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Beyond linearity: an ARDL threshold analysis of inflation's impact on Tanzania's economic growth from 1994 to 2024

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Abstract. *This study examines the threshold effect of inflation on Tanzania's economic growth using annual data from 1990–2024 and a quadratic regression within the ARDL framework. The analysis identifies a clear inflation threshold at 5.82%, indicating that inflation's impact on growth turns negative beyond this point. Tanzania has mostly maintained inflation below this level since 2015, coinciding with stable growth, suggesting the economy has operated within a safe inflation zone. Therefore, the Bank of Tanzania should keep inflation below 5.8% through coordinated monetary–fiscal policies and strong data monitoring to maintain moderate, stable inflation that supports long-term growth.*

Keywords: ARDL, Economic growth, Inflation, Non-linear, Quadratic regression, Threshold.

JEL Classification: C32, E31, O40.

1. Introduction

Achieving price stability remains an important part of economic policy for every country yet its interplay with economic growth is still a subject of debate, particularly in emerging markets like Tanzania navigating global volatility (Mishra and Dubey, 2022; Ha et. al, 2022). This relationship has become more multi-faceted as economies have evolved with recent decades witnessing dramatic inflation streams stemming from supply chain disruptions, geopolitical tensions, global shocks like COVID 19 and monetary innovations including the rise of cryptocurrencies and digital payment systems. Such developments have compelled policymakers to review their approaches so as to seek an optimal balance between promoting economic expansion and maintaining price stability (Auer et al, 2025; Aiello et al., 2023). Empirical findings reveal no universal pattern in the inflation-growth nexus. Rather than exhibiting a simple linear relationship studies have consistently demonstrated that the connection between price changes and economic performance follows intricate and contradictory patterns that defy straightforward representation. Early studies established that extreme inflation clearly weakens economic growth with hyperinflationary periods providing evidence of inflation's destructive potential (Fischer, 1993; Barro, 1995). Yet as researchers expanded their investigations beyond these extreme cases, the relationship became less straightforward. The complication increases when examining moderate inflation rates where the relationship becomes far less predictable. Some studies have found evidence that modest price increases can support economic expansion while others have detected neutral or even negative effects at similar inflation levels (Bruno and Easterly, 1998; Ghosh and Phillips, 1998). This variability suggests that the inflation-growth nexus cannot be captured by universal rules or simple correlations. Instead, the relationship appears to be contingent on numerous factors including institutional quality, economic structure, development level, specific historical circumstances and others. Perhaps most significantly research has increasingly pointed toward the existence of threshold effects where the nature of the inflation-growth relationship changes dramatically at certain critical points.

Sarel (1996) identified such a structural break at around 12% inflation, while Khan and Senhadji (2001) refined these estimates for developing countries in IMF-based study. These findings suggest that inflation's impact on growth is not merely non-linear but fundamentally different across distinct regimes, with the same inflation rate potentially having vastly different effects depending on whether it falls above or below critical threshold levels. Real-world experiences further illuminate this complexity. The United States from 2015 to 2019 maintained inflation near its 2% target while sustaining solid growth, demonstrating that moderate inflation can coexist with economic growth (Armantier et al., 2023). However, other countries have experienced different outcomes with similar inflation rates, reinforcing the notion that context matters in determining how price changes affect economic performance. This recognition of non-linear, threshold-dependent relationships has prompted researchers to abandon simple linear models in favor of more sophisticated approaches. The development of threshold regression techniques, panel smooth transition models, and other advanced methodologies reflects the growing

understanding that capturing the true inflation-growth relationship requires analytical tools capable of accommodating regime switches and structural breaks (Jude and Levieuge, 2017; Kremer et al., 2013).

Current monetary policy practices reflect this evolved understanding of optimal inflation levels. It is noteworthy that countries including the most advanced economies rarely target zero inflation. Instead, most central banks prefer inflation targets in the range of 2% to 3%, a preference driven by several practical considerations. Higher targets preserve policy flexibility and help avoid the zero lower bound problem ensuring that monetary authorities retain adequate room for policy adjustments during economic downturns (Borio and Chavaz, 2025). This policy stance provides compelling evidence that some degree of inflation is generally preferred to complete price stability when considering the broader objectives of economic growth and macroeconomic stability. Studies consistently demonstrate that optimal inflation levels vary substantially between advanced and developing economies, with the advanced countries experiencing negative growth effects at much lower inflation rates than the developing countries. Advanced economies commonly show optimal inflation ranges between 1% and 3%, while developing nations often tolerate inflation rates of 7% to 11% before experiencing growth deterioration (Baharumshah et al., 2016; Ndoricimpa, 2017). These differences reflect key structural disparities in economic structure, institutional development and monetary policy effectiveness. Studies focusing on African economies reveal additional layers of detail with studies identifying threshold levels between 6.5% and 9% that reflect the unique challenges facing the continent (Akinsola and Odhiambo, 2017). However, even within this regional context, significant variation exists across individual countries influenced by factors ranging from natural resource endowments to governance quality to trade patterns. The evolving global economic environment adds another dimension to this intricacy. Globalization has increased economic interdependencies making individual economies more vulnerable to external price shocks and monetary spillovers from major economies. Financial technology developments, digital currencies, and changing payment systems are creating new channels for monetary transmission that may alter traditional inflation-growth relationships (Aiello et al., 2023). These developments suggest that threshold relationships identified in historical data may not remain stable as economic structures continue to evolve.

