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Inflation - Growth Nexus
A Dynamic Panel Threshold Analysis for East African Economies

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Abstract
This paper aims to investigate the role of inflation on economic growth in East African Countries. Panel data over a period of about 26 years starting from 1990 to 2016 was used for six East African countries. A dynamic panel threshold model (DPTM) is introduced to estimate inflation thresholds for long-term economic growth and to test the existence of non-linear relationship between economic growth and inflation. The model allows the estimation of threshold effects with panel data that the existence of Endogeneit is taken into considerations. The estimated results confirm the existence of inflation threshold picking the threshold level to be 10.48 percent. The result confirms that inflation rates exceeding the threshold level (10.48%) are associated with lower economic growth. However, below this threshold, the correlations between the two variables remain insignificant. Since pushing the inflation rate down is always done at the expense of unemployment, government should make sure that they identified the right inflation rate to be achieved.
Keywords: Economic growth, Dynamic panel threshold model, inflation, East African Countries, Generalized Method of Moment

1.Background of the study

Ensuring high and sustained economic growth along with low inflation is one of the major goals of almost all macroeconomic policies makers, government authorities and central banks. Stable price has a key role in determining the growth rate of an economy. To this end, monetary policies are adopted to maintain inflation at a desirable rate through monetary policy instruments. As argued by many scholars, a very high inflation is a drag to economic growth, whereas moderate inflation might accelerate growth (Temple (2000) cited in Little et al., (1993). In addition, Aiyagari (1990), as well as Cooley and Hansen (1991), suggest that the cost of lowering inflation toward zero is higher than the benefit. (Thanabalasingam V. 2013). In line with the above empirical results, macroeconomic theory also favors some acceptable level of inflation by arguing that inflation will play a positive role in the production process by substituting a downward movement of wage (since wage is downward sticky in most cases) and making labor to be cheaper (Mankiw, 2009).

According to Kanchan Datta et al (2011) the impact of inflation on economic growth depends on its effect on investment and saving as the major determinants of economic growth are saving rate and investment. On the other hand Patrick Enu (2013) argues the persistent and continuous rise in general prices of goods and services over time, hinders efficient allocation of productive resource by complicating the signaling role of relative price changes which is an important guide to effective decision making. In addition to that, inflation makes an economy's exports relatively expensive to the rest of the world, and it causes balance of payments to deteriorate and country's international competitiveness to reduce.

From the opposite pole, there are economists who argue that if excess demand arises due to the lack of sufficient technological change, bidding up relative prices in the production` sector; accompanied with price and wage floors in the economy then it will cause inflation to arise and if such factors are at the root of inflationary pressures, then monetary and fiscal policies can slow inflation only at a expense to economic development (Susan M. Wachter, 1979)

Though economists and policy makers recognized the negative impact of inflation on economic growth, there is one obvious question which is remained unanswered: "if high inflation is detrimental to economic growth, then how low should it be?" Vikesh Gokal and Subrina Hanif (2004) responded to this question by saying there is no absolute answer to this question because it depends on the nature and structure of the economy and vary from one country to the other.

There are plenty of research works on the relationship between economic growth and inflation; most of which uses the so called Vector Auto regressive Model (VAR) and Vector Error Correction Model (VECM) aiming to investigate the short run dynamics and the long run relationship between the two variables; L Krishna Veni et al, (2007), In addition to these models, simultaneous equation models are also frequently applied to approach the relationship of the two variables recognizing that inflation and economic growth might have a bi-directional relationship; Kenneth O. Obi et al (2016) . Though, the models they used are relatively different, their conclusions have something in common that high level of inflation is generally growth unfriendly. Later on, researchers start to ask whether the functional relationship between the two variables is identical across the entire observations in a sample, or do they fall into discrete classes? Equivalently, this question tries to find out the threshold rate of inflation at which the growth rate remains unaffected (or positively affected). This question has been addressed using threshold regression techniques. Threshold regression models specify that individual observations can be divided into classes based on the value of an observed variable. (Hansen 1999)

