The effects of money supply on inflation in Tanzania

James Ezekiel Mbongo[1], Felician Mutasa[2], Robert Ebihart Msigwa[3]

[1]Department of Labour and Price, National Bureau of Statistics, Dar es Salaam, Tanzania
[2]The Open University of Tanzania, Dar es Salaam, Tanzania
[3]School of Mathematical Sciences, Dalian University of Technology, Dalian, 116024, China P. R

Email address:

mbongoje@gmail.com (J. E. Mbongo), felicianmutasa@yahoo.com (F. Mutasa), msigwa77@gmail.com (R. E. Msigwa)

Abstract: This paper examines the effects of money supply on inflation in Tanzania. This study uses secondary data extracted from two sources, namely; the National Bureau of Statistics (NBS) and Central Bank of Tanzania (BoT), where all variables employed in the analysis are extracted. The study applies OLS, VAR and ECM technique to examine the effect of selected variables on inflation in Tanzania. OLS and ECM results show that money supply and exchange rate have significant impact on inflation in the short and long run. Further, VAR findings indicate that the current inflation can be influenced by the past state inflation. Therefore, the government of Tanzania is recommended to impose tight monetary policies and expand the proportion of money in the economy from informal to formal transaction. The successful implementation of the suggested indicators to evaluate the inflation in the country will help to cure the instability of inflation, in turn will direct the economy of the country to preferable level.

Keywords: Inflation, Money Supply, Exchange Rate, Tanzania

1. Introduction

Perhaps no subject covers headlines of today's newspaper, economic forums and governments/state agenda as much as inflation. Politicians worldwide talk about it as if it is a horrible visitation like food shortage, foreign invasion or a plague, over which they had no control. For decades, they promise to fight against inflation, unfortunately none of them ever managed to stabilize and cure it. According to the fundamental concept of economics, inflation has been caused primarily by an excess of money supply and increase of credit. Monetary and fiscal policies initiated usually keeps rising inflation. These increases are dominant because when people are allowed to offer more money for goods or the supply of goods cannot be balanced with supply of money automatically raises the price of goods. The price of goods rises, not only because the goods are scarcer than before, but because money is more abundant and less valued.

In the early years, various governments applied the tradition method of clipping and debasing the coinage by grinding more money on a printing press. Today, the approach is slightly different and acts in the indirect way. Currently, governments sell bonds to banks; in turn banks create deposit on books, which can be drawn by the state.

This approach has been criticized by economists arguing that the selling government bond is not a sustainable solution for fighting against inflation. From the economic theories, the value of individual money usually depends on the present money supply and the expected future of money supply. Since the government payments and transactions are through cheques, both cash supply and bank credit affect inflation by selling bonds to banks.

On the other hand, some economists believe that a low and stable inflation rate of 3 percent has a small cost in the economy (Mankiw, 2008). The need to understand the cause and cure of inflation usually lead researchers to different opinions about the appropriate measures to be taken to stabilize inflation. Those advocating on monetary terms have been advising the government to stabilize the budget deficit and restrain credit to public enterprises. Although this approach is viable, but the economic stability cannot exist in the market mechanisms with the dramatic change of inflation. The simple and reliable solution is to control the government expenditures, which causes a deficit in the process of economic development. When the supply of money is very high, the inflation has effects on the following; the value of the monetary unit depreciates very quickly, raises everybody's living costs, wipes out the value of the past savings, discourages the future savings and redistribute

wealth and income wantonly, in return reduces the economic growth. Although the economic growth of Tanzania has many problems, but this paper focuses on examining the effects of money supply on inflation in the country. It is an undeniable fact that money supply, imbalances of economic structures, international motivations and sometimes all factors together have attributed to the increase of inflation. Tanzania located within the East Africa boundaries is not exempted from this drama. For decades, the country has witnessed tremendous change of the commodity prices (e.g., in 2011 the change in price reached 20%).

Despite the targeted inflation to play greater role in assessing the trends of economic growth, but Tanzania for a long time has not managed to realize it. For example, according to macroeconomic projections and policy paper of the government, the target inflation in the mid of 2009 was below 7%, but at the end of the years jumped to 10% (Macroeconomic policy Framework, 2008/09-2010/11). In April 2011, the inflation rate reached 8.6% and the government promised to tackle inflation by taking countermeasures to control in monetary systems and fiscal policy (Economic survey and Government Targets report, 2011/12-2015/16). With all efforts the inflation in the country kept on rising, for instance, in December 2011/1reached 20% and will continue to take off if the policy and authority controlling is relaxed. The mismatch between the inflation and target inflation is unacceptable because all the time causes pressure on other economic variables such as business profits.