What has been emphasized as more knowledge and understanding of the inflation-growth relationship has been understood is that both excessively high and persistently low inflation can be detrimental to economic growth challenging the idea that lower inflation is always preferable. When inflation remains significantly below identified thresholds for extended periods it can create deflationary pressures that worsen debt dynamics, limit monetary policy effectiveness and increase economic vulnerability (IMF, 2015). Central banks have recognized this complication with major institutions confirming that both extreme high and low inflation rates can disrupt economic stability (ECB, 2017). This understanding explains why most advanced economies target positive inflation rates around 2% rather than attempting to achieve zero inflation. Tanzania presents a compelling case for examining these intricate inflation-growth dynamics. Since 2000 the country has demonstrated remarkable economic resilience, sustaining robust growth rates of 6% to 7% annually. This

growth has been driven by a diversified economic base made up of mining operations, agricultural production and a growing tourism sector. This has contributed to considerable improvements in living standards as evidenced by the elevation of GDP per capita from approximately $500 to $1,200 by 2025 (World Bank, n.d). The country achieved a significant milestone in 2020 when it was upgraded from low-income to lower-middle-income status by the World Bank reflecting decades of sustained economic progress. Tanzania's inflation experience has been equally noteworthy, with rates spiking to 16% during the early 2010s due to food and fuel price pressures before stabilizing below 5% by 2025. Despite Tanzania's economic achievements and clear policy objectives significant empirical gaps persist in understanding the country's optimal inflation threshold. A review of existing studies reveals striking discrepancies in findings that show the need for additional research. Epaphra (2016) identified what appeared to be a U-shaped relationship between inflation and growth. This research suggested that economic growth suffers at both very low and very high inflation rates, with an optimal narrow range estimated at 3.25% to 3.75%. Later study by Mbowe and Mpango (2024) reached noticeably different conclusions estimating a much higher threshold level of 7%. This substantial discrepancy between studies with optimal inflation ranges emphasized the sensitivity of threshold estimates to methodological choices, data periods and analytical approaches. This study uses a quadratic regression approach to determine the inflation threshold for Tanzania's economy. The analysis begins from the 1990, marking the period when the country underwent significant privatization, financial sector reforms, and other structural adjustments that continue to shape its economic framework today (Joseph, 2024; Lwesya and Ismail, 2021). This starting point ensures the analysis captures the modern economic structure that remains relevant for current policy formulation.

2. Literature review

2.1. Theoretical Framework

A wide range of theories have attempted to explain the relationship between inflation and economic growth, spanning classical, monetarist, structuralist, and endogenous growth paradigms. Classical economists view inflation as neutral in the long run, while monetarists argue that inflation is primarily a monetary phenomenon that erodes macroeconomic stability and discourages investment (Friedman, 1968). Structuralist models applied to developing economies, acknowledge inflation as an outcome of supply blockages and institutional constraints with more complicated implications for growth (Sunkel, 1960). Endogenous growth models tend to treat inflation as a distortionary factor that hampers innovation and reduces productivity (Barro, 1995). What unites many of these frameworks is their assumption of a monotonic relationship between inflation and growth either consistently negative or neutral over time. This assumption has increasingly come under scrutiny, both theoretically and empirically. None of these models explain in a convincing way the observed non-linear dynamics whereby low to moderate inflation sometimes coincides with improved economic performance, especially in economies with underutilized resources or rigid price systems. This is better explained by Tobin’s portfolio-balance theory and Keynesian demand-side theory.

2.1.1. Tobin's Portfolio-Balance Theory

James Tobin (1965) advanced a framework in which inflation can influence long-run economic growth by altering the composition of asset holdings. Unlike classical models where money is neutral, Tobin treated money and physical capital as imperfect substitutes in wealth portfolios. When inflation rises, the real return on holding money declines which prompts economic agents to shift their portfolios toward real assets, specifically capital. This reallocation leads to greater investment, higher capital accumulation and as a result, faster economic growth. The demonstration is as follows. Let total wealth be allocated between money balances *M* and physical capital *K*, with returns $r_m = -\pi$ for money and $r_k > 0$ for capital. As expected inflation π increases, the relative attractiveness of capital improves. Assuming a standard production function *Y=F (K),* and savings rate that increases with inflation, $s(\pi)$, the capital accumulation dynamic becomes;

$$K^{\cdot} = s(\pi)\, X\, F\,(K) - \delta K$$

Where δ is the depreciation rate. The important insight is that $\frac{ds}{d\pi} > 0$ holds only for low to moderate inflation levels. Thus, inflation induces a shift away from idle balances toward productive investment, supporting growth (Tobin, 1965). However, the mechanism has limits. At higher levels of inflation, uncertainty, volatility, and financial repression can outweigh portfolio reallocation benefits. Levhari and Patinkin (1968) argued that if inflation also reduces real income or raises consumption incentives, the savings function $s(\pi)$ may flatten or even decline. Dornbusch and Frenkel (1973) showed that once inflation induces expectations of further macroeconomic instability, the reallocation toward capital breaks down. Ghatak and Sánchez-Fung (2007) suggested in developing economies, the idea that the Tobin effect functions and may operate within a narrow band of inflation usually below 10% beyond which the benefits vanish. Tobin's theory supports a non-linear relationship between inflation and growth, governed by a threshold beyond which inflation becomes counterproductive.