1.1.Statement of the problem

Nowadays, many monetary authorities and central banks have placed increased emphasis on price stability. Monetary policy-whether expressed in terms of interest rates or growth of monetary aggregates-has been increasingly geared toward the achievement of low and stable inflation. Central bankers and most other observers view price stability as a worthy objective because they think that inflation is costly to the economy. Some of these costs involve the average rate of inflation and others relate to the variability and uncertainty of inflation. But the general idea is that businesses and households are thought to perform poorly when inflation is high and unpredictable. (Robert J. Barro, 2013). On the other hand, increasing price level leads to; a deterioration in the standard of living, unpredictability of government policy actions and of macroeconomic instability (Kenneth O. Obi et al (2016)

Traditionally economists divide the costs of inflation into two parts: The costs of anticipated inflation, and the costs of unanticipated inflation. Anticipated Inflation among others, are Shoe-leather costs (when people are obligated to visit bank more frequently and hence wear out their shoes); Menu costs (costs of changing prices arising from frequent print of price catalogs); Liquidity effect (high nominal interest rates, on borrowed funds). Unanticipated Inflation on the other hand, has a redistribution effect from the creditor to debtors. But this division gets insignificant in developing countries owing to the fact that market information is rarely available to the public at large and if it is available, its accuracy is still questioned which results in the anticipation process to be relatively difficult (inaccurate) as compared with the developed countries.

Among the central objectives of macroeconomic policies, achieving high and sustainable output growth accompanied by low inflation is the major one. But can they coexist? Or is there a trade-off between lowering inflation and achieving higher growth? At the operational level, there is recognition that the growth-inflation relationship depends on the level of inflation an economy is experiencing—at some low levels, inflation may have positive contribution to growth, but at higher levels inflation is likely to harm economic growth. In many recently literature, this has been translated into the use of threshold models, which suggest that when inflation exceeds a certain level (the threshold) higher inflation becomes very costly for output growth, that would call for radical policy intervention as soon as inflation exceeds the threshold. (Raphael Espinoza et al. 2010)

Apart from these empirical evidences, researchers also argue that the threshold value of inflation is significantly different for developing and developed economies so that using a threshold level of inflation identified for developed economies by developing countries as a policy target is miss-leading and inappropriate which seeks for a separate investigation for developing countries where this research is trying to fill the empirical gap.

1.2.Research question

- What is the relationship between inflation and economic growth?
- Does inflation accelerates economic growth in the study area?
- Is there a threshold effect in the relationship between inflation and economic growth?
- What level of inflation should the government target to achieve?

1.3.Objective of the study

The general objective of this study is to assess the empirical relation between inflation, and economic growth in East African countries using dynamic panel threshold analysis. Specifically, the objectives are;

- ✓ Assessing the impact of inflation on economic growth
- ✓ Empirically investigating the existence of threshold level of inflation and estimating the threshold value.
- ✓ Testing the strength of the linkage among these variables at different regimes given the threshold exists.

1.4.Scope and significance of the study

This study explores the effect of inflation on economic growth in east African Economies. To achieve this objective, panel data ranging from 1990 to 2016 were chosen. The whole period is chosen due to the availability of published data for all the variables involved in the model and to avoid using multiple data sources for the same variable. This study limits itself to east African countries (Egypt, Djibouti, Ethiopia, Kenya, Tanzania, Sudan and Uganda). The paper excludes countries such as Eritrea, Somalia and south Sudan due to absence or missing part of the data for a significant period of time.

