaspora remittances from the extended family members into Zimbabwe played a crucial role in determining private consumption in the country. All these had a significant impact on the > 1 GDPMPC rate starting the year 2002. The Zimbabwe Programme for Economic and Social Transformation or ZIMPREST and Economic Structural and Adjustment Programme or ESAP had been heavily involved to work on Zimbabwe's economic growth and poverty reduction (ZIMSTAT, 2021).

Zimbabwe's GDPMPC Pattern and Hyperinflation

The GDPMPC of Zimbabwe seemed to indicate an uptrend during the period 1980-2018. The size of propensity to consume in the Zimbabwe's economy demonstrated the usual pattern of consumption from the year 1980 to 2001. However, the GDPMPC %, which indicated a size of 87.7% in 1980, had started to increase in 2002 to 2018 to a level of more than 102%. In other words, the economy consumed 100% of what it earned, or even more. Particularly, after the 1980's independence, with the removal of international sanction, Zimbabwe's government, built optimism, boost consumer confidence, as well as improvement of the country's terms of trade (Davies & Rattso, 1996, and Munjeyi et al., 2017). Aside from being a deflator to the GDPMPC, Maune et al. (2020) confirmed in their study that inflation was caused by the country's money supply, particularly the M3.

The domino effects of these decisions of the government was the gradual increases of the M3, 18.1% in 1980, 38.8% in 2008 and 41.2% in 2018. With this level of money supply, Bjurek et.al. (2002) cited some of the causes of huge expenditures, that were due to the influx of DIs and FDIs, as well as troops mobilization and payments of the war veterans. It was further aggravated by the printing of money for unavoidable hyperinflation to occur. Makochekanwa (2007) and Kavila & Roux (2017) discovered that expansionary monetary policy, exchange rate premium and inflation expectations would also cause hyperinflation in Zimbabwe. Refer to Table 1.

Literature Review

The underlying literature consists of theoretical framework**,** empirical review, conceptual framework, and research literature gap, which are mainly designed on the original thought of the Keynesian economics, in addition to the other relevant complementing theories.

Table 1

GDPMPC % Uptrends During the Period 1980-2018

DESCRIPTION*	GDP ($-B)**	GDPMPC%	GDPGR%	CPI%	Δ M3	INF (Inflation)
Pre-dollarization g (%)	6.9	1.2	2	7.5	n/a	Uncertain
Post-dollarization g (%)	8.8	-1.7	-5.3	-25.2		Uncertain
Year 1980	2.8	87.7	9.9	12.7	18.1%	7.0%
Year 2008	18.3	121.5	17.2	95.4	38.8%	(79.6×10^{10})%
Year 2018	42.5	102.7	10	5.2	41.2%	10.6%

Source: *Gathered from KNOEMA (validated with the IMF, World Bank and ZRB statistics)****

**Pre-dollarization (1980-2008), and post-dollarization (2009-2018).*
***In billion (B) USD.*

Theoretical Framework

The Keynesian thought on GDP marginal propensity to consume or GDPMPC fundamentally capitalizes on the core concept that aggregate demand and not aggregate supply is the determinant for a crisis to occur as presented by Amadeo (2020). In this section the connotation of crisis in the case of Zimbabwe is associated with hyperinflation, which discusses the underlying economic theories, goods demand-pull and cost-push inflation theory, and credit demand and interest rate theory.

Table 2

Related Underlying Economic Theories of the Study

ECONOMIC INDICATOR	ECONOMIST	THEORY
Y = C + S + G + NTB*	John M. Keynes	Aggregate income and consumption
Y = Permanent, not other Y	Milton Friedman	Permanent income hypothesis
Y ↓, Borrow; Y ↑, Save	Franco Modligiani	Life cycle hypothesis

**Keynesian economics: Y = GDP, which equals C (consumption or GDPMPC, with CPI or consumer price index and PPI or production price index as its deflators) + I (100% invested from S or saving, which are domestic and foreign investments or DI and FDI) + G (government spending) + NTB (net trade balance = export – import, assumed to be excluded in this study.*

The three concepts lead to the theories of the three economists; i.e. aggregate income and consumption by Keynes (1938), permanent income hypothesis by Friedman (1957), and life cycle hypothesis by Modigliani (1966), which are related to each other. In the Keynesian economics the triangulation of the three theories fundamentally gives rise to the fact that inflationary pressure may occur when consumption level, or in the case of this study on Zimbabwe, the GDPMPC%, is larger than the aggregate income level or the GDP. Hence, lower income may lead to borrowing, but higher income to saving. Refer to Table 2.