2.1.2. Keynesian Demand-Side Theory

Another foundation for non-linearity stems from Keynesian macroeconomics, mainly the analysis of economies operating below full employment due to insufficient aggregate demand. In such settings, inflation can play a positive role in stimulating output through two principal channels. These are real wage adjustment and real interest rate effects. Keynes (1936) emphasized that nominal wages are mostly downwardly rigid due to contracts and resistance to nominal wage cuts. This rigidity prevents labor markets from clearing during recessions. Inflation, by raising the general price level *P* effectively reduces the real wage $w_r = \frac{W}{P}$ where *W* is the nominal wage. When real wages fall in this way, firms are more willing to hire labor, increasing employment and output. Simultaneously, inflation lowers the real interest rate when nominal rates are sticky in the short term, improving investment. The real interest rate is defined as;

$$r = i - \pi^e$$

Where i is the nominal interest rate and π^e is expected inflation. A rise in π^e reduces r, which ends up stimulating investment and aggregate demand. These mechanisms are captured within the IS-LM model, where investment $I(r)$ rises as real interest rates fall, pushing output Y higher. Empirical studies have reinforced this view. Akerlof et al (1996) argue that moderate inflation smoothes the labor market by enabling real wage adjustments that support employment. IMF (1999) also finds that countries with very low inflation below 3% may suffer from output volatility suggesting that moderate inflation can improve macroeconomic stability. Card and Hyslop (1996) provide microeconomic evidence that nominal wage rigidity is widespread, further validating the Keynesian explanation of how inflation supports employment when prices rise modestly but wages are slow to adjust. Like Tobin's theory, Keynesian theory also suggests a non-linear relationship. At low inflation levels, price increases facilitate adjustment and stimulate demand but beyond a threshold, inflation generates distortions that harm economic performance.

2.2. Empirical review

Global analyses of inflation thresholds reveal stark contrasts between developed and developing economies emphasizing structural differences in economic resilience. Azam and Khan (2022) examined data from 1975 to 2018, identifying thresholds of 5.36% for developed economies and 12.23% for developing ones. Beyond these levels, inflation significantly limits economic growth likely through reduced investment efficiency and distorted prices. This pattern resonates in analyses of D-8 Islamic developing countries including Bangladesh, Indonesia, Iran, Malaysia, Pakistan, and Turkey where thresholds around 11.88 to 12.88% were estimated from 1971 to 2014. Below these levels, inflation facilitates resource allocation and supports growth; above them, economic output declines due to inefficiencies (Aydin et al., 2019; Hoomani Farahani et al., 2021). These findings suggest that developing economies can tolerate moderate inflation, but exceeding threshold points disrupts economic stability, necessitating tailored monetary frameworks. Asia's dynamic economies exhibit a range of inflation thresholds, influenced by trade integration and monetary policy. In China, stringent controls yield a low 2% threshold, above which inflation hampers growth, reflecting a growth model reliant on export stability (Chen & Kim, 2024). India's situation is a bit complicated, presenting thresholds ranging from 4.77% to 7.84%. A vector autoregression analysis estimated 4.77%, while others reported 6% and 7.84%, noting an asymmetric trade-off where reducing inflation below 6% could cut long-term growth by 0.8 percentage points compared to a 0.3 point loss from slight overshoots suggesting that overly restrictive policies carry significant costs (Mallick and Sethi, 2019; Dholakia et al., 2023). Southeast Asian nations show similar non-linear patterns. A study of ASEAN-5 countries from 2000 to 2016 reported thresholds from 1.16% in Singapore to 5.26% in Indonesia, with inflation stimulating growth below these levels and impeding it above through reduced competitiveness (Galih and Safuan, 2018). Indonesia's provincial data from 1994 to 2019 revealed regional thresholds of 5.75% in western provinces and 9.64% in eastern ones which converges to a national 9.59% or 5.22% excluding crisis periods (Kusumatrisna et al., 2022). Vietnam's analysis from 1986 to 2013 identified a 7% threshold with inflation slightly boosting growth below but reducing it by 0.143–0.21% per percentage point above (Thanh, 2015). Looking at South Asian evidence, Bangladesh has 7.84% and 8% thresholds, alongside Pakistan's 6% threshold which

indicates negligible effects below and reduced growth above reflecting reliance on stable monetary environments (Asaduzzaman, 2021; Younus, 2015; Arby & Ali, 2017). European economies demonstrate resilience to inflation's effects, shifting policy focus to monetary instruments. A study of European Union economies from 2000 to 2023 found no robust evidence that inflation directly harms growth. Instead, aggressive monetary tightening to curb inflation poses greater risks, as its adverse effects outweigh the ambiguous benefits of rapid inflation reduction suggesting that robust institutions and integrated markets allow tolerance for moderate inflation (Pappas & Boukas, 2025). Looking at evidence from Oceanic regions, Papua New Guinea is said to have a 12% threshold above which inflation negatively affects growth, while below, the relationship remains unclear, reflecting challenges in resource-dependent economies with volatile price dynamics (Tumsok, 2023). African economies, marked by structural constraints and volatility tolerate higher inflation thresholds. A panel threshold regression across African nations estimated a 6.7% threshold, rising to 9% for low-income and 6.5% for middle-income countries with low inflation supporting growth in middle-income settings but adverse effects above these levels (Ndoricimpa, 2017). Sub-Saharan Africa regional communities including SADC, COMESA, ECCAS, and the West African Monetary Zone show thresholds of 9% to 10.6% from 2001 to 2021, suggesting that strict monetary convergence criteria may limit growth potential (Pambu, 2023; Olowofeso, 2022). In South Africa studies identify thresholds around 5.4% to 6%, with inflation below stimulating growth and employment, while exceeding 6% exacerbates income inequality and hampers gross domestic product (Khoza et al., 2016; Ndou, 2024). Ethiopia's high 16.46% threshold reflects distinct regimes where low inflation aligns with robust gross domestic product but high inflation signals decline though still positive (Mulu et al., 2025). In North Africa, Morocco's 1990–2019 data suggest a 3% threshold, with inflation insignificant below but negative above, prompting recommendations to relax monetary policies at 2% (Sadok et al., 2022). In Kenya, threshold regression analyses estimate thresholds around 5.83% to 6.13% with inflation below 6.13% stimulating significant growth. A unit increase at 5.83% improves economic growth by 2.89% and positive but potentially weaker effects between 6.13% and 9.63%, with adverse impacts above 9.63% (Mugi, 2017; Kiptum, 2022). In Tanzania, studies are fewer but reflect similar variability. An early study of three EAC countries found an average threshold of 8.46%, with Tanzania's at 8.8%, suggesting moderate inflation could support growth (Yabu and Kessy, 2015). Recent analyses indicate lower tolerance. Manamba (2016) estimated thresholds between 3.25% and 3.75%. Maiga (2024) found high inflation generally slows GDP growth in Tanzania without specifying a threshold. A 2023 study confirmed a negative causal link from inflation to growth without quantifying a threshold (Nkwabi, 2023). Tanzanian thresholds range from 3.25% to 8.8%, reflecting global variability. The limited number of studies and inconsistent threshold estimates emphasize the need for more precise analysis to guide Tanzania's monetary policy. Across multiple studies, what is evident is the non-linear inflation-growth relationship, with thresholds lower in advanced economies of around 4% to 6% and higher in developing ones of around 7% to 12%. Africa and East Africa align with the latter, but methodological differences limit applicability. The variability in threshold estimates, especially ranges rather than precise values represent critical gaps. Tanzania's achievement of lower-middle-income status from low-income in 2020 may change inflation thresholds (World Bank, 2020).