Apart from the well-known models such as VAR and VEC models, which are repeatedly used in the empirical literatures to determine the impact of inflation on Economic growth, this paper tries to adopt a relatively new (at least to the study area) model; dynamic panel threshold model, aiming to determine the threshold level of inflation where beneficial effect of inflation to economic growth is reversed. This paper tries to answer a question where 'which level of inflation should the government and the monetary authorities strive to attain?' given this objective in mind, this study will benefit as a guideline for policy makers in their inflation targeting and serve as a base line reference material for additional study in the topic.

Having the above objective, however, the study has suffered from limitations. The limitations arise from inconsistency of data from different sources (specially different international organization publish significantly different values for the same variable for the same time period is considerably varying) and the data for some variables might sometimes be missing for some counties to take considerably long time series data. In the inflation-growth relationship there might exist more than one threshold values whereas this study only adopts a single threshold level.

2. DATA AND MODEL SPECIFICATION

2.1. Data type and source

To determine the existence of potential threshold point in inflation-growth rate dynamics and hence estimate the impact of inflation on economic growth in different regime for selected east African countries, using the dynamic panel threshold model (DPTM), panel data has been used which is obtained from World development Indicator (WDI), as well as from World Bank database for the time starting from 1990 to 2016. In selecting the countries and the time horizon, the relative similarity of economic environment and the existence of data for the whole variables have been taken into consideration. The mean annual Inflation has been significantly different for developing and developed economies (Stephanie Kremer et al, 2011) so that its behavior should be studied separately. On the other hand, there are also claims by previous researchers that the threshold level of inflation is significantly different for developing and developed countries, calling for separate analysis.

Variables included in the model are Growth rate of GDP at 2010 constant prices, Inflation rate as represented by annual Average percentage change of Consumers' Price Index (CPI) for the year under consideration; Semi-log transformation is made to inflation rate aimed to smooth its initial value while taking care of negative values of inflation.

The control variables chosen in this model are Annual growth rate of population, degree of Trade openness which is proxied by the sum of export and import in percentage of GDP in 2010 constant prices, Terms of Trade (TOT) which is computed as Export value divided by import value, initial income measured in terms of the logarithm of GDP per capita from previous period in constant of USD 2010 prices (logarithm of per-capita real GDP at time t-1), Annual percentage change of the GDP per capita dedicated to investment in constant of USD 2010 prices, standard deviation of Terms of Trade and standard deviation of trade openness. The selection of the variables was made based on the previously done research in the area.

Log of inflation is used as proposed by Thanabalasingam V (2013), Ghosh and Phillips (1998) and Sarel (1996). Logarithmic form is suggested in order to eliminate (or smoothen) strong asymmetry in the initial distribution of inflation, at least partially, and obtain the best fit among nonlinear models. Nevertheless, due to the existence of negative observed values of inflation in the sample, a semi-log transformation method was adopted, following Thanabalasingam V (2013), Stephanie Kremer (2011) and Khan and Senhadji (2001). The semi-log transformation involved the following form;

$$\widehat{\pi}_{it} = \begin{cases} (\pi_{it} - 1), if\, \pi_{it} \leq 1 \\ \log(\pi_{it}), if\, \pi_{it} > 1 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(2.1)$$

Where $\widehat{\pi}_{it}$ is semi-log value of the inflation, which includes both positive and negative values and hence, continuous variable. The values of inflation become linear if it is less or equal to one and it takes the logarithmic form if its value is above one.

Inflation and economic growth are expected to be endogenous determined variables because there might exist a bi-directional causation between the two variables.

2.2. Model specification

According to different theoretical and empirical literature there are various channels through which inflation may affect economic growth either by distorting or accelerating it. According to Stephanie Kremer et al (2011); if these different channels overlap or offset to one another, or exert different and meaningful impacts at different ranges of inflation, the relationship between inflation and economic growth might be characterized by inflation thresholds, where the threshold level at which its impact is reversed is much important for policy targeting by the central bank and policy makers. One of the models which captures the threshold level and used in different empirical analysis of inflation thresholds is the panel threshold model first introduced by Hansen (1999) and later became very familiar among researchers and extended to dynamic version, which is aimed to estimate the threshold values instead of inflation.