Chatziapostolou (2019) classified the content of Keynes' book, the "General Theory of Employment, Interest and Money" (Keynes, 1938) into the pre and post Keynesian thoughts by emphasizing on the constant theory of aggregate income for consumption and saving, which Keynes himself reaffirmed that marginal propensity to consume might not always be less than 1, i.e. GDPMPC % were recorded at > 1 as the 121.5% in the year 2008. Second, in support of Friedman's theory, Chao (2003) elaborated how consumption was related to money supply. Further, Carroll (2001) affirmed that earning additional income for consumption strengthens stability of consumption. Third, in support of Modligiani's theory, Kim et al. (2014) attempted to establish a model by capitalizing borrowing as a determinant for consumption, which Deaton (2005) capitalized demographic factor to respond to Modligiani theory. Younger generation consumes more than the aged.

Demand-pull and cost-push hyperinflation. Since the 1960s the Zimbabweans had been accustomed to live in a high inflation environment, i.e. high imported raw materials, high consumers' prices, high taxes and government spending, high depreciation rate of Rhodesian $ and later Zimbabwean $ since the 1980s. The Zimbabwe's demand-pull case mostly occurred due to the weak domestic investments and unavailability of lands for production because of land reform chaos, high taxes and government spending, and the on-going armed conflict that aggravated the high-cost economy (Munangagwa, 2009). While Nkomazana & Niyimbanira (2014), still within this demand-pull hyperinflation, observed the disrupted domestic production, particularly in the agricultural sector, was the main motive for the government to dollarize its currency to Zimbabwe

$ from the Rhodesian $ in 1980. Figure 2 simply depicts how P1 increases to P2 in the vicious circle relationship due to a shift in demand or an increased consumption from C1 to C2. This increased consumption generally gave rise to the need of an increased production, which didn't occur in the Zimbabwe. Importation seemed to be a prevalent way of people's consumption. In the cost-push case the same commodities supply decreased from S1 to S2, as mentioned earlier, simply because of the land reform chaos and less domestic production, reinforced by more imported products that were expensive (Kairiza, 2009). Mazikana (2017) historically observed this as a trend of Zimbabwe's de-industrialization (with less investments) that was extremely due to unfavorable government policies, political instability, liquidity crunch, labor unproductivity, and poor corporate governance. Hence, these two phenomena, demand-pull and cost-push, ceteris paribus, seriously caused the increased domestic prices. The economy was suffering from a vicious circle of hyperinflation, which denoted the simultaneous occurrence of demand-pull and cost-push hyperinflation.

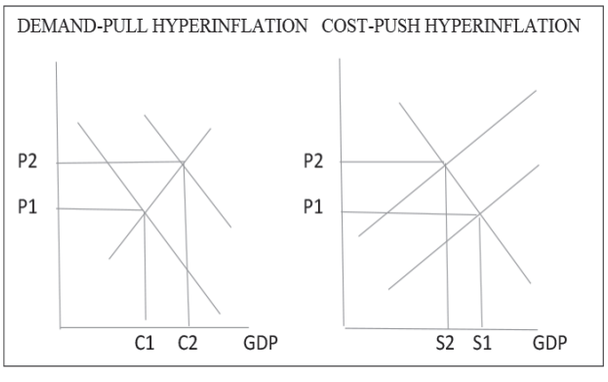

Figure 2. Zimbabwe's Circle of Demand-pull and Cost-push Hyperinflation

Credit demand and interest rate theory. Schwarzer (2018) clearly presented that Milton Friedman's postulated that "*an increase in demand motivates the producers to increase selling prices*." This refers to an inflation that occurs due to an increased demand. Even in the context of banking system, Ahmed & Islam (2005) concluded that demand for money in LDCs was a function of income; and negatively on banking deposits. The income capacity of a debtor leads him to pursue the process of money demand or applying for loan for his business. Their finding on LDCs' demand for money was reinforced by Sidikki (2010), who discovered that there was a unique co-integration and stable long-run relationship among broad and narrow money/capita, domestic interest rate and unofficial exchange rate premiums, also presented by Iftekhar et al. (2017). The reduction of income in Zimbabwe (Y1 to Y2) increases the drive to procure microfinance credits to finance households' expenditures as C1 goes up to C2. It relatively reflects that income is not adequate to finance cost of living. *Microfinance*, which is supposed to be utilized for investment, goes to cost of living. Refer to Figure 3.