Using the standards and targets set when the country didn't achieve this upgrade may leave Tanzania chasing targets which are a level below what they should actually aspire for. Yet no studies examine this transition.

3. Methodology

3.1. Data source and variables

The study uses annual time series data for Tanzania from 1990 to 2024. The data are collected from two main sources: the World Bank's World Development Indicators (WDI) and the International Monetary Fund (IMF) databases. The key variables are:

Table 2.1. *Variables used*

Variable	Proxy
Economic Growth (GDP)	GDP Growth (annual %)
Inflation (INF)	Inflation, Consumer Prices (annual %)
Investment (GCF)	Gross Fixed Capital Formation (% of GDP)
Population Growth	Population Growth (% annual)
Government Spending	General Government Final Consumption Expenditure (% of GDP)
Trade Openness	Trade (% of GDP)
Money Supply (M2)	Broad Money Supply M2 (% of GDP)

Before estimating the model, the study performs several diagnostic checks. Descriptive statistics are generated to understand the general behavior of the variables, including mean, standard deviation, minimum and maximum values. This helps detect outliers or abnormal trends in the data. Then the Augmented Dickey-Fuller (ADF) test is conducted to check the stationarity of all variables. This is important because time series data usually have unit roots, and using non-stationary variables can lead to spurious regression results. The ADF test is applied both at level and first difference. If the results show a combination of I(0) and I(1) variables, the study proceeds to test for cointegration using the Bounds testing approach proposed by Pesaran et al. (2001). This approach is suitable when the data is a mix of stationary and non-stationary variables. Once the cointegration relationship is confirmed, the Autoregressive Distributed Lag (ARDL) model is estimated. The ARDL model is chosen because of its flexibility in dealing with small sample sizes and its ability to handle variables that are integrated at different levels (I(0) and I(1)), as long as none are I(2). It also allows simultaneous estimation of short-run and long-run relationships. The ARDL model includes lagged values of both the dependent and independent variables to capture dynamic behavior in the data. The optimal lag length is selected using Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC). The long-run coefficients from the ARDL model are then used to compute the inflation threshold using the quadratic equation described in the quadratic model earlier.

3.2. Model Specification

To investigate how inflation affects economic growth and whether there is a threshold beyond which its effect turns negative, this study follows the approach used by several earlier researchers who applied non-linear models. In particular, a quadratic form is used to allow for non-linearity between inflation and growth, which makes it possible to capture the potential threshold. The idea is that at low levels, inflation may not harm growth or may even support it but beyond a certain point, its impact becomes negative.

$$logGDP_t = \propto_0 + \beta_1 logINF_t + \beta_2 (logINF_t)^2 + \beta_3 logGCF_t + \beta_4 logPOPG_t + \beta_5 logGOVS_t + \beta_6 logTRADE_t + \beta_7 logM2_t + \varepsilon_t$$

Here, the dependent variable is the logarithm of real GDP growth, while the independent variables include the logarithm of inflation and its square to capture the non-linearity, along with other control variables like investment, population growth, government spending, trade openness, and money supply. All variables are converted into natural logarithms except for those already in percentage growth form. Converting variables into logarithms reduces the scale of variables, making interpretation easier, especially when variables are in different units. Taking logs can help stabilize variance and reduce heteroskedasticity. Coefficients in log models can be interpreted as elasticities, which is useful for policy analysis. Logarithmic transformation is suitable when dealing with exponential growth trends often found in macroeconomic data (Gujarati, 2009). The threshold inflation level is derived from the quadratic regression by taking the first derivative of GDP with respect to inflation and setting it to zero:

$$\frac{d(logGDP)}{d(logINF)} = \beta_1 + 2\beta_2 logINF = 0$$

Solving this equation for log INF;

$$logINF = -\frac{\beta_1}{2\beta_2}$$

Exponentiating both sides, the actual threshold inflation level is:

$$INF = \exp\left(-\frac{\beta_1}{2\beta_2}\right)$$

This gives the turning point at which the effect of inflation on growth changes from positive or neutral to negative.

