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# INFLATION AND ECONOMIC GROWTH IN KENYA: AN EMPIRICAL EXAMINATION

Talknice Saungweme[1] and Nicholas M. Odhiambo

## Abstract

*This paper examines the relationship between inflation and economic growth in Kenya from an analytical and empirical standpoint. The paper applies the autoregressive distributed lag (ARDL) bounds testing approach and the multivariate Granger-causality test using time series data covering 1970-2019. Structural breaks in the time series were also conducted using the Perron (1997) (PPURoot) and Zivot-Andrews (1992) (ZAU Root) techniques. Incorporating structural breaks into time series increases statistical inference's overall validity. Inflation and economic growth in Kenya were found to have structural breaks in 1995 and 1991. These years are marked by Kenya's economic, financial, public sector and institutional reforms. The other findings of the study revealed that inflation has a statistically significant negative influence on long-term economic growth. The multivariate Granger-causality results showed a distinct short-run unidirectional causality from economic growth to inflation in Kenya. In order to mitigate the negative consequences of inflation and the coronavirus on the economy and welfare, the study recommends that Kenya's government should pursue prudent monetary, financial, and fiscal policies.*

**Keywords:** inflation, economic growth, ARDL, Granger-causality, Kenya

**JEL Classification :** E31; C13; O40 O42

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## 1. Introduction

Inflation and economic growth are two of the most widely cited indices of economic development. However, differences in the pace of growth created large variances in the steady-state equilibrium of income per capita and output per worker across world economies today (World Bank, 2020). Broadly, the responsibility of policymakers is to draft and implement macroeconomic policies that lead to the achievement of a high and sustained economic growth rate, while maintaining a low and stable price level, among other objectives (Ghosh & Phillips, 1998). In keeping with this role, Kenya's central bank, for example, has worked to decrease the negative impacts of inflation on the economy and welfare over time by carefully controlling the currency rate, interest rate, and money supply growth (International Monetary Fund/IMF, 2020).

To a certain degree, the macroeconomic distress experienced by the Organisation for Economic Co-operation and Development countries between 1973 and 1984, when inflation averaged 13%, made most developmental economists and politicians believe that rapid and sustainable growth can only occur in an environment where inflation is under control (Andrés & Hernando, 1997). It is no surprise then, that since the development of Keynesian economics in the late 1930s, the existence and nature of the relationship between inflation and economic growth have been hotly debated, with contradictory and conflicting outcomes (Eggoh & Muhammad, 2014; Iqbal & Nawaz, 2009; Andrés, Hernando, & Lopez-Salido., 2004; Mallik & Chowdhury, 2001; Fischer, 1993; Lucas, 1973). The discussion focused not only on the linear relationship between the variables, but also on the inflation rate that optimises growth.

The literature on the inflation-growth nexus is neither full nor universal due to the diverse and contradictory empirical evidence on the relationship between inflation and economic growth. Furthermore, the occurrence of statistically significant nonlinear inflation-growth links in some earlier studies suggests that more empirical research on the nature of this relationship in Kenya is needed, but this is beyond the scope of this paper.

Kenya is one of the African countries that began a series of economic, financial, public sector, and institutional reforms in the 1980s and intensified them in the mid-1990s. The measures were implemented in response to the economy's balance of payments issue and inflationary pressures (Ngui, Chege & Kimuya., 2016; Kimenyi, Mwega & Ndung'u., 2016).

Kenya's domestic and external imbalances worsened dramatically as from 1980, as demonstrated by a doubling of fiscal deficits, debt-to-GDP ratio, and inflation rate (World Bank, 1989: 24). Inflation reached a record high of 45.9% in 1993 and averaged 17.2% between 1980 and 1994 (World Bank, 2020). In general, Kenyan monetary authorities have been undertaking market-based financial sector policy reforms since 1990 to lower and sustain inflation rates in the single digits (with a target of 5%) to accomplish the country's growth and development goals (Ndung'u, 2010). The central bank concentrated on keeping the exchange rate steady and market driven, boosting financial system efficiency, fostering financial stability, and providing a dependable and efficient national payment system (Ndung'u, 2010). Other initiatives included tight controls over the expansion of the money supply (including monetary programming), interest rate liberalization, and cash management throughout the economy (Bigsten, 2002).

Kenya has seen more distinct inflation and economic development dynamics since its independence in 1964 than other African countries. Unlike prior studies that focused on periods ending in the 1980s or the mid-1990s, the current study's time frame (1970-2019) covers a period in Kenya during which important policy shifts occurred. Several policy changes and external shocks occurred during the research period, all of which have likely influenced inflation and economic growth patterns. For instance, the import substitution strategy adopted in the 1970s was reversed in the 1980s when the country adopted various structural adjustment programmes, and from 1991, there was an extensive liberalisation of the economy (Durevall & Ndung'u, 1999). As a result, between 1991 and 1996, the economy slowed down, and this was accompanied by a rapid rise in inflation (World Bank, 2020). From 1996 to 2019, there was a turn of events when the country implemented prudent monetary, financial and fiscal policies, accompanied by a balance of payment support from the international community (IMF, 2010). This led to price stability and positive economic growth rates (IMF, 2020; 2014). Hence, this paper attempts to empirically describe the evolution of Kenya's inflation and the associated impact and causality linkages between inflation and economic growth in Kenya. The study further aims to reduce economic growth susceptibilities while ensuring that inflation and inflation expectations remain within the target band of ± 2.5%, particularly given the covid-19-induced supply chain disruptions (IMF, 2021).

The current study contributes to the existing body of knowledge by examining both the impact and causal relationships between inflation and economic growth in Kenya. Thus, the study is important to Kenya in that it provides a comprehensive empirical analysis of the inflation-growth dynamics, particularly at a time when there is a need to implement a balanced fiscal-monetary recovery policy framework during and after the period of the covid-19 pandemic.