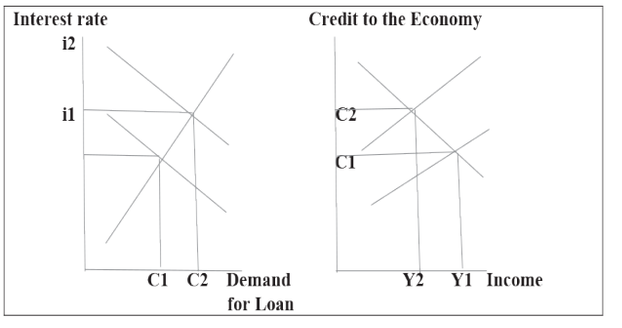

Figure 3. Keynesian-based thought of the Effect of Interest and Credit in An LDC

Empirical Review

The behavioral economics of Zimbabwe's consumption seemed to empirically derive from a number of observations, the process of which was tested with cointegration and Granger-causality analysis. First, GDP marginal propensity to consume or GDPMPC indicated a level of above the national income or GDP, leading to a GDPMPC of more than 1. It generally means that consumption is larger than the GDP. Exactly like what Costanza et al. (2009) described, the welfare of a country's well-beings is not only comparable to the level of higher GDP, which reflects the level of its consumption, but also those that determine better infrastructure, literacy, reduced poverty, improved education and healthcare standards. By applying the Zimbabwe's post-dollarization GDPMPC of more than one hundred percent, i.e. 121.5% in 2008, the author seems to be absolutely right. This high GDPMPC didn't generate the needed components of people's economic welfare. Second, empirical observation with Zimbabwe's domestic prices also came from the lesser

domestic production compared to that of higher importation level. It drove consumers' prices up. Federal Reserve Bank of Dallas (2011) reported a survey which basically confirmed that there were also hyperinflations even in the European continents in history. From the highest down they were Hungary (INF = 12.95 million billion %, in 1945-1946), Serbia (INF = 309 million %, in 1992-1994), Germany (INF = 29,526 %, in 1920-1923), Greece (INF = 11,288 %, in 1942-1945), and other countries in the continents ranging from 53% to 438%. Zimbabwe's hyperinflation in 1980s was only recorded as 796 million %. Third, as national income went down, people resorted to microfinance credits, which were used to satisfy consumption, instead of driving domestic production. The survey of Barnes (2001) on one of the leading microfinance institutions, Zambuko Trust Zimbabwe, indicated that around 60% of the members belonged to the US$ 2 per capita a day poverty bracket, who mostly borrowed for consumption, rather than for the entrepreneurial development of their enterprises. After the independence in 1980, microfinance credits seemed to be favorite sources of consumption funding beside incoming remittances from the people's extended families abroad.

Research Literature Gap

The study observed that references on consumption are widely available, but consumptions of the sub-Saharan nations seemed to be a scarcity, even though it is explorable. Utoikamanu, F. (2020) reported that the United Nations have basically captured the differences between the less developed and more advanced countries' consumption pattern. Ferraro (2008) introduced how the dependency theory had been affecting less developed countries in their consumption and trade. Trade and consumption of the less developed countries are dependent on the more developed countries. Regardless of this theory, the Keynesian postulates seemed to work in the southern African countries like Zimbabwe. Chipaumire et al. (2014) clearly presents the Keynesian postulates and their proof that consumption, government spending, and income growth affect inflation (in terms of CPI and PPI). In the context of this study, they refer to GDPMPC, TRG, and GDPGR, which not many literatures on these are relatively found.

Conceptual Framework

After the H0 testing using the Granger-causality analysis and cointegration test by including the maximum lags with the information criteria; i.e. the LR (likelihood ratio), AIC (Akaike Info Criterion), Hannan-Quinn, and SIC (Schwarz Info Criterion), the stationarity of the time series will maintain that there will exist a constant linear combination of time series statistics over time as postulated by Engle & Granger (1987).

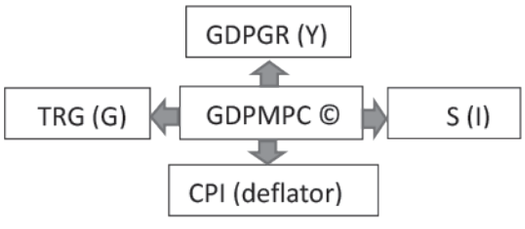

Figure 4. Conceptual Framework of GDPMPC as A Stable Equilibrium Model (The Keynesian income equation, Y = C + I + G + net trade balance)

In this study the economic behavior is expressed in terms of Zimbabwe's GDPMPC, which is explored by the VAR-based Granger-causality of the economic indicators. Refer to Figure 4.