Following Thanabalasingam V (2013), Stephanie Kremer et al (2011), Myung Hwan Seo et al. (2014), Christophe Hurlin, (2010), Chien-Ho Wang et al (2010), Saad Ahmad and Andrea Civelli; this study adopts the dynamic version of Hansen (1999); dynamic panel threshold model. The dynamic panel threshold model takes the form;

$$Y_{it} = \mu_i + \beta_1 \hat{\pi}_{it} I[\hat{\pi}_{it} \leq \gamma] + \beta_2 \hat{\pi}_{it} I[\hat{\pi}_{it} > \gamma] + \alpha X_{it} + \zeta_{it} \text{ .... (2.2)}$$

Where i = 1, 2…..N representing space dimension
t = 1, 2 ….T representing time dimension

ζ_{it} is the error term which is assumed to have mean zero and serially uncorrelated.

The dependent variable Y_{it} represents the growth rate of GDP for country i at time ‘t’

μ_i on the other hand, represents the country specific fixed effect

$\hat{\pi}_{it}$ is a threshold variable (inflation) which is assumed to be exogenous though time variant.

I(.) is representing the indicator function

X_{it} is vector of explanatory variables which are divided into predetermined variables and endogenous variables

γ is the threshold level of inflation parameter which divides the sample data into two regimes with coefficient β_1 and β_2 so that equation 1 can be re-specified as follows;

$$Y_{it} = \begin{cases} \mu_i + \beta_1 \hat{\pi}_{it} + \alpha X_{it} + \zeta_{it}, if\, \pi_{it} \leq \gamma \\ \mu_i + \beta_2 \hat{\pi}_{it} + \alpha X_{it} + \zeta_{it}, if\, \pi_{it} > \gamma \end{cases} \text{ ....(2.2.1)}$$

2.2.1. Elimination of fixed effect

Since the model contains time-invariant individual country specific effect, this effect has to be eliminated in advance before we use two-stage least square (2SLE) estimation methods so as to obtain the consistent coefficient estimators; Stephanie Kremer et al (2011), Thanabalasingam V (2013), Chien-Ho Wang et al (2010).

The individual country specific effects μ_i is eliminated through a fixed-effects transformation mechanism while without violating the underlying distributional assumptions made by Hansen (1999; 2000) and Caner and Hansen (2004). In the dynamic model, the standard within transformation applied by Hansen (1999) is criticized by; Stephanie Kremer et al (2011) as it leads to inconsistent estimates since the lagged dependent variable will always be correlated with the mean of the individual errors and hence, to all of the transformed individual errors. First-differencing of the dynamic equation as usually done in the context of dynamic panels implies negative serial correlation of the error terms such that the distribution theory developed by Hansen (1999) is not applicable anymore to panel data. As motivated by Thanabalasingam V (2013), and other researchers, this study adopts the transformation method called “forward orthogonal deviation,” which was proposed by Arellano and Bover (1995) to eliminate individual fixed effects. Therefore, for the error term, the required transformation is given as follows;

$$\zeta_{it}^{\ast} = a_t \{\zeta_{it} - \frac{1}{(T-t)}(\zeta_{i(t+1)} + ... + \zeta_{iT})\} \text{ .... (2.3)}$$

Where $a_t = \sqrt{\frac{T-t}{T-t+1}}$

The serially correlation assumption will still be ensured because $\text{var}(\zeta_{it}) = \sigma^2 I_T$ and $\text{var}(\zeta_{it}^{\ast}) = \sigma^2 I_{T-1}$

Following similar procedures for each variable in the equation (3.1), we obtain the new and transformed equation as follows:

$$Y_{it}^{\ast} = \mu_0 + \beta_1 \hat{\pi}_{it}^{\ast} I[\hat{\pi}_{it}^{\ast} \leq \gamma] + \beta_2 \hat{\pi}_{it}^{\ast} (I)[\hat{\pi}_{it} > \gamma] + \alpha X^{\ast}_{it} + \zeta^{\ast}_{it} \text{ .... (2.4)}$$