Many studies on inflation have been carried out in the country, but there are limited literature linking the effects of money supply on inflation. For example, the following empirical studies have attempted to included money supply as a separate entity in studying the causes and cure of inflation in the country (Ndanshau, 2011; Mbowe, 2008; Aikaeli, 2007; Mwase, 2006; Rutasitara, 2004; Kwimbere and Mbowe, 2004; Somaila et al., 2001; Ottaru, 2001 and Mtui, 1996). Although their works have pointed out some important areas to be evaluated, particularly the mismatch between the inflation and the target inflation, but unfilled gap remains in literatures for relating money supply and inflation in the country.

Therefore, this study intends to examine money supply effects on inflation using the vector autoregressive (VAR) and error correction mechanism/model (ECM). The study uses secondary data collected from 2000 to 2011. The vector error correction mechanism corrects the lapses using the OLS. VEC results are used in addressing the relationship of inflation and other variables in the short and long run measurements.

The remaining part of this study is presented as follows; the next section discusses the literature reviews. Methodology and data are demonstrated in section three. Section four presents the findings. Conclusion, discussion and policy implication recommendation is provided in section five.

2. Literature Review

Recent theories of the inflation stated in literatures show that in the past decades the causes and cure of inflation have been dominated by politicians, policy credibility, and the political will of addressing the problem. Leyrea and Sumaila (2001) noted that the whole process of addressing inflation rate in Tanzania has been dominated by political economy approaches than the macroeconomic policy. The traditional methods for curing inflation, such as clipping and debasing inflated by politicians and the institution is no longer applicable instead government bond selling has emerged to be the way of controlling inflation. The new approach has been criticized by economists arguing that in order to cure inflation, the government should strengthen the industrial structure.

In developing countries, these structures may include; industrial protection, trading policies and weather conditions. The country can cure inflation through protecting the infant industries from intra-current area trade and promoting domestic market for agriculture products by imposing stiff import restrictions. However, before adopting the policy it is important to evaluate all factors contributing to inflation otherwise the structured firms will create monopoly and oligopoly. Also, these policies can cause high inflation when the price of some controlled items rises quickly. Weather condition, such as drought affecting crop product, directly destabilizes inflation because food products have a large weight in the measure of consumer price index (CPI). Through experience, during the good weather (particularly rainy season) the future of the food price is expected either to fall or rise. As aforementioned, the insight of understanding of the effects of the money supply on inflation have been studied by many scholars including;

Moriyama (2008) applied both structure vector autoregression and vector error correction model as a single equation to investigate the inflation dynamics in Sudan. Results indicated that money supply expansion and the nominal exchange rate affected inflation in 18-24 month time lag. Structural autoregression used to forecast inflation in Sierra Leone found that the domestic inflation rate was dominated by the rise of oil prices, money supply and nominal exchange rate depreciation (Gottschalk et al., 2008). Cointegration and error-corrections modeling used to examine the inflation and monetary pass through in Guinea in 1992-2003 (Blavy, 2004). The results confirm the close relation between money supply and consumer prices. Short-term found to influence the long run effects and the impulse response found to create shock in the money stock in two or more years consecutively before stabilizing at high level. Almounsor (2010) explained the underlying determinants of inflation dynamic in Yemen using the structure autoregression model and a vector error correction model as a single equation. The study found that the inflation dynamic in Yemen has been influenced by its own dynamics and changes in the international prices, exchange rate devaluation, domestic demand shock as well as financial

innovations. Alturki et al., (2010) pointed out short- term, long-term dynamics and forecasting inflation using a vector error correction model (VEM) and Autoregressive Moving Average model (ARIMA) in Tajikstan. Different transmission channels through VECM used to evaluate the relative dominance magnitude and speed of the transmission to the equilibrium price level. The excess supply of foreign money found to affect inflation in the short and long term. In addition, dynamic analysis of exchange rate and international inflation found to affect local product price. Akinboade et al. (2004) examined the determinant of inflation in South Africa, using the Least Square Estimation method. They found out that the joint movement of the nominal effective exchange rate and foreign money on the inflation reflect directly to the shift of domestic prices in the long run. The short run dynamics of inflation correlate significantly with labour cost and inflation. Applying Dynamic model, Durevall et al. (1999) realized that the inflation in Kenya is affected by excess supply of money and interest rate in the short run while the exchange rate, foreign prices in terms of trade affected inflation in the long run. Also, limited supply of food items found to affect inflation. Ndanshau (2011) studied the budget deficits, money supply and inflation in Tanzania. Findings reveal that a pair of Granger test has one way casual effect, directing from inflation to the budget deficit and monetary base. VECM results indicate the existence of a significant inflation inertia and causal effect on the budget deficit over the short run. Changes in monetary policy significantly affect inflation and budget deficits.