4. Results

4.2. Descriptive Statistics

To get a general picture of how the variables have behaved over the period from 1990 to 2024, basic summary statistics were calculated. These include the mean, median, maximum and minimum values, standard deviation, and normality checks.

Table 4.1. *Descriptive Statistics*

Variable	LGDP	LINF	LGCF	LPOPG	LGOVS	LTRADE	LM2
Mean	1.5212	2.1487	3.2452	1.0319	2.2679	3.5967	2.9275
Median	1.7185	1.8870	3.4391	1.0296	2.2805	3.5707	3.0028
Std. Dev.	0.5845	0.7322	0.4012	0.1374	0.2089	0.2313	0.2110
Skewness	-1.9070	0.5787	-0.5594	-0.7809	-0.1296	0.0512	-0.5024
Kurtosis	6.3564	2.0422	2.1421	5.0982	2.4195	1.9813	1.8825
Jarque-Bera	36.569	3.1977	2.8160	9.6934	0.5724	1.4847	3.1995
Probability	0.0000	0.2021	0.2446	0.0078	0.7510	0.4759	0.2019
Sum	51.721	73.058	110.33	35.085	77.111	122.28	99.536
Observations	34	34	34	34	34	34	34

The mean of LGDP is around 1.52, but with a wide range from about -0.54 to 2.04. This indicates there were years with low or even negative growth, and the high negative skewness confirms that the distribution is pulled more to the left. LINF averages 2.15, showing moderate inflation levels during the period. It varies from 1.19 to 3.58, which reflects Tanzania's experience with both low and high inflation years. LGCF and LPOPG have means of 3.25 and 1.03 respectively, with small standard deviations, suggesting they didn't fluctuate too much over the years. LGOVS, LTRADE, and LM2 also show somewhat a stable behavior, with values clustered around their means and low dispersion. There are no extreme outliers for these variables, and the distributions seem symmetric in most cases. From the Jarque-Bera test results, only LGDP and LPOPG show clear signs of non-normality. But since the ARDL model is robust to normality violations, this isn't a major issue.

4.1. Unit root test

Before estimating the model, it's important to check whether the variables are stationary to avoid spurious results. The ADF test was used to test for unit roots, and the results are summarized in table 4.2 below.

Table 4.2. *Unit root test from ADF*

	At Level			At First difference		
Variable	t-stat	5%	Prob	t-stat	5%	Prob.
LNGDP	-2.481884	-2.954021	0.1288	-6.159559	-2.957110	0.0000
LNINF	-1.792110	-2.954021	0.3777	-5.852451	-2.960411	0.0000
LNGCF	-0.978429	-2.954021	0.7493	-6.010785	-2.957110	0.0000
LNPOPG	-2.438172	-2.960411	0.1401	-7.160039	-2.960411	0.0000
LNGOVS	-3.151286	-2.960411	0.0330	-5.744097	-2.889314	0.0000
LNTRADE	-2.472033	-2.957110	0.1315	-3.723579	-2.957110	0.0084
LNM2	-1.695823	-2.957110	0.4237	-3.770813	-2.957110	0.0075

Most of the variables including LNGDP, LNINF, LNGCF, LNPOPG, LNTRADE, and LNM2 were found to be non-stationary at level but became stationary after taking the first difference, meaning they are integrated of order one, or I(1). This is shown by the fact that their t-statistics at level are not more negative than the 5% critical values, but become significant at first difference. Also, all their prob values become less than 0.05 which proves their significance. Since the variables are a mix of I(0) and I(1), but none are I(2), it is appropriate to proceed with the ARDL model which allows for such a combination. This also justifies using the Bounds test to check for cointegration among the variables.

4.3. Bounds Test for Cointegration

Since the ADF results showed that the variables are a mix of I(0) and I(1), the ARDL bounds testing approach was used to check whether a long-run relationship exists among them.

Table 4.3. *Bounds test*

F-Stat	Critical Value	Lower bound I(0)	Upper bound I1)
25.062407	5%	2.17	3.21

The computed F-statistic from the bounds test is 25.06, which is well above the upper bound critical value of 3.21 at the 5% significance level. This means the null hypothesis of no cointegration was rejected. In simpler terms, this suggests that the variables move together in the long run a stable long-term relationship exists between GDP growth and its determinants, including inflation.

4.4. ARDL Estimation and Threshold Calculation

With the confirmation of cointegration from the bounds test, the next step was to estimate the ARDL model. The model includes the lagged levels and first differences of the main variables, with a special focus on inflation (LINF) and its squared term ($LINF^2$) to capture the possibility of a non-linear threshold effect on economic growth.

Table 4.4. *ARDL Long run Coefficients*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.3900	0.8865	-4.9522	0.0003
LGDP(-1)	-1.5005	0.1262	-11.8876	0.0000
LINF(-1)	3.8118	0.5760	6.6181	0.0000
$LINF^2$(-1)	-1.0844	0.1241	-8.7402	0.0000
LGCF(-1)	-1.7762	0.2699	-6.5801	0.0000
LPOPG(-1)	0.2282	0.3965	0.5757	0.5755
LGOVS(-1)	-0.4164	0.3038	-1.3704	0.1957
LTRADE	1.1891	0.5475	2.1721	0.0506
LM2(-1)	2.1029	0.8216	2.5595	0.0250

From the long-run results:

i. The coefficient for lagged LINF(-1) is 3.81 and is statistically significant ($p < 0.01$).

ii. The coefficient for $LINF^2$(-1) is -1.08, also significant ($p < 0.01$).