Where μ_0 is now time and space invariant (fixed across time and individual countries) and

$$X_{it}^{\ast} = a_t \{X_{it} - \frac{1}{(T-t)}(X_{i(t+1)} + ... + X_{iT})\} \text{ ....(2.4.1)}$$

2.2.2. Problem of Endogeneit

Due to the presence of possible endogeneity problem in the above Structural equation, it needs some mechanism to deal with it. To solve the problem of endogeneity, instruments are introduced into the model and as suggested in many literatures (Thanabalasingam V. (2013), the lags of initial income is used as instruments for the predetermined regressors and for transformed initial income, (X^{*}_{it}), the untransformed value (X_{it}) are used. Following Roodmans' (2009) and (Thanabalasingam V (2013) collapsed-form instrument method, the following (T − 1) moment condition is adopted, by employing the entire lags starting from lag 1 until (T-1).

The instrumental variable parameter or 2SLS estimator are computed using a two-step procedure. The first step involves constructing a reduced-form regression for the endogenous variable, by expressing all the endogenous variables (X^{1*}_{it}) in terms of the instruments (z_{it}), exogenous variables and the error terms. It takes the form;

$$x_{it}^{1*} = \theta_0 + \theta_1 \sum_{j=1}^{T} z_{i,t-j} + \theta_2 \hat{\pi}^*_{it} I[\hat{\pi}^*_{it} \le \gamma] + \theta_2 \hat{\pi}^*_{it} (I)[\hat{\pi}_{it} > \gamma] + \theta'(X^{2*}_{it}) + v_{it} \ldots (2.5)$$

Where the instrument and the error term are uncorrelated ($E(v_{it}, z_{it}) = 0$)

$\theta = (\theta_0, \theta_1, \theta_2)$ are reduced form parameters of the structural equation

Then, the reduced-form parameter θ and the fitted value of the endogenous variable ($\hat{x}_{it}^{1*}$) will be computed, using the least square method, and then the endogenous variable (X^{1*}_{it}) is replaced by its fitted value ($\hat{x}_{it}^{1*}$) in equation (2.5), and hence, equation (2.5) can be re-specified as follows

$$Y_{it}^{*} = \mu_0 + \delta \hat{x}_{it}^{1*} + \beta_1 \hat{\pi}^*_{it} I[\hat{\pi}^*_{it} \le \gamma] + \beta_2 \hat{\pi}^*_{it} I[\hat{\pi}_{it} > \gamma] + \alpha X^{2*}_{it} + \zeta^{*}_{it} \ldots\ldots\ldots (2.6)$$

From the above step, the instrumental variable parameter (β_{IV}) is estimated, from equation (2.6) for any given threshold γ. Then, the residual sum of square (RSS) is computed as a function of the threshold γ

$$\begin{aligned} \hat{\zeta}_i &= y - x'\beta_{IV} \\ RSS(\gamma) &= \hat{\zeta} * \hat{\zeta} \end{aligned} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.7)$$

Where RSS stands for residual sum of square

After the endogeneity problem is solved by the above steps, the next procedure involves estimating the threshold values. The threshold level of inflation is calculated by using the conditional least square method. To estimate the threshold γ, we repeat the procedure described above (by NT number of times at most if each value of inflation is considered) by changing the threshold level of inflation and finally the threshold value is selected as the value associated with the smallest residual sum of square (RSS). In other word, the threshold value of inflation is the value which minimizes the RSS which can be expressed mathematically as:

$$\hat{\gamma} = \underset{\gamma}{\arg\min}\, RSS_n(\gamma) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.8)$$

Since the RSS(γ) depends on γ only, through the indicator function I( ), the sum of squared error function is a step function with at most (NT) steps, with the steps occurring at distinct values of the observed threshold variable π_{it}. Thus the minimization problem can be reduced to searching over values of γ equaling the distinct values of π_{it} in the sample. As proposed by Hansen (1999) the minimization process can be implemented by sorting the distinct values of the observation on the threshold variable π_{it} and by eliminating the smallest and largest $\eta\%$ for some $\eta > 0$ and the remaining 'n' values constitute the values of γ which can be searched for $\hat{\gamma}$. And the search should also be limited to integer values.