Despite the extensive literatures investigating money supply and inflation, there is an unfilled gap to be discussed. This paper examines the effects of the money supply on inflation in Tanzania, particularly the mismatch between the targeted and realized inflation. Overall picture about the causes and cure of inflation is useful to direct government and stakeholders to take appropriate measures to fight against inflation.

3. Research Methodology and Data

This research seeks to explore the inflation dynamics in Tanzania. Time series secondary data including; the headline CPI, the broader classification of money (M2), real exchange rate (RER), the price of fuel (Pf) and the price of maize flour (Pm) applied to analyze the dynamics of inflation. This study uses the secondary data gathered by the National Bureau of Statistics (NBS) and the Central Bank of Tanzania (BoT). Variables employed in this study selected after thorough observation of its trend in relation to inflation.

3.1. Model Formulation

In this study, the headline CPI is regarded as the dependent variable while money supply, exchange rate, inflationary deflated price of fuel and maize flour are explanatory variables. Numerous studies have pointed out that these variables either directly or indirectly affect the inflation in Tanzania (Ndanshau, 2011; Mbowe, 2008 and

Aikaeli, 2007)

The model used in this study is expressed as;

$$CPI_t = f(\beta_0 + \beta_1 M2_t + \beta_2 RER_t + \beta_3 Pf_t + \beta_4 Pm_t + \varepsilon_t) \tag{1}$$

where; CPI_t : Headline Consumer Price Index; $M2_t$: Broader classification of money; RER_t : Real exchange rate; Pf_t : Price of fuel; Pm_t: Price of maize, and; ε_t : is the disturbance or error term

The model described above can be written in the regression form as follows;

$$CPI_t = \beta_0 + \beta_1 M2_t + \beta_2 RER_t + \beta_3 Pf_t + \beta_4 Pm_t + \varepsilon_t \tag{2}$$

The proposed theoretical model shows that the money supply, real exchange rate, the price of fuel and maize flour are important variables in determining the inflation in Tanzania. In the economic perspective; money supply, the price of fuel and maize flour tends to relate positively with inflation, while the real exchange rate exhibit inverse relation to inflation. Nevertheless, it is important to convert these variables to log in order to reduce the heteroscedasticity before comparing with standard regression (Gujarati and Porter, 2009). The application of log model gives appropriate coefficients of the elasticity for the CPI against explanatory variables. Therefore, this paper uses a log model to fulfill OLS conditions in analyzing the inflation in Tanzania.

The equation (2) is transformed into econometric model

$$nlcpi = \beta_0 + \beta_1 nlm2_t + \beta_2 nlrer_t + \beta_3 nlpf_t + \beta_4 nlpm_t + \mu_t \tag{3}$$

Where; nl stands for natural log

3.1.1. Testing for Unit Root

This study applies the Augmented Dickey-Fuller test in order to test the presence of a unit root. It is recommended to use this test under the assumption that the error term may be correlated. It includes the lagged values of the dependent variable. The advantage of using the Augmented Dickey-Fuller test is the ability to include enough terms so that the error term becomes uncorrelated. The model is expressed as;

$$\Delta nlcpi_t = \beta_1 + \beta_2 t + \delta nlcpi_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta nlcpi_{t-1} + \varepsilon_t \tag{4}$$

Where;
t is a trend and $\Delta nlcpi_{t-1} = (nlcpi_{t-1} - nlcpi_{t-2})$

3.1.2. Testing for Cointegration

Cointegration has gained remarkable considerations in analyzing time series data in order to avoid spurious

regression. In the case, where the individual variable exhibit stochastic process, the technique is appropriate for choosing coefficient for stationary. In this study when the unit root analyzed subjected to research the stationary is denoted by I(0) and the individual variable is represented by I(1). In this sense, the linear combination cancels out the stochastic trend in the model. With this assumption, stochastic variable in the model generates meaningful results and correspond to the long run equilibrium relationship.

$$\mu_t = nlcpi_t - \overline{\beta}_0 - \overline{\beta}_1 nlm2_t - \overline{\beta}_2 nlrer_t - \overline{\beta}_3 nlpf_t - \overline{\beta}_4 nlpm_t \tag{5}$$

Testing the existence of cointegration, Augmented Engel-Granger (AEG) test usually helps to identify the presence of cointegration.