More precisely, this paper differs from previous studies on the subject in a number of respects. First, unlike previous studies, it estimates a dynamic impact model to investigate the short-run and long-run relationship between inflation and real output growth in Kenya. When compared to other time series methodologies, the used autoregressive distributed lag (ARDL) bounds testing strategy was determined to be superior. For example, this technique has the advantage of establishing stronger cointegration relations in small samples, as is the case in this work. Furthermore, it also provides unbiased long-run model estimates and accurate statistics; even when part of the regressors are endogenous (Odhiambo, 2008; Pesaran & Shin, 1999). Secondly, in view of Kenya's important economic reforms, the analysis includes a structural break in the model, which was omitted in prior analyses. The addition of structural breaks to time series increases the statistical inference's overall validity (Perron, 1989). Thirdly, this study used the dynamic multivariate Granger-causality model, which has several advantages over bivariate causality models, including the reduction of omission-of-variable bias, the elimination of spurious correlations, and an increase in the general validity of the causation test (Odhiambo, 2021; Lütkepohl, 1982). After accounting for intermittent factors, the causal relationship between variables can change the direction of causality or the magnitude of variables (Lin, 2008). Fourth, unlike most previous cross-country regression analyses, the study uses a more recent dataset (1963–2019) on a single country, Kenya, allowing for the examination of country-specific impacts of inflation on economic development and vice versa. As a result, the empirical findings of this study are expected to give a clear analytical framework that will contribute to the ongoing debate on the inflation-growth relationship and guide policymakers in Kenya on the subject.

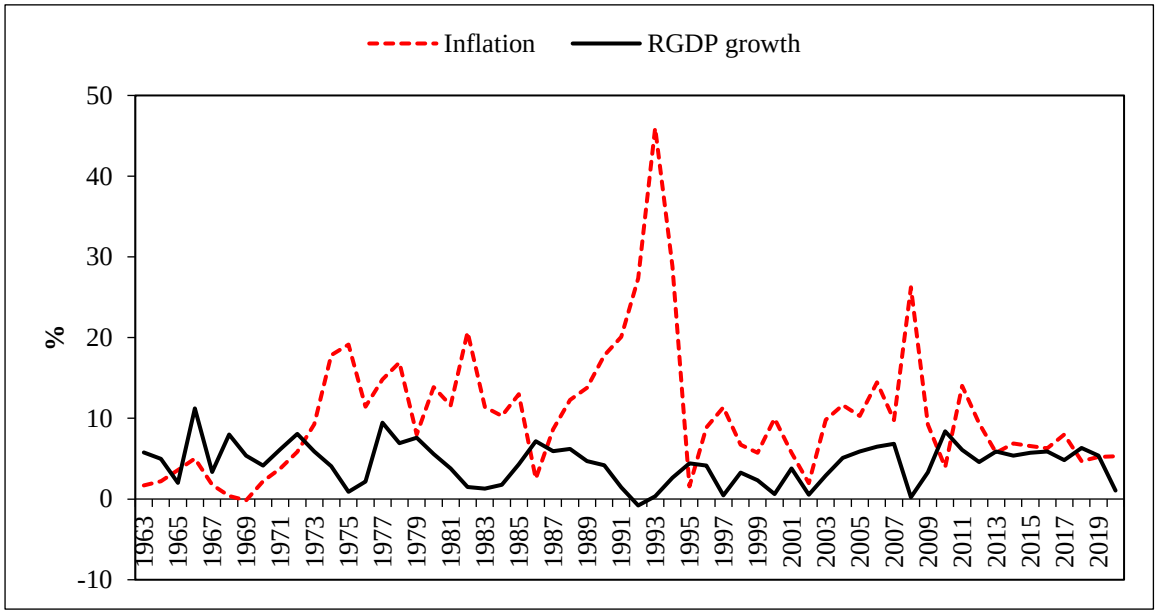
The remainder of the paper is organised as follows in view of the foregoing. Kenya's inflation growth trends are highlighted in section 2. The theoretical and empirical literature review is presented in section 3, and the empirical model and estimation methodologies are

presented in section 4. The empirical findings are discussed in section 5 of the paper and the study comes to a close in section 6.

## 2. Inflation and economic growth dynamics in Kenya

The dynamics of inflation and economic growth rates in Kenya across the study period were inextricably linked to changes in the domestic and global economies. The percentage variations in inflation and real GDP growth rates indicate that the series' behaviour pattern can be separated into four periods: 1963-73, 1974-85, 1986-95, and 1995 and onwards. Figure 1 indicates the trends in inflation and real GDP growth in Kenya during the period 1963-2020.

**Figure 1. Inflation and real GDP growth rates in Kenya (in percent) – 1963-2020**




*Source: Authors' computations using World Bank Development Indicators data (World Bank, 2020)*

The first ten years of political independence, from 1963 to 1973, were characterised by widespread policy and structural reforms (Ngui et al., 2016; Gertz, 2009; Zeleza, 1991). These reforms were enacted to address historical social inequities and to foster economic self-sufficiency by expanding the economy and creating a plethora of job opportunities (Foroutan, 1993). Despite the fact that the real GDP growth trend was noticeably volatile during this time, the annual growth rate remained positive, averaging 5.9%. During that time, the government intensified its involvement in the economy through the import substitution strategy, which promoted and funded new industrial enterprises (Ngui et al., 2016). Positive real GDP growth rates were achieved as a result of favourable global commodity prices and a series of broad-

based economic policies that encouraged diversification of the economy, including plastics and pharmaceuticals (Gertz, 2009). Thus, inflation was not a policy issue throughout Kenya's first decade of independence, from 1963 to 1973, when it averaged 2.6% per year.

The second phase, from 1974 to 1985, saw a falling tendency in GDP growth and an upward trend in the overall price level. The only notable exceptions to GDP growth were between 1976 and 1979, when both the value and volume of coffee exports increased (Bevan, Collier & Gunning, 1999). From 1974 through 1985, yearly inflation averaged 14%, compared to 4.1% actual GDP growth. It is important to note that, unlike the first period, the graph of inflation in Figure 1 is above the line of GDP growth, signifying a general contraction in output and an increase in general price levels. The tail effects of the first world oil shock in 1973, the second global oil price shock in 1977/78, the disastrous drought of 1983/84, and a severe decline in terms of trade – particularly in terms of coffee exports and other commodities – were all factors in the economic disaster (Bevan et al., 1999). In the end, the balance of the payment crisis, along with expansionary fiscal and monetary policy, triggered an economic downturn in 1974.

The economy was in recession from 1986 to 1995, reaching a point of depression in 1992 – the only year the country saw negative growth throughout the period under consideration. Inflation and monetary growth increased exponentially over that time period (1986-95), as did the nominal exchange rate, with inflation reaching a high of 45.9% in 1993 before dropping to 1.6% in 1995. Again, in a combination of deteriorating terms of trade, the 1993 drought and political developments negatively affected economic activities and the flow of external financial support (Swamy, 1994). As a result of the economic difficulties, Kenya adopted structural adjustment programmes that the IMF and the World Bank supported. The reforms compelled the government to embrace more liberal trade and interest rate regimes, and a more outward-oriented industrial policy (Swamy, 1994).