Once $\hat{\gamma}$ is estimated in equation (2.8), the coefficients estimate can be obtained by generalized method of moment (GMM) estimation

$\hat{\beta} = \hat{\beta}(\hat{\gamma})$; where $\hat{\beta}$ stands for $\hat{\beta}_1$ and $\hat{\beta}_2$

The step by step search for the threshold value and then estimating the parameters for the two regime follows Caner and Hansen (2004) which accounts for the possible endogeneity by performing the threshold estimation in a three separate steps. The first step involves regressing the endogenous variables on the instruments along with the other exogenous explanatory variables in the model. In step two, the predicted values of the endogenous variable from step one is used instead of the actual values in the grid search for finding the threshold estimate.

Finally, the estimated threshold value is used to split the sample into two regimes and a two stage least square (2SLS) or general method of moments (GMM) estimator is used to get the coefficient estimates in each regime.

3. RESULTS AND DISCUSION

The econometric literature on dynamic models has long been interested in the implications of the existence of a particular kind of nonlinear asymmetric dynamics. These models lie in allowing us to draw inferences about the underlying data generating process or to yield reliable forecasts in a manner that is not possible using linear models. Recently, however, most econometric analysis has started studying the issues of nonlinear asymmetric mechanisms explicitly within a dynamic panel data context. Hansen (1999) develops a static panel threshold model where regression coefficients can take on a small number of different values, depending on the value of exogenous stationary variable. Initiated by investigations of this kind, this study estimates the inflation growth nexus on the East African countries.

3.1. Descriptive statistics

Table 3.1 Description of the Data

Variables		Mean	Std. Dev.	Min	Max	Observations
	overall	0.868	1.240	-9.484	2.123	N=162
logCPI	between		.420	.120	1.387	n= 6
	within		1.179	-8.736	2.394	T=27
	overall	5.25	3.532	-8.672	13.572	N=162
GDP	between		1.1925	3.705	6.622	n =6
	within		3.359	-10.044	12.200	T=27

Source: own computation

Conformability of the data is also checked before the estimation such as outliers and different data irregularities has been checked. The stationarity of each variable is also tested using panel data stationarity testing mechanisms as presented below.

Table 3.2 unit root test Results

Variables	Harris-Tzavalis test		Breitung test	
	Statistics	P-value	Statistics	P-value
LogCPI	0.0819	0.000	-2.7555	0.000
GDP	0.3444	0.000	-3.4908	0.000
INV’T	0.7965	0.017	-1.0582	0.145
POPN	0.9237	0.750	0.9786	0.836
TOT	0.6729	0.000	-2.8044	0.000
OPENNESS	0.9292	0.787	-0.3661	0.357

Source: own computation

As in the case of time series analysis, unit roots can also lead to spurious regressions and misleading inferences in a panel framework. This is specifically a concern with inflation, which is often associated with high levels of persistence (Culver, 1997) as cited in (Saad Ahmad Andrea Civelli, 2015). So in this section, we determine the stationarity of the panel series by applying some general panel unit root tests as provided in Table 4.2. Two different test results of this panel unit root are posted in the table. First, Harris-Tzavalis unit-root test is employed which assume common autoregressive parameters and include both panel mean and time trends. The other test is Breitung unit-root test which assumes both time and space components to be asymptotically infinity. Both tests claim the presence of unit root in the panel under its null against the alternative hypothesis which claims Panels are stationary.