Research Questions and Hypotheses

Based on the research questions, the study sought to test the following hypotheses at null form (H0), including how data were analyzed:

- H0-1 for question 1 – "*GDPMPC doesn't Granger-cause GDPGR, TRG, CPI, PPI, TRG, DI and FDI,*" and "*(GDPGR, TRG, CPI, PPI, DI and FDI) do not Granger-cause GDPMPC*" - were answered using the pair-wise Granger-causality test reinforced by the descriptive statistics of the panel data.
- H0-2 for question 2 – "*The co-integration of the screened time series during the period 1980-2018 does not seem to form a model for the long-term future equilibrium of Zimbabwe's GDPMPC.*" – were answered using the Johansen cointegration test.

Methodology

The research methodology consists of scope of research, econometric analysis and step-wise formulas used.

Scope of Research

Zimbabwe's pattern of GDPMPC and how it Granger-causes the other indicators, were based on the longitudinal time series data for the period 1980 to 2018, which comprised of the pre-dollarization of Z$ as legal tender (1980-2008) and the post-dollarization of foreign currencies, particularly the USD. The inflation, routinely consists of the following CPI consumption basket (as per Zimbabwe National Statistics Agency's February 2021 record): Food & housing (61.1%), transport (9.8%), clothing & footwear (6.0%), etc.

Econometric Analysis

In order to analyze the research questions and test their H0 accordingly, the study has adopted the pair-wise Granger-causality and co-integration analysis, as well as the vector autoregressive or VAR test to model Zimbabwe's GDPMPC in the long-run equilibrium. First, the econometrics would explore the stationarity of the data's time series using the ADF unit root test, after which an optimal lag was determined. If the H0 (that there is a unit root or absence of the co-integration) is rejected at a 95% level of confidence, as the second step, the co-integration of vector auto-regression or VAR, in the level and first difference, should be run using the trace test and maximum eigenvalue test (Johansen, 2009). Third**,** the VAR model would be run to determine the direction of long-term equilibrium of Zimbabwe's GDPMPC pattern through the normalized co-integration co-efficient.

Step-wise Formulas Used

The sequence of econometric analysis would involve two main formulas; the Granger-causality and co-integration shown in Figure 5.

First, the Granger-causality test is performed to screen the real two-vector relationship of the time series variables. The H0 that needs to be tested is "*GDPMPC doesn't Granger-cause CPI (hyperinflation) and GDPGR (income growth), and vice versa.*" The following is the mathematical equation:

$$y\,(GDPMPC, t) = a0+\beta 1(y\ GDPGR, t)+\beta\ 2(y\ M\&F\ variables, t)+\beta\ 3(y\ CPI\ variable, t)+\beta\ 4(y\ TRG\ variable, t)+\beta\ 5(y\ I\ variable, t)+et \quad (1)$$

where,

GDPMPC = Gross domestic product marginal propensity to consume,

GDPGR = Aggregate output or GDP growth rate,

M & F = Monetary & fiscal variables, which consist of broad money supply or M3 (money in the circulation + banking deposits + deposit substitutes),

CPI = Consumers price index, and PPI or production price index,

TRG = Tax revenue and government spending from the fiscal policy, and

I = Investment variables, which consists of FDI or foreign direct investment, and DI or domestic investment.

et = vector of error terms.

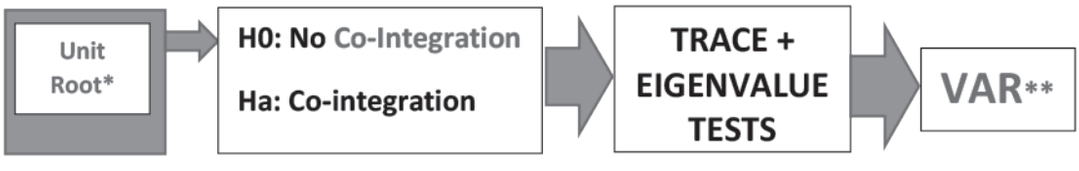

Figure 5. Priority Steps in Co-Integration Statistics for Achieving Stable Long-term Equilibrium

*Including determination of optimal lag.
**Vector autoregressive or VAR for long-range equilibrium

Second, after the above set of variables have proven to be of two-direction Granger-causes according to the Keynesian theory, then the co-integration analysis shall be performed to get the direction of the long-term equilibrium model. The co-integrating equation is presented below.

$$CE\ t\text{-}1 = a0 + \beta 1\ Yt\text{-}1 + \beta 2\ Yt\text{-}2 + \ldots\ldots \beta n\ Yp\ Yt\text{-}p + et \quad (2)$$

where,

CE_{t-1} = Coordinating equation at lag minus 1 or scaled to 1,

a_0 = constant vector,

$\beta_1\ Y_{t-1\ =\ Coefficient}$ of Y or GDPMPC value in period t, and

et = vector of error terms. This formula is not designed for the Engle-Granger test.