3.1.3. Vector Autoregressve Model (VAR)

Despite the VAR model resembling Autoregressive Moving Average (ARIMA) models, VAR models, analyze vector with more than one variable. VAR model works well when there is no distinction between the endogenous or exogenous and there is true simultaneity among variables. This study assumes that the model contains p number of lagged values for each variable and predetermined lagged value of variables is uncorrelated with the error term. These assumptions allow the use of OLS in estimating the VAR.

$$nlcpi_t = \alpha_0 + \sum_{i=1}^{p}\beta_{1i}nlcpi_{t-i} + \sum_{i=1}^{p}\alpha_{1i}nlm2_{t-i} + \\ \sum_{i=1}^{p}\delta_{1i}nlrer_{t-i} + \sum_{i=1}^{p}\sigma_{1i}nlpf_{t-i} + \sum_{i=1}^{p}\phi_{1i}nlpm_{t-i} + \mu_{1t} \tag{6}$$

Where; $nlcpi_{t-i}$ is the lagged values of $nlcpi$; $nlm2_{t-i}$ is the lagged values of $nlm2$; $nlrer_{t-i}$ is the lagged values of $nlrer$; $nlpf_{t-i}$ is the lagged values of $nlpf$; $nlpm_{t-i}$ Is the lagged value of $nlpm$ and μ_t is the stochastic error term. Akaike information criteria is used to determine the appropriate number of lags

3.1.4. Error Corrections Mechanism (ECM)

Although long run equilibrium can be achieved using the proposed model, yet there might be disequilibrium in the short run. ECM corrects disequilibrium in the short run by presenting variables in the linear trend and transforming variables to structures related to cointegration. In addition, the error term produced is termed as equilibrium error.

The ECM model is presented as follows

$$\mu_t = nlcpi_t - \beta_0 - \beta_1 nlm2_t - \beta_2 nlrer_t - \beta_3 nlpf_t - \beta_4 nlpm_t + \beta_5 t \tag{7}$$

Consider the following model

$$\Delta nlcpi_t = \alpha_0 + \alpha_1 \Delta nlm2_t + \alpha_2 \Delta nlrer_t + \\ \alpha_3 \Delta nlpf_t + \alpha_4 \Delta nlpm_t + \alpha_5 \Delta \mu_{t-1} + \varepsilon_t \tag{8}$$

Where; ε_t is the white noise disturbance and μ_{t-1} is the lagged value of the error term in the previous model. When the equilibrium error is nonzero, the model is disequilibrium. The absolute value of α_5 shows how quickly the equilibrium converges.

3.1.5. The Granger Causality Test

This study uses the Granger Causality test to identify the direction of the influence between the money supply and inflation. From the work of Ndanshau (2011) and the theory presented by Mankiw (2008) point out that there is a close relationship between money supply and inflation, but none of them proved the existence of the causality. Causality test is important for policy makers to point out the source of influence and the outcomes after implementation of the policy.

The Granger causality test is expressed as;

$$nlcpi_t = \sum_{i=1}^{p}\alpha_{1i}nlm2_{t-i} + \sum_{i=1}^{p}\beta_{1i}nlcpi_{t-i} + \sum_{i=1}^{p}\delta_{1i}nlrer_{t-i} + \\ \sum_{i=1}^{p}\sigma_{1i}nlpf_{t-i} + \sum_{i=1}^{p}\phi_{1i}nlpm_{t-i} + \mu_{1t} \tag{9}$$

$$nlm2_t = \sum_{i=1}^{p}\alpha_{1i}nlm2_{t-i} + \sum_{i=1}^{p}\beta_{1i}nlcpi_{t-i} + \sum_{i=1}^{p}\delta_{1i}nlrer_{t-i} + \\ \sum_{i=1}^{p}\sigma_{1i}nlpf_{t-i} + \sum_{i=1}^{p}\phi_{1i}nlpm_{t-i} + \mu_{1t} \tag{10}$$

where; nl denote natural logarithm.
    p is the maximum lag length.
μ_{1t} Stochastic error terms (normally distributed with zero mean and constant variance)

The causality test is tested using the following formula;

$$F = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)} \tag{11}$$

where; RSS_R restricted sum of squares RSS_{UR} is the unrestricted sum of squares and m is the lag length of M2.