According to Harris-Tzavalis test, except population growth rate and degree of openness all variables are stationary at 5 percent significance level. On the other hand in addition to the two non-stationary variables investment has a unit root according to the Breitung test, while other variables are still stationary. But given some minor adjustments such as inclusion of a time trend, subtraction of a cross-sectional mean and making small sample adjustment to time makes all the variables to be stationary at 5 percent.

Table 3.3 Correlation among the variables

	logcpi	gdp	invtgdp	popgro~h	openness
gdp	-0.2012				
invtgdp	-0.0866	0.3965			
popgrowth	-0.0363	0.0032	0.0626		
openness	0.0552	0.0173	-0.1061	0.5970	
tot	0.1010	-0.1614	-0.1676	-0.4624	-0.2000

Source: own computation

When the whole set of data is considered, growth rate has a negative correlation with inflation implying that, without considering the causation, growth rate and inflation move in opposite direction such that time of high inflation is associated with low economic growth and vice versa. Except Term of Trade, other variables have a positive association with economic growth whereas inflation has a negative correlation with investment and population growth rate and positively correlated with degree of openness and terms of trade.

Table 3.4 the threshold value of inflation

Threshold value of inflation ($\widehat{\gamma}$)		
Log(π)	π	P-value
1.02	10.48%	0.024

Source: Own computation

The threshold level of inflation is computed through a step by step grid search. The value is picked based on the minimization of the Residual Sum of Square.

Table 3.5 Estimation results of the control variables

gdp	*Coef.*	*Std. Err.*	*z*	*P>|z|*	*[95% Conf.*	*Interval]*
gdp_{t-1}	*0.3716*	*0.0826*	*4.50*	*0.00**	*0.2096*	*0.533*
gdp_{t-2}	*-0.1459*	*0.0815*	*-1.79*	*0.07****	*-0.3057*	*0.0138*
invt	*0.1929*	*0.0565*	*3.41*	*0.00**	*0.0820*	*0.3038*
$Lcpi_{t-1}$	*0.5596*	*0.2021*	*2.77*	*0.00**	*0.1633*	*0.9558*
popg	*-0.2100*	*0.7285*	*-0.29*	*0.77*	*-1.638*	*1.217*
openness	*4.38*	*2.65e*	*0.17*	*0.86*	*-4.75e*	*5.63e*
tot	*-2.440*	*1.296*	*-1.88*	*0.06****	*-4.980*	*0.1005*
_cons	*1.787*	*2.544*	*0.70*	*0.48*	*-3.199*	*6.773*
$\widehat{\beta}_1$	*-0.0196*	*0.2167*	*-0.09*	*0.92*	*-.4444*	*0.4050*
$\widehat{\beta}_2$	*-2.927*	*1.126*	*-2.60*	*0.00**	*-5.135*	*-0.7192*

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
gdp	142	10	3.021	0.323	67.91	0.000
LR test	….	…	…	…	6.71	0.034

*Legend: * p<.0.01; ** p<0.05; *** p<.0.1*

Source: Own computation (Stata Estimation result)

The estimated threshold value of inflation divides the sample into two separate regimes and the estimated coefficients of inflation for the two regimes are $\widehat{\beta}_1$ and $\widehat{\beta}_2$ which measure the impact of inflation on economic growth for the inflation value below and above the threshold (10.48%) respectively. The two coefficients have the same sign (negative) but only the second parameter '$\widehat{\beta}_2$' is statistically significant at one percent level. The coefficient of inflation for below the threshold value is statistically insignificant at any acceptable level of significance. The coefficient of inflation for above the threshold level, on the other hand, is found to be negative and significant at 1 per cent level of significance having the value equal to -2.927. this estimated result suggests that the negative pressure of inflation on economic growth will get stronger if the inflation rate gets higher and higher whereas if inflation is kept at its lowest rate it doesn't have any significant impact on economic growth. Fortunately, this finding is in line with most policy makers' objective of keeping inflation rate at a single digit. This finding is against the general perceptions that moderate inflation is growth promoting. Against this argument, this study claims that irrespective of its level, inflation is always growth hampering and its negative pressure aggravates if its rate gets bigger.