Results And Discussions

The results herewith presented the co-integration analysis and Granger-causality of the GDPMPC with the selected aggregate economic and monetary-based indicators during the period 1980-2018.

First H0: Granger-Causality of Zimbabwe's GDPMPC and the Trends

Based on the conceptual framework in Figure 4, the study sought to evaluate how Zimbabwe's GDPMPC, as the dependent variable, would Granger-cause the remaining economic indicators. Zimbabwe's GDPMPC with an average rate of 93.24% apparently had formed a monotonic uptrend with an MK-stat of 353 and p-value of 0.24, indicating a non-significant level. It points to the evidence that it is not sufficient to conclude with confidence that a trend exists. Another uptrend with non-significance was the DI (p-value = 0.34).

GDPMPC and the Related Descriptive Statistical Trends

The FDI (p-value = 0.000) indicated a lesser risk of (s = 1.33%), which Gwenhamo (2009) and Gochero & Boopen (2020) mentioned, had contributed to the country's economy, i.e. gold mine, manufacturing, banking and retail business. These investments covered some USD 444 million in the year 1998. The Jarque-Bera test, for the other variables with p = lesser than 0.05, computed by the formula: $JB = n[(\sqrt{b1})^2/6 + (b2\text{-}3)^2/24]$, where: n = sample size, $\sqrt{b1}$ = sample skewness coefficient, b2 = the kurtosis coefficient, indicated that their H0s (that *"the time series data are normally distributed"*) for GDPGR, M3, TRG, CPI, and PPI, must be rejected at p = 0.05. They didn't seem to be perfectly and normally distributed. The Kurtosis for GDPMPC and DI indicated a positive sign at the rate of 2.02 and 1.86, respectively, with less outliers. Refer to Table 3.

Table 3

Zimbabwe's Descriptive Statistical Data – Period 1980-2018

INDICATOR	x̄	M	s	Skew	Kurtosis	Jarque-Bera	p-value
GDPMPC	93.24	89.02	11.88	0.45	2.02	2.85	0.240
GDPGR	5.27	2.93	21.98	3.52	19.56	525.88	0.000
M3	31.87	25.41	23.12	3.77	19.67	544.26	0.000
TRG	12.7	4.0	12.1	0.447	1.184	700.0	0.000
CPI	2.92	244	17.29	3.83	22.51	713.91	0.000
PPI	118.05	106.56	79.51	3.11	14.31	270.72	0.000
DI	18.67	18.76	9.76	0.08	1.86	2.14	0.340
FDI	0.95	0.5	1.33	2.5	11.63	161.57	0.000

Source: *Evaluated from the descriptive statistical section of the E-View software.*

Related Granger-causality of GDPMPC, GDPGR and TRG to Inflation

GDPMPC and GDPGR to Inflation. Even though the GDPMPC is the center point, the study also focuses on Zimbabwe's other economic indicators in terms of their causality. First, the Granger-causality test revealed that there were significant proofs to say that GDPMPC had Granger-caused CPI (F-value = 7.851, p-value = 0.008) and GDPGR Granger-caused CPI (F-value = 6.060, p-value = 0.019), which was the more significant vector. Zimbabwe's national consumption seemed to trigger business to grow, but also inflationary pressures in the country. It definitely reinforces the Keynesian's theory that consumption Granger-causes inflation in general or Zimbabwe's hyperinflation in particular. Also, CPI and GDPGR demonstrated a significance of Granger-causing the GDPMPC.

Table 4

Granger-Causality Tests of Zimbabwe's GDPMPC and Other Economic Indicators

INDICATOR	Granger-cause*	n	Lag 1-F	Lag 1-p	Lag 2-F	Lag 2-p	Lag 3-F	Lag 3-p
GDPMPC**	**CPI**	37	7.851	**.008**	7.029	0.003	5.267	0.005
	GDPGR**	37	8.101	.007	6.131	0.006	4.629	0.009
	PPI	37	4.288	.046	n/a	n/a	n/a	n/a
GDPGR**	**CPI**	37	6.060	**.019**	n/a	n/a	n/a	n/a
	GDPMPC**	37	4.789	.035	n/a	n/a	n/a	n/a
PPI	DI	37	11.621	.002	5.267	0.011	3.859	0.019
	FDI	37	5.747	.022	4.300	0.022	3.270	0.035
TRG	**CPI**	37	9.887	**.003**	4.487	0.019	3.574	0.026

Source: *Using E-View software, the data on Appendix A were run for the F-value and p-value.*
*Granger-Cause of one direction.
**Granger-Caused (both direction, vice versa).