4. Results

This section presents results obtained in the analysis using time series data. To analyze data ordinarily least square (OLS), vector autoregressive (VAR) and error correction model (ECM) employed to test the effects of the money supply on inflation. Results further used to test the designed hypothesis proposed in this study. The scatter plot (not presented due to limited spaces) confirms the positive relationship between the general price level and money supply. The decreasing value of the Tanzania shilling significantly relates to the increase of the general price level.

The fuel price indicates the mixed pattern in relation to CPI while the price of maize positively relates to general price level

4.1. Tests for Unit Root

Table 1. *Testing Unit Root*

	Names of variable			
	dnlcpi	*dnlm2*	*dnlrer*	*dnlpf*
ADF Test Z(t) Statistics	-6.851	-7.683	-7.625	-5.252
1% Critical Value	-4.026	-4.026	-4.026	-4.026
5% Critical Value	-3.445	-3.445	-3.445	-3.445
10% Critical Value	-3.145	-3.145	-3.145	-3.145
Order of Integration	*I(0)*	*I(0)*	*I(0)*	*I(0)*
Stationarity Status	Stationary	Stationary	Stationary	Stationary

The findings presented in table1 consisting the log of CPI, m2 are non-stationary confirming the importance of including some transformation to turn variables into stationary in order to avoid the spurious regression effects.

Computed tau (τ) values for dnlcpi (-6.851), dnlm2 (-7.683), dnlrer (-7.625) and dnlpf (-5.252) are less than the critical value (-3.445) at the 5 % level. The null hypothesis is rejected and all variables have been transformed to stationary as indicated in table1

4.2. Cointegration test for Long Run Relationship

Cointegration highlights the existence of long run equilibrium which converges over time. All individual variables found to exhibit stochastic process I (1) except for maize flour. Results in table2 show the applicability of Augmented Engle-Granger test in testing long run relationship of the variables under study.

Table 2. *Augmented Engle-Granger test for Cointegration*

Residuals from Regression of;	Computed τ (=t) Statistics	Engle-Granger 1% Critical τ Value	Engle-Granger 5% Critical τ Value	Engle-Granger 10% Critical τ Value
nlcpi and nlm2	-3.495	-4.026	-3.445*	-3.145
nlcpi and nlrer	-3.336	-4.026	-3.445	-3.145**
nlcpi and nlpf	-3.442	-4.026	-3.445	-3.145**

Table2 presents the residual values represented by the CPI and M2 (-3.495) which is less than the Engle-Granger (-3.445) at the 5% level. There is evidence of significant long run equilibrium between CPI and exchange rate at 5% level. Moreover, in testing the existence of cointegration between the CPI and fuel price, the computed τ (=t) (-3.442) is less than than the critical value (-3.145) at the 10% level. Therefore, the null hypothesis is rejected and concludes that CPI posses a long run relation to the money supply, real exchange rate and the fuel price

4.3. Ordinary Least Square Results

Ordinary least squares (OLS) are used in a log transformed variables to estimate the influence of explanatory variables on inflation. Table 3 provides regression results covering 2000:1 to 2011:12 dataset.

Table 3. *Estimation Results of OLS regression*

Variables	Coefficient (β_t)	Standard Error	t Statistics	Probability(P >|t|)
nlm2	0.3402047	0.019428	17.51	0.000
nlrer	-0.2995788	0.043822	-6.84	0.000
nlpf	-0.1669998	0.031914	-5.23	0.000
nlpm	0.0464676	0.021908	2.12	0.036
Constant	4.434438	0.296126	14.97	0.000
R-squared = 0.9797; Adj R-squared = 0.9791				
F (4, 139) = 1678.29; Prob > F = 0.0000; Root MSE =0.03494				

Table 3 shows the performance of regression fit and probability of F-test (0.000). The overall performance of the model is relatively high with the adjusted R-squared (0.9791), implying that 97.91% of the inflation in Tanzania is explained by the explanatory variables selected in this study. The probability value of F-test reveals that an increase of 1% of the money supply will affect the inflation by 0.34% when other variables are held constant. The results relate to the claims of monetary researchers advocating that the inflation is significantly influenced by money supply in the economy. Moreover, the decrease of 1% in the exchange rate of Tanzania shilling against US dollar pushes the inflation to 0.3% when other variables remain constant.