Even though the individual countries are similar in terms of their level of growth, there is no guarantee that they have similar macroeconomic environment so that the transmission mechanism through which inflation affects economic growth might significantly vary from country to country. Therefore the estimated threshold level of inflation should not be conservatively applied to all countries in the study. Lin and Ye (2009) as cited in Stephanie Kremer et al. (2011), for example, show that the performance of inflation targeting in developing countries can be affected by further country specific characteristics. Accordingly, inflation thresholds in developing countries and, thus, the appropriate level of the inflation target might be also country-specific which calls for separate investigation for each country.

Apart from the relationship between inflation and economic growth, the lagged value of inflation is found to be positively and significantly correlated with economic growth rate. On the other hand the portion of GDP assigned to investment has a positive correlation with economic growth as expected. The first and second lag of GDP is also incorporated into the model while the lag length is determined by information criteria. The immediate lag of GDP has a positive correlation with economic growth while its second lag become negative. The two lags are statistically significant at 1 and 10 percent respectively. Population growth and degree of openness, on the other hand, are statistically insignificant in affecting economic growth.

3. CONCLUSION AND POLICY IMPLICATIONS

This paper tries to tests whether low inflation rate is growth promoting as it has been advocated by the governments. Conventionally, every government and policy makers strive to keep the rate of inflation as low as possible accepting the general theory that high inflation adversely affects the rate of economic growth. Apart from this, there is no clear figure for the right inflation rate that the policy makers should target to achieve. Most importantly, it is unclear that the achieved low inflation rate is actually the optimum one. Given this in mind, there have been attempts in resent time to estimate the threshold level of inflation, the rate at which the growth friendly level of inflation is exhausted and it became a threat for economic growth. After Hansen (1999, 2004) and other related literatures, this paper attempts to estimate the relationship between inflation and economic growth using dynamic panel threshold model for east African countries (Egypt, Ethiopia, Kenya, Tanzania, Sudan and Uganda) for the year 1990 to 2016. Other east African countries such as Eretria, Djibouti and Somalia are excluded from the sample because of insufficiency of the data for the whole period.

This paper provided new evidence and the first in its nature (at least for the study area) on the non-linear relationship between inflation and economic growth. Motivated by Hansen (1999) and Caner and Hansen (2004), this study adopted a dynamic threshold model with endogenous regressors. Aimed to keep the original distributional assumption of the threshold model applied to static panels as in Hansen (1999) is still valid in a dynamic context, this study applied the forward orthogonal deviations transformation suggested by Arellano and Bover (1995) and used by many previous researchers in the area. Monte Carlo simulation was adopted to test the statistical significance of the selected threshold value as there is no standard test.

The dynamic panel threshold model estimation result confirms the existence of threshold for inflation - growth relationship. The estimated threshold value of inflation is about 10.48 percent where inflation rate above this rate is harmful for economic growth. On the other hand, inflation rate below the threshold has no significant impact on economic growth. Apart from its empirical justification that a moderate inflation is beneficial to economic growth by reducing real wage and hence making labor relatively cheaper, this research simply show that there is no sign that low inflation is growth acceleratory.

Given the universally pronounced macroeconomic theory which postulates the controversy in of inflation and employment targeting, this study warns that governments should not target to attain a very low level of inflation which is lower than necessary, in order to avoid unnecessary cost associated with the lower inflation level (higher level of unemployment). This can only be achieved if a single digit inflation targeting which is Adhocly applied by most policy makers is replaced by the right amount identified through a careful investigation

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