The final phase covers the years 1996 to 2020. This period was characterised by major economic and public sector (financial and expenditure) reforms. The reforms were in response to the international creditor community's ease of debt repayment responsibilities, as well as the government's increased endeavour to get the economy back on track (Bigsten, Kimuyu & Söderbom, 2010). The economic recovery and decrease in inflation rate were aided by a

combination of enhanced international balance of payment support, favourable climatic conditions, improved public sector financial management and accountability, and overall improvements in production in most economic sectors (IMF, 2021; 2010; Bigsten et al., 2010). The inflation rate averaged 8.4% between 1996 and 2020, and remained relatively stable (see Figure 1). The only noticeable increase in 2008 was most likely due to the global financial crisis, which had a negative impact on Kenya's primary export destinations (IMF, 2010). Overall, the prudent public financial management and governance, as well as continuing foreign assistance for the country were the main factors that contributed to the positive economic growth rates and low inflation rates between 1996 and 2020 (IMF, 2020; 2014; 2010).

Kenya's economy was doing well prior to the global covid-19 pandemic, real GDP growth was 5.4% in 2019, and inflation was 5.2% (World Bank, 2020). However, a close examination of Figure 1 reveals that real GDP growth abruptly slowed in 2020, while the inflation rate began to rise. The central government's lockdown measures, which were implemented in accordance with the World Health Organization's (WHO) recommendations to combat the spread of the coronavirus, may have had a significant impact on the economy. These restrictions slowed growth in 2020, wreaking havoc in agricultural exports, services, remittances, and the country's financial account, and eroding the country's external position (IMF, 2020).

## 3. Theoretical and empirical literature survey

The link between inflation and economic growth has been discussed extensively in both theoretical and empirical researches due to its importance in determining the effectiveness of monetary policy in the economy (Aye & Odhiambo, 2021). This paper reviews three major conceptions of inflation that exist, that is, the monetarist theory, the Keynesian theory and the structuralist view. These theoretical viewpoints differ in their hypotheses about the causes and controls of inflation. In addition to decades of monetary research, world economies' economic experiences before and after the Great Depression of the 1930s have increasingly focused on modelling inflation and investigating the many transmission channels through which monetary policy might affect inflation (Mayes & Viren, 2004; Mishkin, 2000; Fama, 1982).

The first is the monetarist theory of inflation, which assumes that inflation is caused by unjustified rises in government deficits, which are paid primarily by increases in high-powered money. In the short run, money supply is seen as the only effective policy tool for economic stabilisation (Friedman, 1968). Inflation is fractionally related to changes in employment and largely influenced by the growth in money supply in excess of output, according to Ricardo's theory of money matter' in the 18th century, and further expanded by Fischer (1911), Pigou (1936), and other neo-classical economists in the 20th century (Marcuzzo & Rosseli, 1994). Ricardo's theory, which was later extended and popularized by Sidrauski (1967), assumes that money is neutral, meaning that changes in its nominal quantity have no effect on real variables like production or capital formation – super-neutrality of money (Sidrauski effect).

The Keynesian hypothesis, which is essentially a demand-pull inflation theory, is the second hypothesis (Ming-Tang, 1967). According to this hypothesis, inflation is produced by a mismatch between aggregate demand and aggregate supply. As predicted by the Phillips Curve, any fluctuation in the demand side of the economy, such as fiscal or monetary policy changes, expectations, and labour market changes, affects both prices and output in the short run (Blanchard & Kitoyaki, 1987; Dornbusch, Fischer & Kearney, 1996). Inflation is thought to be a long-term phenomenon that occurs once full employment has been reached. A rise in aggregate demand is accompanied by a sustained rise in the price level beyond this point of equilibrium.

In the short run, which is assumed to be associated with underemployment and underutilisation of resources, an increase in investment and money supply leads to a proportionate increase in aggregate demand, output and employment (Keynes, 1936). This process persists until full employment is attained. The observed Philips curve in the short run reflects cyclical variations in unemployment in response to unanticipated disturbances to prices (Blanchard & Kitoyaki, 1987; Tobin, 1972). Inflationary processes are driven by frictional or structural limits in the labour market (Perry, 1978).

The Mundell-Tobin effect suggests a positive relationship between inflation and capital accumulation, and hence a positive effect on economic growth (Tobin, 1965; Mundell, 1963). Mundell (1963) and Tobin (1965) state that since money balances and capital are substitutable, a rise in inflation makes investment more preferred than consumption. Thus, during

inflationary periods, there will be a corresponding increase in capital accumulation, which ultimately leads to an increase in steady-state equilibrium output (De Gregorio, 1996; Solow, 1956). Similarly, in an endogenous growth theory setting, the rate of economic growth depends on the rate of return on capital. Since inflation behaves like a tax on capital, it erodes the real rate of return, which then inhibits capital accumulation, thus reducing economic growth rate (Gillman & Kejak 2011; Cooley & Hansen, 1989; Stockman, 1981; Fama & Schwert, 1977).

In the long run, after the full equilibrium point, the trade-off between inflation and unemployment vanishes (Keynes, 1936). Prices are assumed to be largely determined by the costs of inputs, mostly labour. This neo-Keynesian model takes into account inertia in wage inflation and some feedback responses flowing from prices to wages (Perry, 1980). Using this view, unanticipated inflation comes from monetary surprises. Thus, the positive relationship between inflation and output evident is a short-run phenomenon. In the long run, the positive relationship is unsustainable and turns negative with a higher inflation rate.

The third hypothesis is the structuralist view of inflation, which falls between the monetarist and Keynesian theories of inflation discussed above. The proponents of the structural theory believe that inflation is the outcome of unbalanced growth that arises due to changes in the composition of demand in the economy, accompanied by inflexibilities in the production sector, as well as a relative downward rigidity of money prices (Boianovsky, 1968; Perroux & Lisle, 1957). Economic instabilities arise from improper institutional rearrangements, demand-pull and cost-push factors, and exchange rate misalignments, among other features of the business environment (Taylor, 1983). For instance, inflation causes exchange rate misalignment, which reduces international competitiveness, hence, a deterioration of the trade balance and capital outflows (Boianovsky, 1968). This negatively impacts the long-term economic growth to the degree that foreign assistance becomes available to make the supply of imports more elastic (Boianovsky, 1968).