This shows an inverted U-shaped relationship between inflation and GDP growth meaning inflation at first boosts growth but beyond a certain point it begins to hurt growth. This justifies the use of a quadratic equation in the model to capture that turning point. To determine the inflation threshold, we follow the standard procedure of taking the first derivative of the regression equation with respect to inflation and setting it equal to zero:

$$\frac{d(logGDP)}{d(logINF)} = \beta_1 + 2\beta_2 logINF = 0$$

Substituting the coefficients

$$3.81 + 2(-1.08)\ X \log(INF) = 0$$

Solving for log(INF):

$$-1.08\ X2 \log(INF) = 3.81$$

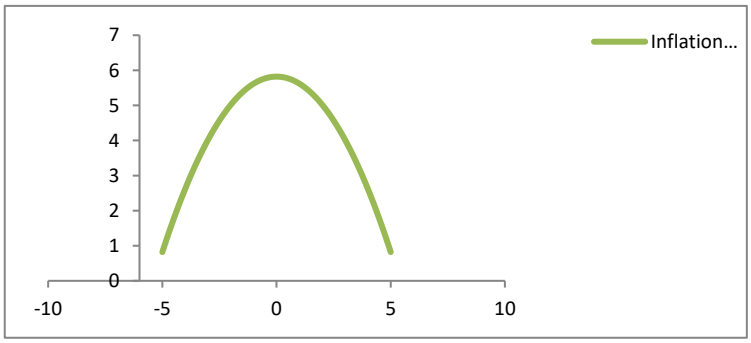
$$\log(INF) = \frac{3.81}{2\ X\ 1.08} \approx 1.76$$

Exponentiating both sides to get the threshold in regular terms:

$$INF = e^{1.76} \approx 5.82\%$$

The threshold inflation for Tanzania's inflation in relation to economic growth is 5.82%.

Figure 4.1. *Turning point/threshold inflation*



Source: Researcher (2025).

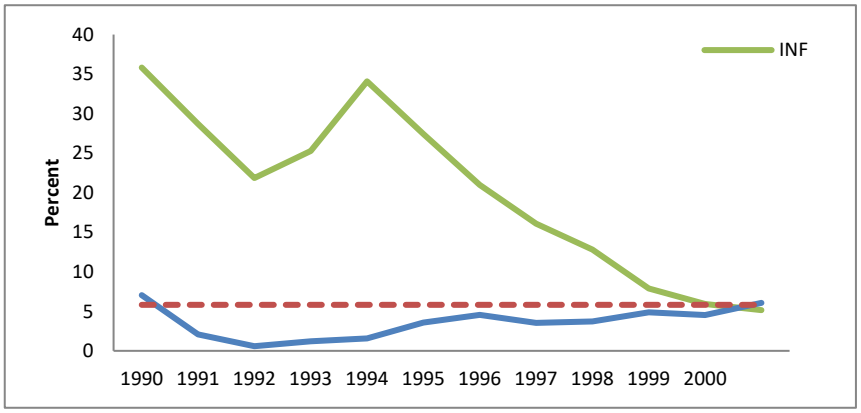
So, the estimated inflation threshold for Tanzania is about 5.8%. Below this level, inflation seems to not hinder economic growth, while above it, the impact becomes negative. This kind of non-linear behavior is important for policymakers because it suggests that inflation targeting should aim to keep inflation below this threshold to avoid harming long-run growth.

4.5. Perspective from different decades

4.5.1. High Inflation, Low and Unstable Growth (1990 to 2000)

The decade from 1990 to 2000 was marked by extremely high inflation with most years far above the 5.82% threshold. In fact, in 1990 inflation stood at 35.83%, and although growth was decent that year at 7.05%, the following years saw major drops in GDP. In 1991 and 1992, inflation was still above 20%, but growth fell to as low as 0.58%. This pattern continued throughout the decade, with inflation averaging around 20–30%, while growth stayed modest and inconsistent.

Figure 4.2. *Inflation and economic growth 1990-2000*



Source: Researcher (2025).

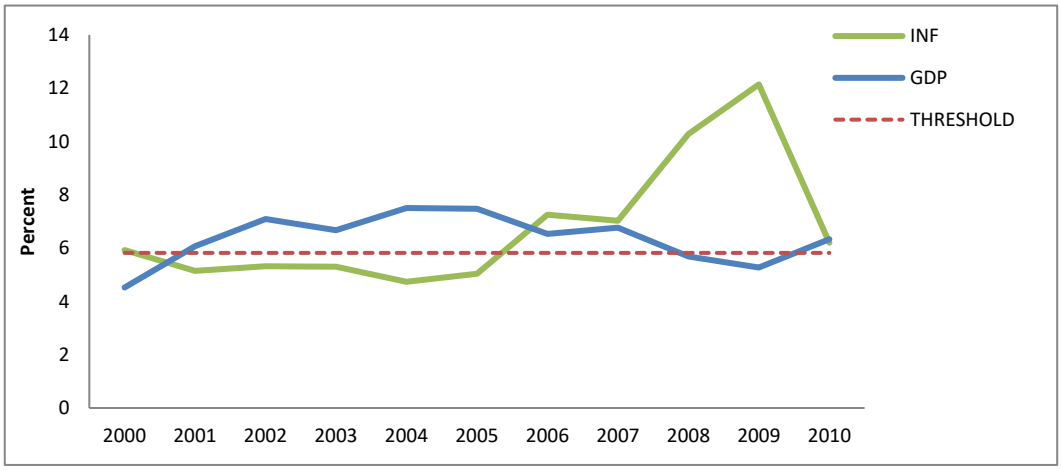
The year 1994, for instance, had 34.08% inflation but only 1.57% growth. Even as inflation began to decline slightly by the late '90s, it was still high at 16.09% in 1997 and 12.80% in 1998. Only in 1999 did inflation begin to approach single digits at 7.89%, and GDP growth

improved to 4.86%. Overall, this period was far from the threshold, and the frequent inflation shocks likely affected the country's ability to maintain stable growth. It's clear that this was the most inflationary and unstable decade in the dataset.