TRG to inflation. Second, Zimbabwe's national government revenues and spending or TRG (F-value = 9.887, p-value = 0.003) seemed to be even more significant Granger-cause of the country's hyperinflation. It was revealed from these statistics that Zimbabwe's government revenues and spending were one of the causes of this "much to learn–hyperinflation." The TRG within the observed period (1980-2018) experienced an uptrend with Engle-Granger p-value = 0.000. In general, when tax revenues are increased, the tax payer business sector is actively fueling the economy with the multiplier effects of high prices.

The above result corresponds with the three Keynesian postulates; i.e. government spending (G = Y - (C + S), consumption (C = Y – (S + G), and inflation (when C ↑, P ↑, when consumption rises, price also rises). The VAR test would ultimately answer the second H0 cointegration (the time series do not seem to form a pattern for the long-term equilibrium of GDPMPC). Please refer to Figure 6.

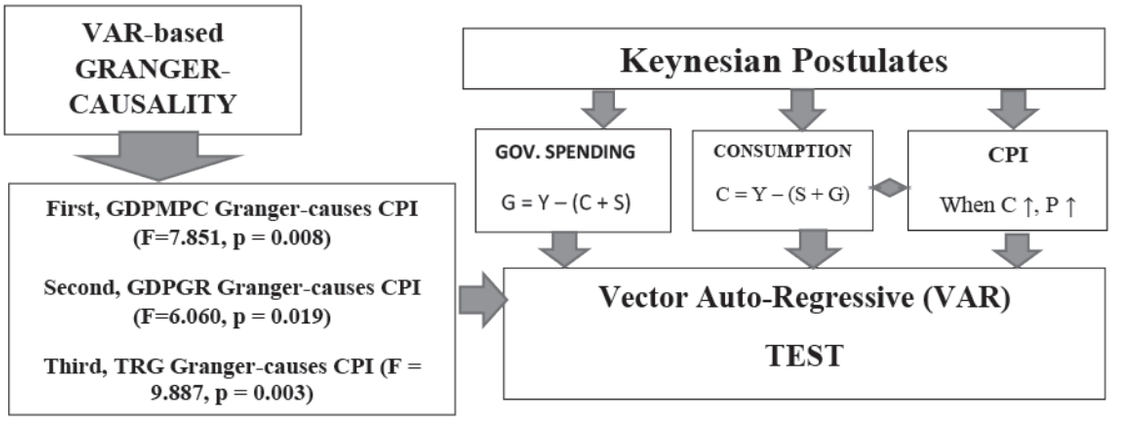

Figure 6. Step-wise GDPMPC Granger-cause Test Using Vector Autoregressive (VAR)

Second H0: Cointegration of Zimbabwe's GDPMPC and Equilibrium

The study has tested the cointegration of Zimbabwe's GDPMPC and its long-term equilibrium equation.

Zimbabwe's Long-term Equilibrium of its GDPMPC Using the VAR Analysis

After the unit roots test, the lag optimality, and Johansen's trace and maximum eigenvalue tests, the equilibrium is interpreted by the normalized cointegrating coefficients.

Unit Roots and optimal lag determination. The four variables of the model, the GDPMPC, GDPGR, TRG, and CPI, were subjected to unit root test using the ADF procedure.

Table 5

Unit Roots and ADF (Level & 1st Difference) Analysis of GDPMPC, GDPGR, and CPI

VARIABLE	Optimal Lag		ADF – LEVEL			ADF – FIRST DIFFERENCE		
			F-value	t-value	p	F-value	t-value	p
GDPMPC			4.035	0.99	0.747	83.687	-9.148	0.000
GDPGR			28.748	-5.361	0.000	50.236	-6.643	0.000
CPI			5.643	-3.352	0.019	9.142	-4.784	0.000
TRG			5.644	-3.353	0.019	9.143	-4.780	0.000
Criteria:								
LR	2	21.675						
AIC	**3**	21.541						

Source: *Using E-View software, the unit roots and lag optimality are determined*.