Previous empirical studies that were carried out on the relationship between inflation and economic growth can be conveniently put into three broad clusters. The first cluster of studies examined the linear relationship between inflation and growth. In this first group, there are three possible outcomes regarding the impact of inflation on output and growth, that is, positive (Ozdemir, 2010; Rapach, 2003; Mallik & Chowdhury, 2001), negative (Gillman & Harris,

2010; Fountas, Karanasos & Kim., 2006; Gillman, Haris & Matyas, 2004; Faria & Carneiro, 2001), and none (Cameron, Hum & Simpson, 1996; Sidrauski, 1967).

The second cluster of studies explored the nonlinear relationship between inflation and economic growth and include Aye and Odhiambo (2021); Arawatari, Hori and Mino (2018); Phiri (2018); Eggoh and Muhammad (2014); Kremer, Bick and Nautz. (2013); and Sarel (1996). In these studies, the nonlinear impact of inflation on economic growth attested to the presence of an inverted U-shaped relationship between the two variables. That is, the impact of inflation on economic growth is theorised to have either no significant effect, or a positive effect on economic growth at lower levels, and a statistically significant negative effect at higher levels of inflation. A few other studies proved the existence of a U-shaped relationship between inflation and economic growth – suggesting that the economy is better off only at exceptionally low levels of inflation (Manamba, 2016).

The third cluster looked at the correlations between inflation and economic growth. Most previous studies in this cluster have shown evidence for a unidirectional causal flow from inflation to economic growth (Rutayisire, 2013; Fischer, 1993). On the other hand, Ramzi and Wiem's (2019) findings revealed that the causal relationship between inflation, innovation, and economic growth differs significantly between nations analysed, with innovation being more responsive to inflation in the most innovative countries. The empirical research on the inflation-growth relationship is summarised in Table 1.

**Table 1**

*Summary of Empirical Studies on the Inflation-Growth Relationship*

| Empirical Studies on the Inflation-Growth Linear Relationship | | | |
|---|---|---|---|
| Author(s) | Sample | Research Method(s) | Outcome |
| Gillman & Harris (2010) | 13 transition countries (1990-2003) | Fixed effects panel approach<br>Maximum likelihood estimation technique<br>Three-equation simultaneous system | Negative relationship |
| Ozdemir (2010) | United Kingdom (1957:Q2-2006:Q4) | VARFIMA-BEKK MGARCH model | Positive relationship |
| Benhabib & Spiegel (2009) | 17 countries (1862-1995) | Linear and nonlinear specifications | Positive relationship |
| Fountas et al. (2006) | Seven advanced economies - G7 countries | Bivariate GARCH approach<br>Two-step procedure | Negative relationship |
| Gillman et al. (2004) | OECD and APEC member countries (1961-1997) | Panel regressions | Negative relationship |
| Rapach (2003) | 14 industrialised countries | Structural vector autoregression framework | Positive relationship |
| Mallik & Chowdhury (2001) | Four South Asian countries (Bangladesh, India, Pakistan and Sri Lanka) (1961-1997) | Johansen's maximum-likelihood procedure<br>Error correction model | Positive relationship |
| Faria & Carneiro (2001) | Brazil (1980-1995) | Bivariate VAR model | Negative relationship (short run)<br>No relationship (long run) |
| Cameron et al. (1996) | Four countries (Canada, United States, United Kingdom, West Germany) (1953-1991) | Long quarterly and annual datasets<br>Cointegration analysis | No relationship |
| Empirical Studies on the Inflation-Growth Nonlinear Relationship | | | |
| Aye & Odhiambo (2021) | Developing countries | Dynamic panel threshold regressions | Nonlinear (inverted U-shaped curve)<br>Threshold level: 5.997%. |
| Phiri (2018) | South Africa | STR model | Nonlinear (inverted U-shaped curve)<br>Threshold level: 5.4%. |

| | | | |
|---|---|---|---|
| Ndoricimpa (2017) | African countries | Dynamic panel threshold regressions | Nonlinear (inverted U-shaped curve) Threshold level: 2.7% (whole sample). |
| Eggoh & Muhammad (2014) | Developed and developing countries | PSTR models | Nonlinear (inverted U-shaped curve) Threshold level: 12.4%. |
| Kremer et al. (2013) | 124 non-industrialised and industrialised countries | PSTR models | Nonlinear (inverted U-shaped curve) Threshold level: 2.5% in industrialised countries; and 17% in non-industrialised countries. |
| Rutayisire (2013) | Rwanda | Quadratic regression model | Nonlinear (inverted U-shaped curve) Threshold level: 12.7%. |
| López-Villavicencio & Mignon (2011) | 44 industrialised and emerging economies | PSTR models | Nonlinear (inverted U-shaped curve) Threshold level: 2.7% in industrialised countries; and 17.5% in emerging economies. |
| Empirical Studies on the Inflation-Growth Causal Relationship | | | |
| Rutayisire (2013) | Rwanda | Pairwise Granger causality model | Inflation → growth |
| Fischer (1993) | 93 developing and industrial countries | Panel regressions | Inflation → growth |

*Note:* *PSTR = panel smooth transition regression; and STR is smooth transition regression.

The literature assessment revealed that the bulk of previous empirical research suggests a negative association between inflation and economic growth, with the flow of information being from inflation to growth. Furthermore, the majority of these earlier studies relied on panel regression analysis, which resulted in the generalisation of conclusions, leaving country-specific differences unaccounted for. Furthermore, the distribution of studies is slanted in favour of developed and emerging economies, rather than being balanced. These studies also revealed that the inflation-growth link varied depending on the level of inflation. Consequently, despite the growth in the inflation-growth literature, current country-specific research is still restricted, and, to the best of our knowledge, the analysis has not been applied to the Kenyan economy. Thus, using both a dynamic autoregressive and multivariate Grange-causality model on a single country (Kenya), this study sought to fill this vacuum in the literature.

## 4. Research methodology and estimation techniques

### 4.1. Data and variable description

This study used time series data stretching from 1970 to 2019, obtained from the World Development Indicators, an online database of the World Bank. Unlike other, preceding studies that concentrated on periods ending in the 1980s or mid-1990s, the selected time span extends over a period when major policy shifts in Kenya were undertaken. Table 2 gives variable description.