4.5.2. Approaching the Threshold with Stronger Growth (2000–2010)

The 2000s showed a major improvement in both inflation control and GDP growth. Right at the start of the decade, in 2000, inflation stood at 5.92%, just slightly above the estimated threshold. This was followed by a few years from 2001 to 2005 where inflation mostly stayed below or right around the 5.82% mark. In 2001, inflation was 5.15%, and GDP grew by 6.07%. In 2004 and 2005, inflation was 4.74% and 5.03% respectively, while growth remained strong at around 7.5%. This suggests that inflation closer to or under the threshold may have supported a more favorable environment for growth. However, after 2006, inflation started to rise again, hitting 7.25% in 2006 and remaining above the threshold through to 2009. The highest was in 2009, when inflation reached 12.14%, though growth remained positive at 5.27%. While inflation wasn't as wild as the previous decades, this decade had a lot of volatility. Early years performed well when inflation was close to or below the threshold, but the later years again showed the downside of going beyond it. This coincided with the economic crisis from 2008

Figure 4.3. *Inflation and economic growth 2000-2010*



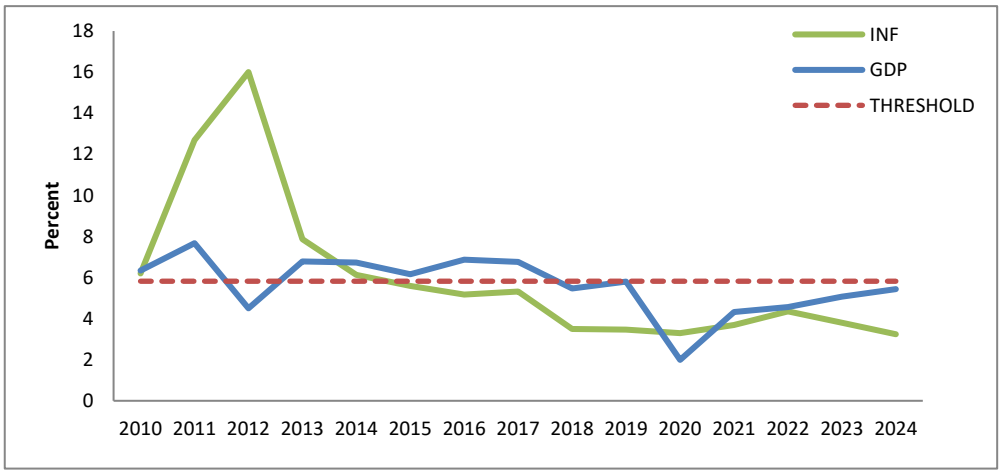
Source: Researcher (2025).

4.5.3. Stable inflation below the threshold and steady growth (2010–2024)

From 2010 onward, inflation in Tanzania showed much more stability and remained mostly below the 5.82% threshold. Although there was a brief spike in 2011 and 2012 with inflation at 12.69% and 16% respectively, most of the following years saw inflation drop significantly. By 2015, it had gone back down to 5.59%, and since then it has mostly remained in the 3–5% range. At the same time, GDP growth was relatively stable and healthy, averaging around 6% in many years. For example, in 2017, inflation was just 5.32%, and growth was 6.76%. Even during the global pandemic in 2020, inflation remained low at 3.29%, and although growth dipped to 1.99%, it recovered quickly in the

following years. The most recent years, like 2022 to 2024, show inflation well below the threshold while growth remains moderate. Compared to the previous decades, this is the closest Tanzania has come to consistently staying below the 5.82% mark.

Figure 4.3. *Inflation and economic growth 2010-2024*



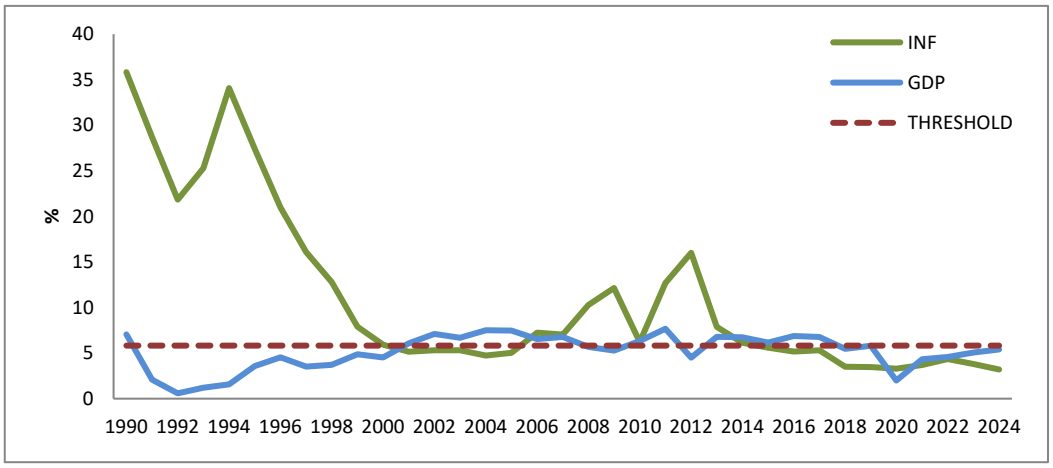
Source: Researcher (2025).