It revealed that the ADF first difference of GDPMPC at t-value = -9.148 (> 1.96 at 0.95 level of confidence), as well as GDPGR (t-value = -6.643), CPI (t-value = -4.784) and TRG (t-value = -4.780), didn't have any unit root (all p-values = 0.000). However, the ADF level did have unit root or I (1) as its t-value = 0.990 < 1.96 at the same level of confidence. The remaining variables under the ADF-level, GDPGR and CPI, obviously didn't have any unit roots, because all t-values were > 1.96 (significant at 0.95 level). This unit roots test had simultaneously determined the optimality of the lag, which the E-View software generated as lag = 3. Refer to Table 5.

GDPMPC's normalized cointegration coefficients. Upon checking the units roots and optimal lag (lag = 3, using the Akaike Information Criterion), the Johansen test of the H0 of no co-integration, evaluated the trace and maximum Eigenvalue tests. From the two, the trace test seemed to be the more significant one as the hypothesized number of cointegration equations or CE were rejected at p-value = 0.000 for no co-integration and at most 1. This scheme used the second (2) formula to test the normalized co-integration that *GDPMPC Granger-causes GDPGR and CPI* in order to determine the long-range equilibrium model. Refer to Table 6.

Table 6

GDPMPC's Johansen Co-Integration Results (Trace and Max Eigenvalue Test)

HYPOTHESIZED # C.E.	TRACE TEST			MAX. EIGENVALUE TEST		
	Observed	Critical	p-value	Observed	Critical	p-value
None	45.679	29.797	0.000	26.398	21.132	0.008
At most 1	19.282	15.495	0.000	17.264	14.265	0.016
At most 2	2.017	3.841	0.155	2.017	3.841	0.155
NORMALIZED CO-INTEGRATION COEFFICIENT:						
	GDPMPC	CPI	GDPGR	TRG		
Coefficients	1	-0.554	-0.167	-1.860		
Standard errors		-0.04	-0.039	-0.854		
t-value		13.85	4.282	2.178		

Source: *Using E-View software; GDPMPC, CPI and GDPGR, excluding the TRG, were run for #CE.*

Based on the summary in Table 6, the long-range equilibrium pattern for GDPMPC was stated as follows:

$$CE_{t-1} = a_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2 + \ldots\ldots} \beta_n Y_p Y_{t-p} + et$$

$$CE_{t-1} = 1.000\ GDPMPC_{t-1} + 0.554\ GDPGR_{t-1} + 0.167\ CPI_{t-1} + 1.860\ TRG_{t-1\ +}\ et.$$

It confirms that the co-integration equation at (t – 1) will have the GDPMPC with a complete integer of 1 for every 0.554 GDPGR, 0.167 CPI and 1.860 TRG.

Zimbabwe's Long-term Equilibrium of Its GDPMPC Using the Engle-Granger Test

Even though not as accurate as that of Granger-causality using the VAR version, the GDPMPC's long-term equilibrium may also be evaluated from the Engle-Granger's stationarity test. It constructs residuals or errors based on the static regression. It explores whether the unit roots exist using the ADF test. The resulting GDPMPC model, is only interpreted by the lag 3 differences (p-value = 0.013) of the ADF test. In spite of their stationarity, the Engle-Granger test didn't seem to indicate a clear pattern of the co-integration, but a sporadic and fragmented pattern. Under this scheme, the first (1) formula is used to interpret that *Zimbabwe's GDPMPC depends on GDPGR, M3, CPI, PPI, TRG, DI and FDI*.

Conclusion

The following findings on the pattern of GDPMPC % of the Zimbabwe's economy during the period 1980-2018 are presented below. The related implications of the findings and conclusion are also presented to open the horizon of more comprehension.

Based on the analysis of the two questions and hypotheses, the study had generally summarized that Zimbabwe's GDPMPC (consumption), GDPGR (income growth), and TRG (taxation and government spending), had significant effects on CPI or hyperinflation. In particular, the following were findings of the study:

1. During the review (1980-2018); GDPMPC, FDI and TRG, had developed a good uptrend direction due to the good investment policy and trade openness in Zimbabwe.
2. In line with the Keynesian economic theory, GDPMPC (consumption), GDPGR (income growth), and TRG (government spending) had Granger-caused Zimbabwe's CPI (inflation) by using the VAR-based Granger-causality.
3. Using the Akaike Information Criterion (AIC) lag = 3, and Johansen co-integration analysis, the normalized co-integration coefficients revealed Zimbabwe's GDPMPC, GDPGR, CPI and TRG as having a long-range equilibrium equation: $CE_{t-1} = 1.000\ GDPMPC_{t-1} + 0.554\ GDPGR_{t-1} + 0.167\ CPI_{t-1} + 1.860\ TRG_{t-1} + et.$
4. In spite of the clear model under the VAR-based cointegration technique, the Engle-Granger co-integration analysis didn't offer any model, but discovered significant p-value = 0.013 at lag 3, confirming that GDPMPC would depend on the remaining economic indicators.