Fuel price effects of price inflation in Tanzania are significantly observed. It is represented by the unexpected sign in which the increase of fuel price by 1%, the inflation will be decreased by 0.17% when all other variables are kept constant. These findings are similar to those presented by Crowley (2010) in the study conducted in the Middle East, North Africa and Central Asia. The study noticed the complication of linking the local prices in inflation are due to local prices controls, taxes and subsidies provided in the country under concern. Finally, maize flour significantly affects the inflation at 5% level. An increase of 1% of maize flour will be affecting inflation by 0.05% when other variables remain constant.

Although the significance level is low, yet these findings provide useful information related to that presented by Khan et al (2006) and Durevall et al (1999) that variation of prices in cereals affects inflation significantly.

4.3. Vector Autoregressive Model

VAR model is applicable under the assumption that, there is true simultaneity among variables and all variables must be treated on the same footing (i.e. No distinct between endogenous and exogenous variables). The model is developed basing on the two laggs that are determined using Akaike Information Criteria (AIC)

Table 4. *VAR model results*

Variables	Coefficient (β_t)	Standard Error	t Statistic	Probability(P>|t|)
nlcpi				
L1	1.1596	0. 0998831	11.61	0.000
L2	-0. 2414503	0. 0956163	-2.53	0.013
nlm2				
L1	0. 032808	0. 0572284	0.57	0.567
L2	0. 0040749	0. 0626889	0.07	0.948
nlner				
L1	-0. 0485057	0. 0595114	-0.82	0.417
L2	0. 0359496	0. 0593239	0.61	0.546
nlpf				
L1	-0. 0799694	0. 0346711	-2.31	0.023
L2	0. 0678716	0. 034271	1.98	0.050
nlpm				
L1	0. 0106667	0. 0120875	0.88	0.379
L2	-0. 0160014	0. 0121525	-1.32	0.190
Constant	0. 25954	0. 1842985	1.41	0.161
R-squared = 0.9977				
Adj R-squared = 0.9976				
F (4, 139) = 5773.21				
Prob > F = 0.0000				
Root MSE = 0. 01187				

Table 4 confirms that the model involving all variables in this study is statistically significant (F-test= 57773.21). All lagged terms are statistically significant at the 5% level. Despite the unexpected sign of the second lag of lncpi showing negative relationship, yet the coefficients of lncpi in the first (1.1596) and second (-0.2415) are statically significant at the 5 % level. The fuel price coefficient for first and second lags (-0.08000 and 00679) are significant at 5% and 10% level with the p-value of 0.023 and 0.050 respectively. The first lag posses negative sign, which is contrary with economic theories that fuel price has positive influences on inflation, that is an increase of the fuel price tends to decrease the general price in the economy. Although the first and second lags of the money supply, real exchange rate and the maize flour is statistically insignificant at the 5%, however, some of the lagged give expected sign. For example, the coefficient of the first lag of the money supply (0.0328), real exchange rate (-0.0485) and the price of maize flour (0.0107) unveiled the expected sign as suggested in economic theories

4.4. Error Correction Model

Table 5. *Error Correction Mechanism (ECM)*

Variables	Coefficient (β_t)	Standard Error	t-Statistic	Probability (P>|t|)
Δ nlm2	-0. 2147361	0. 0508715	-4.22	0.000
Δ nlrer	-0. 3022962	0. 0419437	-7.21	0.000
Δ nlpf	-0. 0482195	0. 0292109	-1.65	0.101
Δ nlpm	-0. 0058528	0. 009874	0.59	0.554
ε_{t-1}	-0. 1564431	0. 0494562	-3.16	0.002
Constant	0. 0091584	0. 0012022	7.62	0.000
R-Squared = 0.2572				
Adj R-Squared = 0.2301				
F(5, 137) = 9.49			Prob > F = 0.0000	
Root MSE = 0.0115				