**Table 2**

*Variable Description*

| Variable | Description |
|---|---|
| Economic growth (y) | Real GDP per capita |
| Inflation (INFL) | Annual growth rate of the consumer price index |
| Financial depth (FD) | Ratio of broad money supply to GDP (M3/GDP) |
| Openness (TRADE) | (Exports + Imports)/GDP |
| Foreign direct investment (FDI) | Ratio of foreign direct investment to GDP |
| Investment (INV) | Ratio of gross fixed capital formation to GDP |
| Government expenditure (GE) | Government final consumption expenditure (% GDP) |
| Credit to private sector (CREDIT) | Monetary Sector credit to private sector (% GDP) |

### 4.2. Inflation and economic growth – impact analysis

In this work, an ARDL approach is used to determine the link between inflation and economic growth. The chosen method overcomes the drawbacks of prior cointegration strategies, such as the need for mutual integration of the time series for estimation (refer to section 1, also see Odhiambo, 2008; Pesaran, Sin & Smith, 2001). A structural break in inflation is also included in the research. The empirical ARDL model specification used in this study can be described as follows, according to Pesaran et al. (2001) (also see Saungweme & Odhiambo, 2021; Odhiambo, 2021):

$$\Delta y_t = \phi_0 + \sum_{i=1}^{n} \phi_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \phi_{2i} \Delta INFL_{t-i} + \sum_{i=0}^{n} \phi_{3i} \Delta FD_{t-i} + \sum_{i=0}^{n} \phi_{4i} \Delta TRADE_{t-i} + \sum_{i=0}^{n} \phi_{5i} \Delta FDI_{t-i} + \sum_{i=0}^{n} \phi_{7i} \Delta GE_{t-i} + \sum_{i=0}^{n} \phi_{8i} \Delta CREDIT_{t-i} + \sigma_1 y_{t-1} + \sigma_2 INFL_{t-1} + \sigma_3 FD_{t-1} + \sigma_4 TRADE_{t-1} + \sigma_5 FDI_{t-1} + \sigma_6 INV_{t-1} + \sigma_7 GE_{t-1} + \sigma_8 CREDIT_{t-1} + \sigma_9 D_{95} + \mu_{1t}. \quad (1)$$

Where $\phi_0$ is the constant; $\phi_1 - \phi_8$ and $\sigma_1 - \sigma_9$ are short-run and long-run regression coefficients, respectively; $\Delta$ is the difference operator; n is the lag length; $\mu_{1t}$ is the error term; t is the time period; and $D_{95}$ is a dummy variable whose value was equal to 0 during the period 1970-1995, and 1 otherwise; and all other variables are as described in Table 2. The error correction model based on Equation 1 is expressed as follows:

$$\Delta y_t = \phi_0 + \sum_{i=1}^{n} \phi_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \phi_{2i} \Delta INFL_{t-i} + \sum_{i=0}^{n} \phi_{3i} \Delta FD_{t-i} + \sum_{i=0}^{n} \phi_{4i} \Delta TRADE_{t-i} + \sum_{i=0}^{n} \phi_{5i} \Delta FDI_{t-i} + \sum_{i=0}^{n} \phi_{6i} \Delta INV_{t-i} + \sum_{i=0}^{n} \phi_{7i} \Delta GE_{t-i} + \sum_{i=0}^{n} \phi_{8i} \Delta CREDIT_{t-i} + \sum_{i=0}^{n} D_{95} \Delta DU_{t-i} + \psi_1 ECM_{t-1} + \mu_{2t}. \quad (2)$$

Where $\psi_1$ is the coefficient of the ECM; $D_{95}$ represents the short-run coefficient of the dummy variable; $\mathrm{ECM}_{t-1}$ is the error-correction term lagged by one period; and all the other variables are as described in Equation 1.

There are three basic steps to the ARDL-bound test technique. The first step is to create a tentative model. The preliminary unconstrained model is then estimated using the Ordinary Least Squares technique in the second stage. The Akaike Information Criterion (AIC) or the Schwartz-Bayesian Criterion must be used to determine the order of lags on the initial differenced variables to be retrieved from the unrestricted model (SBC). Repeated diagnostic checks will yield the necessary empirical model for the investigation. The Wald test (F-test) is used in the final step to see if there is a long-run relationship between the model variables.

The null hypothesis of no long-run relationship is compared to the alternative hypothesis of a long-run relationship. In this approach, the obtained F-statistic is compared to two sets of critical values: I(0) and I(1). The null hypothesis of no cointegration is rejected after the estimated F-statistic exceeds the upper bound critical value. The null hypothesis of no cointegration is accepted when the estimated F-statistic is below the lower bound critical value. The result is inconclusive if the estimated F-statistic falls between the lower limit and upper bound critical values.

### 4.3. Inflation and economic growth – causality analysis

Two intermittent variables, namely financial depth and trade openness were introduced to the causality model to reduce omission-of-variable-bias and to improve the general validity of the causation test. To minimize spurious correlations, the study employed the generic ARDL model of Pesaran et al. (2001) to establish a set of four cointegration equations, as follows (Odhiambo, 2021):

$$\Delta y_t = \phi_0 + \sum_{i=1}^{n} \phi_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \phi_{2i} \Delta INFL_{t-i} + \sum_{i=0}^{n} \phi_{3i} \Delta FD_{t-i} + \sum_{i=0}^{n} \phi_{4i} \Delta TRADE_{t-i} + \phi_5 y_{t-1} + \phi_6 INFL_{t-1} + \phi_7 FD_{t-1} + \phi_8 TRADE_{t-1} + \varepsilon_{1t}. \quad (3)$$

$$\Delta INFL_t = \lambda_0 + \sum_{i=0}^{n} \lambda_{1i} \Delta y_{t-i} + \sum_{i=1}^{n} \lambda_{2i} \Delta INFL_{t-i} + \sum_{i=0}^{n} \lambda_{3i} \Delta FD_{t-i} + \sum_{i=0}^{n} \lambda_{4i} \Delta TRADE_{t-i} + \lambda_5 y_{t-1} + \lambda_6 INFL_{t-1} + \lambda_7 FD_{t-1} + \lambda_8 TRADE_{t-1} + \varepsilon_{2t}. \quad (4)$$

$$\Delta FD_t = \beta_0 + \sum_{i=0}^{n} \beta_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta INFL_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta FD_{t-i} + \sum_{i=0}^{n} \beta_{4i} \Delta TRADE_{t-i} + \beta_5 y_{t-1} + \beta_6 INFL_{t-1} + \beta_7 FD_{t-1} + \beta_8 TRADE_{t-1} + \varepsilon_{3t}. \quad (5)$$

$$\Delta TRADE_t = \omega_0 + \sum_{i=0}^{n} \omega_{1i} \Delta y_{t-i} + \sum_{i=0}^{n} \omega_{2i} \Delta INFL_{t-i} + \sum_{i=0}^{n} \omega_{3i} \Delta FD_{t-i} + \sum_{i=1}^{n} \omega_{4i} \Delta TRADE_{t-i} + \omega_5 y_{t-1} + \omega_6 INFL_{t-1} + \omega_7 FD_{t-1} + \omega_8 TRADE_{t-1} + \varepsilon_{4t}. \quad (6)$$