5. Discussions

The results of this study confirm the existence of a non-linear relationship between inflation and economic growth in Tanzania, with a clear turning point. The threshold level of inflation was estimated at 5.82%, meaning that inflation below this level has a no detriment on economic growth, while inflation above it becomes harmful. This finding aligns with the general belief that a moderate amount of inflation can support growth, but too much of it becomes a drag on the economy. When comparing this threshold to past literature, we see that it falls within the middle of what other studies have found for Tanzania. Yabu and Kessy (2015) found a threshold of 8.8%, while Manamba (2016) suggested a much lower range of 3.25% to 3.75%. So, the estimated 5.82% seems to sit somewhere in the middle of these earlier results. One possible explanation for this middle ground could be that Tanzania's economic structure has slightly changed in recent years, but not enough to drastically shift inflation dynamics. This result is also somewhat in line with regional studies. Ndoricimpa (2017) found a threshold of 6.7% for Africa. However, other studies like Inam and Ebong (2023) for Nigeria and Mulu et al. (2025) for Ethiopia found much higher thresholds of 13% and 16.46% respectively.

This suggests, countries with different macroeconomic environments may tolerate higher inflation levels before growth is affected. Since Tanzania is still considered a low-middle income country, and relatively more stable in terms of inflation targeting, it makes sense that its threshold is not as high as in countries with more volatile inflation histories. The movement between inflation and economic growth also confirmed a negative relationship above the threshold level.

Figure 5.1. *Inflation and economic growth 1990-2024*



Source: Researcher (2025).

Whenever inflation is above the threshold level of 5.82%, economic growth seems to decline. The 1990s is the period where inflation was the furthest from the threshold peaking above 35% in 1990 and averaging above 20% in the first half of the decade. This period coincided with major structural reforms, including trade liberalization, financial sector restructuring, and privatization under the structural adjustment programs (Balele et. al, 2018). While these reforms aimed to improve efficiency and attract investment, they initially destabilized prices due to exchange rate devaluations, removal of subsidies, and fiscal imbalances. From 2000 to 2007 inflation mostly hovered near or below the 5.82% threshold alongside stable growth of around 6% to 7.5%. The global financial crisis and global food and fuel price shocks from 2008 onwards disrupted prices which shot inflation to around 12%. An important observation is that the decade between 2015 and 2025 was the most stable period for inflation. Throughout this entire time, inflation never once crossed the estimated 5.82% threshold, staying consistently below it. This is quite significant because according to the findings of Maiga (2024), Tanzania's economic growth tends to perform better under low and stable inflation conditions, even though his study didn't specify a threshold. The fact that GDP growth also remained relatively steady during this low inflation decade averaging around 5% to 6% supports the view that moderate inflation is good for growth but too much of it is damaging. This reinforces the idea that the Bank of Tanzania's recent monetary policies which managed to keep inflation low around 5%, might have contributed to more stable growth during this time. It also shows that Tanzania has already experienced what seems to be an optimal inflation environment, and maintaining this could be key to future economic success.

6. Conclusion

This study set out to examine the threshold effect of inflation on economic growth in Tanzania using the ARDL approach and a quadratic inflation term to capture non-linearity. The main objective was to determine whether there is a specific inflation level beyond which economic growth is negatively affected. The secondary objective was to review the

overall relationship between inflation and economic growth across the years, considering the existence of such a threshold. The results showed a clear inflation threshold at 5.82%, meaning that inflation below this level generally supports growth, while inflation above it has a harmful effect. This confirms the idea that inflation impacts economic growth in a non-linear way moderate inflation may reflect a growing economy, but excessive inflation reduces purchasing power, increases uncertainty, and slows investment. Examining the historical data, Tanzania has managed to keep inflation consistently below this threshold during the period from 2015 to 2025, which corresponds to a relatively stable economic growth phase. This suggests the country has been operating within a safe zone for inflation and maintaining this stability should remain a priority.

7. Policy recommendation

From the results of this study, it can be seen clear that keeping inflation under control is important for Tanzania's economic growth. The Bank of Tanzania should continue focusing on policies that keep inflation below the threshold of about 5.8%, since going above that tends to hurt growth. This means managing the money supply carefully and avoiding actions that could push inflation too high. At the same time, it is important that the government manages its spending wisely. If fiscal policy leads to big deficits or too much borrowing, it can cause inflation to rise beyond the safe level. So, coordinating monetary policy with fiscal discipline will help keep inflation stable and predictable. Improving how inflation data is collected and monitored can make a big difference. If the authorities have better and quicker info on inflation trends, they can react faster and avoid surprises that might harm growth. It is worth noting that very low inflation or deflation isn't good either. The goal should not just be to keep inflation low, but to keep it moderate and stead, where it supports growth instead of holding it back.

Contributions

The main author`s name is Christopher Sylvestor Machibula (CSM) and author`s email is christopher.machibula@mu.ac.tz and the corresponding author is Neema Aspedito Mfugale (NAM) .The authors confirms his contribution to his work as follows: Research concepts and design were provided by CSM and NAM. Data collection was provided by CSM, and NAM. And interpretations of the results were provided by CSM and NAM. Manuscript design production was provided by CSM and NAM. All authors reviewed the results and approved the final version of the manuscript.

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Data availability statement

Upon reasonable request, the appropriate author (CSM) will provide the data.

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