The ECM results show that exogenous variables in the model have a positive influence of inflation in the short run. The coefficient value of lnm2 and lnpf with value -0.2147 and -0.3023 at the 5% level give description for short run, respectively. The adjustment coefficient, error term is nonzero and negative as expected and statistically significant at the 5% level signifies the dynamic stability of inflation. In the short run, the model is out of equilibrium, therefore, any changes in the inflation (CPI) can be regulated by adjusting the money supply in the economy, real exchange rate, the price of fuel and the price of maize flour towards the equilibrium. In that sense, the relation between the inflation and the explanatory variables are important for long run plan. The coefficient of the error correction term presented in table5 (-0.1564) gives the adjustment mechanism of the equilibrium with the break of the model at 0.16 units. This result explains that, 16% of the disequilibrium in the model will be corrected immediately to restore equilibrium within a month

4.5. The Granger Causality Test

The direction of causality between money supply and inflation has been noted by Mankiw (2008), Gujarati (2009) and Ndanshau (2011). Granger causality test is applied to investigate the causal influence between money supply and inflation in Tanzania. The direction of influence is important to identify the possible source of influence, which helps to simply the policy implementation

Table 6. *The results of Granger causality test*

Direction of causality	F- value	Decision
$CPI \rightarrow M2$	0.47	Do not reject
$M2 \rightarrow CPI$	8.98	Reject

Table6 presents F value that is statistically significant at the 5% level, the null hypothesis is rejected and concluding

that the money supply Granger causes inflation. In addition, money supply and inflation exhibit unidirectional with the fact that, the only Granger value of the money supply causes inflation in Tanzania

4.6. Conclusion, Discussion and Policy Implication

Data extracted from the National Bureau of Statistic (NBS) and Central Bank of Tanzania (BoT) is confidently relevant for analysis in this study. In testing the hypothesis, non-stationary variables are converted to stationary before applying the regression model to test the model fit. The transformation of variables is important for avoiding the spurious regression effect.

The cointegration test between the CPI and explanatory variables rejects the null hypothesis, concluding that money supply, exchange rate and maize flour ha a long run relationship with CPI at 5% and 10% level. In the long run, money supply, real exchange rate and fuel prices significantly exert inertia on inflation. Applying the OLS, VAR and ECM model indicated to be significant in all cases with the probability of F-test (0.0000). The proposed model generates accurate estimates for determining the effect of the money supply and other variables on the inflation in Tanzania. In addition, VAR results reveal the importance of previous state inflation in examining the current inflation. Overlooking the past inflation may significantly compromise the implementation of policies in the long run due to inflationary effects. OLS results show that money supply and exchange rate significantly affect inflation in the country. An increase of 1% of inflation will contribute an increase of 0.34% in the money supply and 0.3% increase will be caused by a 1% increase in exchange rate. The results also reveal that maize flour has an influence on inflation, but in the short run of EMC indicate that the money supply and exchange rate can very well describe the inflation in the country.

Since money supply and exchange rate affect directly the inflation in the long and short run, it is evident that the instability of the inflation in Tanzania for a long time is caused by excess supply of money and the deterioration of the exchange rate in Tanzania shilling against foreign currency. Fuel price cannot be used to describe the inflation trends in Tanzania. The interpretation is not clear because sometimes the increase of the fuel price leads to an increase of general price, but in some circumstances the general price keeps decreasing despite the stagnation of fuel price. The presence of low level of competition in the economy usually leads to such phenomena. The disconnection between the economic variables is the main reason of vagueness as realized in the fuel price. Consequently, the cure of inflation in Tanzania should be considered in the excess of money supply, exchange rate and previous state of inflation rather than managing fuel price.

In mid to late 2011 the economy was overwhelmed with the highest level of the money supply and the exchange rate deteriorated to the worst reaching 1,800 Tanzania shilling against 1 US dollar. With this finding, we suggest the government to reduce huge expenditures and control budget deficit while for central bank must stop creating artificial cheap money in the economy by controlling the excess supply of money.

4.6.1. Short-Term Policy Implication

Although other determinants can influence inflation, but excess money supply and exchange rate affect inflation extremely. The central bank of Tanzania introduced many reverse money programs to maintain the core inflation to a single digit (Monetary Policy Statement, 2011) by opening markets operations to control the liquidity level of the economy. Unfortunately, the approach has not managed to cure the overall inflation in the country. Therefore, the central bank of Tanzania is recommended to invest in open market strategy together with another flexible approach, which in turn, removes all excess money in the economy.