Where $\phi_0$, $\lambda_0$, $\beta_0$ and $\omega_0$ are respective constants; $\phi_1 - \phi_4$, $\lambda_1 - \lambda_4$, $\beta_1 - \beta_4$ and $\omega_1 - \omega_4$ are respective short-run coefficients; $\phi_5 - \phi_8$, $\lambda_5 - \lambda_8$, $\beta_5 - \beta_8$ and $\omega_5 - \omega_8$ are respective long-run coefficients; $\varepsilon_1 - \varepsilon_4$ are the error terms; $\Delta$ is the difference operator; n is the lag length; t is the time period; and all the other variables are as described in Table 2.

The set of cointegration equations (Equations 3-6) only supports causality in at least one direction. Only the Granger-causality models can determine the real direction of causality (Odhiambo, 2021; Narayan & Smyth, 2008).

$$\Delta y_t = \phi_0 + \sum_{i=1}^{n} \phi_{1i} \Delta y_{t-i} + \sum_{i=1}^{n} \phi_{2i} \Delta INFL_{t-i} + \sum_{i=1}^{n} \phi_{3i} \Delta FD_{t-i} + \sum_{i=1}^{n} \phi_{4i} \Delta TRADE_{t-i} + \phi_9 ECM_{t-1} + \mu_{1t}. \quad (7)$$

$$\Delta INFL_t = \lambda_0 + \sum_{i=1}^{n} \lambda_{1i} \Delta y_{t-i} + \sum_{i=1}^{n} \lambda_{2i} \Delta INFL_{t-i} + \sum_{i=1}^{n} \lambda_{3i} \Delta FD_{t-i} + \sum_{i=1}^{n} \lambda_{4i} \Delta TRADE_{t-i} + \lambda_9 ECM_{t-1} + \mu_{2t}\ . \quad (8)$$

$$\Delta FD_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta y_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta INFL_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta FD_{t-i} + \sum_{i=1}^{n} \beta_{4i} \Delta TRADE_{t-i} + \beta_9 ECM_{t-1} + \mu_{3t}\ . \quad (9)$$

$$\Delta TRADE_t = \omega_0 + \sum_{i=1}^{n} \omega_{1i} \Delta y_{t-i} + \sum_{i=1}^{n} \omega_{2i} \Delta INFL_{t-i} + \sum_{i=1}^{n} \omega_{3i} \Delta FD_{t-i} + \sum_{i=1}^{n} \omega_{4i} \Delta TRADE_{t-i} + \omega_9 ECM_{t-1} + \mu_{4t}. \quad (10)$$

Where $\phi_9$, $\lambda_9$, $\beta_9$ and $\omega_9$ are coefficients of $ECM_{t-1}$; $ECM_{t-1}$ is the error correction term lagged by one period; and all the other variables are as described in the cointegration model.

## 5. Empirical analysis

### 5.1. Descriptive statistics

The summary statistics of each series used in the current study is reported in Table 3.

**Table 3**

*Summary Statistics*

| Variable | Summary Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| | N | Mean | Median | Standard Deviation | Kurtosis | Skewness | Jarque-Bera P-Value |
| Y | 50 | 1.369 | 1.243 | 3.967 | 3.680 | 0.567 | 0.917 |
| INFL | 50 | 11.626 | 9.898 | 8.046 | 3.238 | 0.920 | 0.488 |
| FD | 50 | 34.449 | 35.506 | 4.841 | 2.835 | -0.116 | 0.243 |
| TRADE | 50 | 56.178 | 55.669 | 8.923 | 3.507 | -0.359 | 0.447 |
| FDI | 50 | 0.808 | 0.510 | 0.762 | 5.186 | 0.077 | 0.165 |
| INV | 50 | 20.564 | 20.351 | 3.354 | 2.626 | 0.359 | 0.504 |
| GE | 50 | 16.326 | 16.355 | 1.933 | 2.852 | -0.131 | 0.236 |
| CREDIT | 50 | 23.702 | 21.982 | 6.090 | 3.396 | 0.011 | 0.191 |

The summary statistics reported in Table 3 showed that there were 50 observations for each variable, that is, the sample size was large enough to provide precise estimates of parameters, such as mean, median, skewness and kurtosis. The results further indicated that the average inflation and economic growth rates between 1970 and 2019 were 11.6% and 1.4%, respectively. The marginal differences between mean and median values for all the series show that the data set is overall symmetric. This finding is also substantiated by the values of skewness, which is less than one. The Jarque-Bera p-values of more than 0.1 imply that the series are normally distributed. This result is corroborated by kurtosis values that are around 3. In the main, the summary statistics showed that the data set could be used to perform further statistical operations, and would give reliable and consistent parameters.

### 5.2. Stationarity test

In order to correctly classify series and apply appropriate modelling techniques, the stationarity of the series was tested in this study using the Perron (1997) (PPURoot) and Zivot-Andrews (1992) (ZAU Root) techniques. According to Perron (1989), structural change in time series can influence the results of tests for unit roots. Therefore, the selected unit root testing techniques of Perron (1989) and Zivot-Andrews (1992) are exogenously and endogenously correct for structural breaks, respectively, thus correctly determining the order of the integration among the variables. The results of the unit root tests are presented Table 4.

**Table 4**

*Unit Root Results*

| Variable | Stationarity of all Variables in Levels | Break Point | Stationarity of all Variables in First Difference | Break Point |
|---|---|---|---|---|
| Panel 1: PPURroot Test | | | | |
| Y | -3.740 | 1991 | -5.367** | 1993 |
| INFL | -4.511 | 1995 | -10.547*** | 1995 |
| FD | -4.513 | 1991 | -8.119*** | 1992 |
| TRADE | -4.614 | 2010 | -5.507** | 1993 |
| FDI | -7.340*** | 2010 | - | - |
| INV | -5.348** | 1991 | - | - |
| GE | -3.654 | 2000 | -7.907*** | 2006 |
| CREDIT | -3.980 | 2011 | -7.762*** | 2010 |
| Panel 2: ZAU Root Test | | | | |
| Y | -3.745 | 1991 | -6.319*** | 2006 |
| INFL | -3.997 | 1995 | -8.166*** | 1994 |
| FD | -4.706 | 1992 | -8.109*** | 1996 |
| TRADE | -4.296 | 2011 | -8.164*** | 1988 |
| FDI | -8.213*** | 2011 | - | - |
| INV | -6.270*** | 1992 | - | - |
| GE | -3.839 | 2011 | -7.244*** | 1994 |
| CREDIT | -3.401 | 2011 | -8.038*** | 2011 |

The results of the PPURoot and ZAU tests reported in Table 4 indicated that only foreign direct investment and gross fixed capital formation are stationary in levels, while the rest of the series is integrated of order one. These results confirmed that the time series is conclusively integrated of order not exceeding one, and that the structural break in inflation and economic growth series occurred in 1995 and 1991, respectively.