The study concluded that the analysis of the 39-year economic panel data demonstrated a significant time series cointegration of the GDPMPC effects, which had shown a clear direction on the GDPGR, CPI and TRG, with the following equation: $CE_{t-1} = 1.000\ GDPMPC\ (consumption)_{t-1} + 0.554\ GDPGR\ (national\ income)_{t-1} + 0.167\ CPI\ (hyperinflation)_{t-1} + 1.860\ TRG\ (government\ spending) + et$. By virtue of the equation and with the proofs that Keynesian postulates worked in Zimbabwe, GDPMPC should have an imperative implication on three factors, the GDPGR or national income (positive impact), CPI or people's purchasing power (critical impact) and TRG or government's spending (critical impact), which are elaborated in the recommendation.

Finally, based on the findings, it is recommended that the Zimbabwe's government to implement the following:

GDPGR for Better National Income

First, sustainable-based industrialization using Zimbabwe's real economic resources like land, natural resources, human resources and pool of experts, and funding, must be efficiently formulated, implemented and mobilized for the people's welfare. Second, development of the logistic system of the country's resources. Third, invite more foreign direct investments or FDIs as a means to develop the country's industrialization and technology. Fourth, banking system deregulation that prioritizes on domestic third-party funding and credits for the economy. It entails the thorough development of the Monetary Board's open market policies for effective money supply control, and effective interest rate management. Fifth, innovative digitization system on strategic industries and Infrastructure-based fiscal policies must be formulated and properly implemented. Sixth, national program for entrepreneurship together with the micro-finance infrastructure must be formulated nationwide. It will assist the Zimbabweans to be self-supporting in earning their income.

CPI Control for Stronger Domestic Purchasing Power

First, the Z$ as Zimbabwe's legal tender must be maintained, and its redenomination of Z$ is imperative. It seeks to prevent national confusion on how income is earned. Second, national price control must be closely exercised by a consortium of RBZ, Ministry of Trade and the local mass organization. Third, employment must be created for all people, particularly the working-age population. Fourth, there must be a close coordination between government spending and how the Reserve Bank of Zimbabwe implements

monetary policies. Avoid printing money before attempting to implement these policies.

TRG Reform and Wiser Government Spending

First, the RBZ in coordination with the Zimbabwe's monetary board must always be concerned with money supply control through a prudent open-market policy, especially money in circulation and bank deposits. Second, from the Granger-causality test it revealed that expenditures or government spending on tax revenues must also be controlled because of the inflationary pressure it created in Zimbabwe. Third, discount rate adjustment must also be prioritized to curb inflationary pressure.

Table 7

Summary of Recommendations

Recommendation	Implication	Authority	Previous Studies
GDPGR POLICIES			
Industrialization program	Reduced poverty Enhanced economics	Trade & Industry	Ferraro, V. 2008
Logistic system	Support industrialization	Logistic Dev Authority	Davies & Rattso, 1996
Innovative digitization	Innovative banking	Trade & Industry	Utoikamanu, F., 2020
Foreign direct investments	Industrialization	Board of Investment	Mazikana, A.T., 2017
Banking deregulation	Effective monetary policy Third-party funding NPL reduction *	RBZ***	Ahmed & Islam, 2005
Entrepreneurship	Development funding	Trade & Industry	Deaton, A., 2005
CPI PRICE CONTROL			
Z$ legal redenomination	Z$ exchange system	Monetary Board	Carroll, C.D., 2001
Effective price control	Demand & supply **	Price Control Board	Sidikki, J.U., 2010
Employment development	Strategic competency	Labor Department	Iftekhar , T. et al. 2017
TRG (GOV. SPENDING)			
Open-market policy	Controlled M3	RBZ***.	Sikwila, M.N., 2017
Tax reform implementation	Controlled spending	Ministry of Finance	Sikwila, M.N., 2017
Discount rate adjustment	Reasonable interest rate	RBZ***.	Sikwila, M.N., 2017

*NPL = Non-performing loan of the Zimbabwe's existing banking system
**Demand & supply of goods through the better coordination of the Zimbabwe's Ministry of Trade & Industry
***Reserve Bank of Zimbabwe (RBZ) as the central bank

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