On the other side, the central bank of Tanzania has been participating in the foreign exchange market through inter-bank foreign exchange market (IFEM). The main objective of IFEM is to smooth the short term fluctuations of injected foreign exchange for liquidity. However, in a speculative economy, such intervention may not yield the preferable solution. To stabilize exchange rates, BoT is recommended to impose firm regulations and take appropriate countermeasures to commercial banks in the foreign exchange market. The implementation of suggested points will help to identify the exchange rate that is purely determined by the state of the economy rather than those determined by speculators. Since Tanzania is a net importing country, the deterioration of exchange rate significantly affects the inflation.

4.6.2. Long Term Policy Implication

BoT has been developing good strategy and policies to control the excess supply of money and exchange rate, but the economy of the Tanzania is based on the informal sectors which is an the obstacle in obtaining the desired solution (Ndulu, 2012). Currently, only 35% of money in the circulation is in the formal system transactions and the remaining percentage is controlled by informal systems. Currently, BoT has a power to control only one third of money circulating in the economy. Therefore, money supply and exchange rate are the central problem of inflation in Tanzania. It is important to formalize the transaction to the level that both money supply and exchange rate can easily be monitored by the BoT, otherwise inflation will continue increasing every year. The reason of the fuel price not to affect the inflation in the country is that the government has established the regulatory authority to control fuel price. It is important for the state to support this authority because the unregulated fuel price has multiple effects. In this case, uncontrolled fuel price usually raises the production cost and increases commodity prices, which in turn, affect inflation. On the supply side, the government and stakeholder are recommended to invest in the agriculture sector, particularly food production in order to protect the economic instability from the increase of food inflation.

Acknowledgements

References

[1] J. Aikaeli, "Money and inflation dynamics: a lag between change in money supply and the corresponding inflation process in Tanzania". Bank of Tanzania working paper,2007.

[2] O. Akinboade, F, Siebrits, and E. Niedermeier, "Determinants of Inflation in South Africa". University of South Africa, 2004.

[3] A. Almounsor, "Inflation dynamics in Yemen: an empirical analysis". IMF working paper, 2010.

[4] F. Alturki, and S.Vtyurina, "Inflation in Tajikistan: forecasting analysis and monetary policy challenges". IMF working paper, 2010.

[5] R. Blavy, "Inflation and monetary pass-through in Guinea". IMF working paper, 2004.

[6] J. Crowley, "Commodity prices and inflation in the Middle East, North Africa and Central Asia". IMF working paper, 2010.

[7] D. Durevall and N. Ndung'u, "A dynamic model of inflation for Kenya, 1974-1996". IMF working paper, 1999.

[8] J.Gottschalk, K, Kalonji, and K. Miyajima, "Analyzing determinants of inflation when there are data limitation": The case of Sierra Leone. IMF working paper, 2008.

[9] M. Khan, and A.Schimmelpfennig "Inflation in Pakistan: money or wheat". IMF Working paper, 2006.

[10] D.Kwimbere, and W. Mbowe "Inflation process in Tanzania". Bank of Tanzania working paper, 2004.

[11] G. Mankiw, "Principales of Macroeconomics". Fifth Edition. TSI Graphics Inc, 2008.

[12] W. Mbowe, "Monetary policy implementation and its effect on inflation in Tanzania: an empirical investigation for the period 1995-2005". PhD Thesis. University of Dar es Salaam, 2008.

[13] K.Moriyama, "Investigating inflation dynamics in Sudan". IMF working paper, 2000.

[14] J.Mtui, "Exchange rate depreciation, money supply and inflation: the Tanzanian experience 1970-1994". Masters Dissertation. University of Dar es Salaam, 1996.

[15] N. Mwase, "An empirical investigation of the exchange rate pass-through to inflation in Tanzania, 1990-2005". IMF working paper, 2006.

[16] M.Ndanshau, "Budget deficit, money supply and inflation in Tanzania. a granger causality test, 1967-2010". University of Dar es Salaam, 2011.

[17] B. Ndulu B. "Government securities bidding go online". Business standard, page 11, 4th-10th Septermber 2012.

[18] P. Ottaru, "The dynamics of inflation in Tanzania: a multivariate time series analysis". Masters Dissertation. University of Dar es Salaam, 2001.

[19] L.Rutasitara "Exchange rate regimes and inflation in Tanzania". *African Economics Consortium*, 2004, Paper 138.

[20] U. R. Sumaila and A. S. Layrea, "Determinants of inflation in Tanzania", WP 2001:12, 2001, http: /www.cmi.no/public/2001-12.PDF.