### 5.2 Inflation-growth - Impact analysis

#### 5.2.1 Cointegration test: ARDL-bounds testing approach

In order to establish the existence or nonexistence of a long-run relationship between the variables in the estimated model, the study applied a bounds F-statistic test. Table 5 presents the results of the cointegration test based on the joint bounds F-test.

**Table 5**

*Bounds F-Test for Co-Integration*

| Dependent Variable | Function | | | F-Statistic | | Cointegration Status |
|---|---|---|---|---|---|---|
| ARDL (1, 0, 1, 1, 2, 0, 0, 2) Selected based on Akaike Information Criteria | | | | | | |
| Y | F(y\|INFL, FD, TRADE, FDI, INV, GE, CREDIT, $D_{95}$) | | | 6.74*** | | Cointegrated |
| | Asymptotic critical values (unrestricted constant and no trend) | | | | | |
| Pesaran et al. (2001: 300) critical values [Case 3] | 1% | | 5% | | 10% | |
| | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) |
| | 2.96 | 4.26 | 2.32 | 3.50 | 2.03 | 3.13 |

*Note:* *** denotes statistical significance at 1%.

The reported results indicated that the computed F-statistic is greater than the indicated upper bound critical value at 1% significance level. This means that the study rejected the null hypothesis, implying that there is a long-run cointegration relationship between real GDP per capita growth and its determinants, namely, inflation, financial depth, trade openness, foreign direct investment, gross fixed capital formation, government expenditure and credit to private sector.

#### 5.2.2 Long-run and short-run estimation results

Following the confirmation of a cointegration relationship among the variables used in the study, the next step is to estimate long-run and short-run coefficients for Equation (1). The results are reported in Table 6, Panels 1 and 2, respectively.

**Table 6**

*Long-Run and Short-Run Coefficients*

| Panel 1: Estimated Long-Run Coefficients: Dependent – y | | | |
|---|---|---|---|
| Regressors | Coefficient | T-Ratio | P-value |
| C | 18.183** | 2.260 | 0.029 |
| INFL | -0.282*** | -2.959 | 0.006 |
| FD | 0.121*** | 2.880 | 0.007 |
| TRADE | -0.345*** | -3.501 | 0.001 |
| FDI | 0.646 | 1.279 | 0.208 |
| INV | 0.652** | 2.146 | 0.039 |
| GE | -0.081** | -2.457 | 0.018 |
| CREDIT | 0.442 | 1.354 | 0.123 |
| $D_{95}$ | 0.016* | 1.773 | 0.084 |
| Panel 2: Estimated Short-Run Coefficients: Dependent – ΔY | | | |
| Regressors | Coefficient | T-Ratio | P-value |
| Δy | 0.232* | 1.834 | 0.074 |
| ΔINFL | -0.036 | -1.319 | 0.195 |
| ΔFD | 0.592 | 1.310 | 0.438 |
| ΔTRADE | -0.247** | -2.736 | 0.041 |
| ΔFDI | 0.081* | 2.033 | 0.082 |
| ΔFDI(1) | 0.459 | 1.526 | 0.619 |
| ΔINV | 0.053*** | 3.673 | 0.001 |
| ΔGE | -0.746* | -2.001 | 0.055 |
| ΔCREDIT | 0.436*** | 3.064 | 0.004 |
| ΔCREDIT(1) | 0.748 | 1.018 | 0.397 |
| $\Delta DU_{95}$ | 0.133 | 1.456 | 0.510 |
| $ECM_{t-1}$ | -0.438*** | -4.303 | 0.000 |

R-bar-squared: 0.681; F-statistic: 10.129; Prob[F-statistic]: 0.000; DW statistic: 1.806; AIC: 10.054; SBC: 10.521

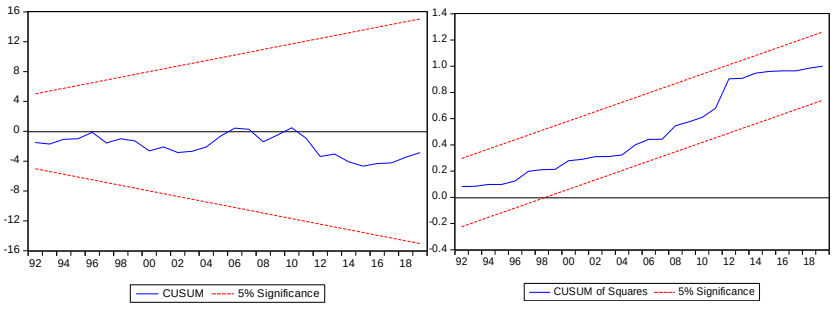
*Note*: *, ** and *** denotes stationarity at 10%, 5% and 1% significance levels, respectively.

The long-run results presented in Table 6, Panel 1, showed a statistically significant negative sign of inflation. This implies that inflation has an overall negative impact on economic growth in Kenya in the long run, but no impact in the short run. The finding is not unique to this research but is consistent with both theoretical literature and other previous findings in Eggoh and Muhammad (2014) and Gillman and Harris (2010). The statistically significant positive sign of financial depth in the long run, and investment both in the long run and short run, suggests that a well-developed and strong financial system and capital formation

are necessary for economic growth. Financial deepening and a strong investment base help in reducing the negative effects of global volatility on the domestic economy (Rewilak, 2017). The results, however, showed that trade openness and government expenditure have a negative impact on economic growth in Kenya, both in the short run and in the long run. This suggests that government recurrent spending has a strong crowding-out effect on capital investment in the country studied, thus inhibiting growth. According to Butkiewicz and Yanikkaya (2011), government recurrent spending has a strong adverse impact on economic growth in countries with ineffective governments (Dudzevičiūtė et al., 2016). More so, the coefficients of economic growth, foreign direct investment and monetary sector lending to the private sector are statistically significant and positive, implying that economic growth, foreign direct investment, and credit lagged by one period are likely to stimulate economic growth in Kenya in the short run. The results further indicated that $DU_{95}$ has a statistically significant and positive impact on economic growth in the long run. This suggests that the mid-1990s economic, financial and trade reforms implemented by the government, which largely supported a more outward-oriented industrial policy, were growth enhancing (Swamy, 1994). The error correction term ECM(-1) has the expected statistically significant negative sign, implying that in the event of a shock in the economy, economic growth adjusts to equilibrium at a rate of 43.8% per annum.

Regarding diagnostic tests, the Breusch-Godfrey serial correlation LM test results show an F-statistic value of 0.059 with a p-value of 0.809 signifying the absence of serial correlation problem. Furthermore, model stability test results are presented in Figure 2.

**Figure 2: CUSUM and CUSUMQ plots**




The applied model passes the stability test, as revealed by the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMQ) plots in Figures 2 that are within the boundaries at a 5% significance level, implying that the estimated results are consistently reliable.

### 5.3 Inflation-growth - causality analysis

The first step in conducting causal link tests is to determine whether there is any cointegration among the variables in the model. This procedure helps to avoid spurious regressions and ensure robust results. Therefore, to establish if there is cointegration in the variables under study, the bounds F-test is employed. Only in the presence of cointegration will an error correction term be incorporated as one of the regressors in the estimated causality model. The cointegration and causality test results are reported in Tables 7 and 8, respectively.

**Table 7**

*Bound F-Test for Cointegration Results*

| Dependent Variable | Function | F-statistic | Cointegration Status |
|---|---|---|---|
| Y | F(y\| INFL, FD, TRADE) | 4.424** | Cointegrated |
| INFL | F(INFL\| y, FD, TRADE) | 1.723 | No cointegration |
| FD | F(FD\| y, INFL, TRADE) | 2.269 | No cointegration |
| TRADE | F(TRADE\| y, INFL, FD) | 2.526 | No cointegration |

| Asymptotic Critical Values (Unrestricted Intercept and No Trend) | | | | | | |
|---|---|---|---|---|---|---|
| Pesaran et al. (2001: 300) | 10% | | 5% | | 1% | |
| Table CI(iii) Case III | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) |
| | 2.72 | 3.77 | 3.23 | 4.35 | 4.29 | 5.61 |

*Note:* ** implies statistical significance at 5% and 1%, respectively

In Table 7, cointegration exists in the economic growth function. This finding is validated by the respective F-statistic of the economic growth function vis-à-vis the Pesaran et al. (2001) asymptotic bound critical values. The optimal lag lengths in Table 8 were determined using the AIC method.

**Table 8**

*ECM Based Granger-Causality Test Results*

| Dependent Variable | F-statistics [probability] | | | | $ECT_{t-1}$ [t-statistics] |
|---|---|---|---|---|---|
| | $\Delta y_t$ | $\Delta INFL_t$ | $\Delta FD_t$ | $\Delta TRADE_t$ | |
| $\Delta y_t$ | - | 0.324<br>[0.787] | 0.721<br>[0.298] | 6.706***<br>[0.000] | -4.864***<br>[3.768] |
| $\Delta INFL_t$ | 4.936**<br>[0.038] | - | 0.534<br>[0.132] | 1.637<br>[0.583] | - |
| $\Delta FD_t$ | 3.327*<br>[0.094] | 5.592**<br>[0.049] | - | 3.033**<br>[0.018] | - |
| $\Delta TRADE_t$ | 3.765**<br>[0.023] | 0.601<br>[0.829] | 1.482<br>[0.348] | - | - |

*Note:* *, ** and *** imply statistical significance at 10%, 5% and 1% levels, respectively.

The multivariate Granger-causation results in Table 8 revealed a distinct short-run unidirectional causality between economic growth and inflation. The associated F-statistic of economic growth in the inflation function, which is statistically significant, confirms this result. These causality findings indicated that, in the short run, economic growth patterns have a major impact on Kenyan inflation dynamics. This finding is not unique to this study; it is consistent with Rutayisire's (2013) findings for Rwanda. The other causality results between inflation, economic growth, and the two intermittent variables – financial depth and trade openness – were shown to vary significantly across time. In the short run, the results likewise revealed a unidirectional causality from economic growth, inflation, and trade openness to financial depth. These short-run causal flows are confirmed by the corresponding F-statistics of economic growth, inflation and trade openness in the financial depth function, which are statistically significant. The other results presented in Table 8 indicate that there is: (i) a bidirectional causality between trade openness and economic growth, irrespective of whether the causality test is carried out in the short run or in the long run; and (ii) no causality between trade openness and inflation, and trade openness and financial depth.

## 6. Conclusion

This paper examined the dynamic impact and causality relationships between inflation and economic growth in Kenya, using time series data spanning from 1970 to 2019. The study is particularly significant in view of the ongoing fight against covid-19 infections and the

necessity for balanced fiscal-monetary recovery measures both during and after the pandemic. Furthermore, the study was prompted by the lack of thorough studies of inflation-growth links in Kenya, on the one hand, and the literature's overall inconclusive results on the relationship between inflation and economic growth, on the other. The analysis added structural breaks in an attempt to improve the general validity of statistical inference – an element that had been missing in earlier time series analyses – in view of the important economic and financial reforms that happened in Kenya during the period under review. In addition, two intermittent variables, financial depth and trade openness, were introduced to the causality model to reduce omission-of-variable-bias and to improve the general validity of the causation test. The study utilised an ARDL approach and ECM-based Granger-causality test to examine the linkages. The impact results showed that inflation negatively affects economic growth in Kenya in the long run. The causality results showed a distinct short-run unidirectional causality from economic growth to inflation in Kenya.

Given the empirical findings, the paper advises Kenya's government to maintain prudent monetary, financial, and fiscal policies to mitigate the negative effects of inflation and the covid-19 lockdown on the economy and welfare. Specifically, the country should implement an accommodative monetary policy, promote private sector creditor development, encourage stronger public sector investment, and keep inflation under control through rolling growth-enhancing fiscal consolidation measures. However, the study also acknowledges a growing body of recent empirical literature suggesting that the link between inflation and growth is nonlinear and that there is a point above which inflation is growth-inhibiting and below which it is growth-enhancing. Based on the findings of this study, future research on this topic should include a precise assessment of the threshold level in the studied country.

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