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Investigation of the Economic Factors Explaining Inflation in Burundi

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Abstract

This study analyzes the explanatory factors of inflation in Burundi by applying the ARDL model over the period 1990-2022. The main objective is to examine the short- and long-term relationships between inflation and some key macroeconomic variables, including money supply, trade openness, gross fixed capital formation, and GDP per capita growth. The results indicate that the model has a high explanatory power (R2 = 0.9864), suggesting that the selected independent variables explain 98.64% of the variation or evolution of inflation. The study reveals a rapid adjustment mechanism for long-term inflationary imbalances, with a correction coefficient of -0.7310 (p = 0.008), meaning that 73.10% of the imbalances are corrected each year. In the long run, a 1% increase in GDP per capita reduces inflation by 3.35%, while a 1% increase in the money supply leads to an increase in inflation of 0.67%. Trade openness has an inflationary effect (+0.90%), although not statistically significant, while gross fixed capital formation has a disinflationary effect (-1.39%), also not significant. In the short run, the effects are more dynamic. A 1% increase in productive investments initially increases inflation by 2.02%, before generating a disinflationary effect after two periods. Similarly, an increase in the money supply temporarily reduces inflation by 1.84%, which can be explained by a strategic use of liquidity. These results highlight the importance for Burundian policymakers to control the money supply, stimulate economic growth and manage investments effectively to minimize inflationary pressures. Prudent management of budget deficits and trade policies is essential to stabilize inflation and propel a process of economic development.

Keywords: Inflation, ARDL model, money supply, trade openness, economic growth, Burundi.

1. Introduction

Inflation is a major concern due to its direct impact on citizens' purchasing power, business competitiveness and overall economic stability, and thus represents a major challenge for economic authorities (Chikobava, 2019; Przekota and Szczepańska-Przekota, 2022). Across the world, there is a shift to a high inflation regime, requiring stricter management measures than in previous periods of low inflation (Podrugina and Lysenko, 2023).

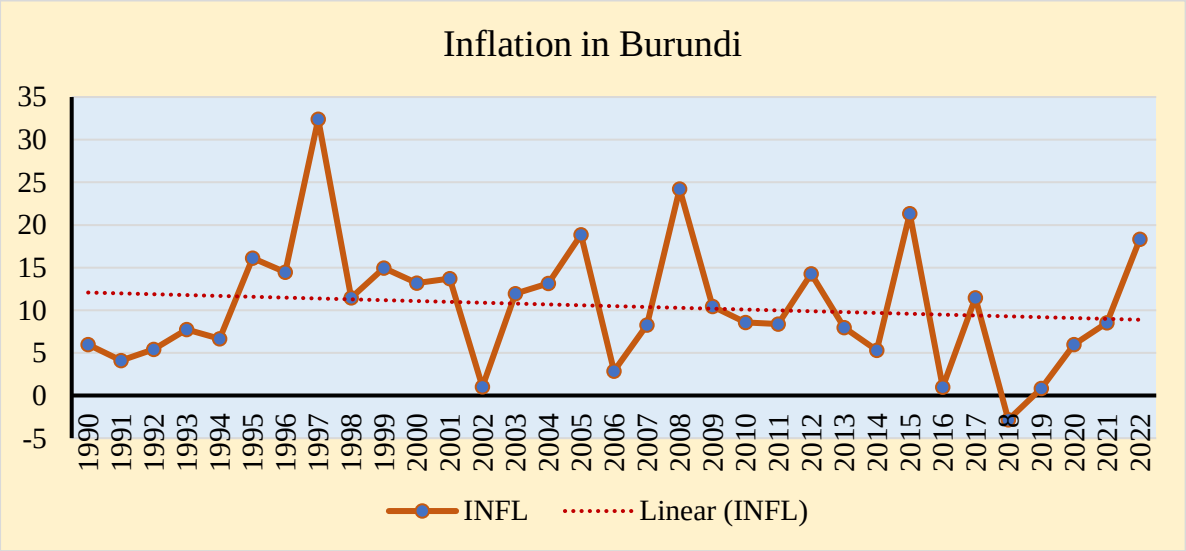
For several years, inflation has been marked by historically high levels and significant economic impacts worldwide. From 1983 onwards, inflation experienced a sharp increase, peaking at 39.33% in 1990. This period was marked by global economic tensions, particularly due to oil shocks and expansionary monetary policies. In 2008, inflation rises significantly to 6.28%, due to the impact of the global economic crisis. A significant increase in inflation occurs

in 2022 (8.63%), due to global disruptions caused by the pandemic, the war in Ukraine, and commodity price hikes (Statista Research Department, 2025).

Inflationary pressures are also a concern in Africa, with food prices being particularly volatile (Alper et al., 2016). Studies show that inflation volatility has a negative impact on foreign direct investment in sub-Saharan Africa, although better governance can mitigate this effect (Bobbo, 2018). Global supply chain disruptions have had a significant impact on inflation in sub-Saharan Africa, highlighting the importance for central banks to monitor these disruptions for effective monetary policy (Andriantomanga et al., 2023).

Within the Eastern Africa region, member countries are implementing monetary and fiscal policies to control inflation while promoting economic growth. Burundi, as a member, faces the same challenge. According to Aboyitungiye and Prasetyani (2021), Burundi's agricultural sector, although essential, faces obstacles limiting its expansion, while inflation remains a problem in both the short and long term. (Ezako, 2023) identified an inflation threshold of 13%, above which Burundi's economic growth is negatively affected, and recommends this threshold as a ceiling for policymakers; suggesting the need for tighter monetary policy to maintain price stability. In low-income countries, such as Burundi, periods of sharp inflation swing in recent decades have not only disrupted economic life but also limited sustained growth efforts.

Graph n°1 : Evolution of inflation in Burundi (period 1990-2022)



Source: Authors, based on World Bank data (2024)

The evolution of inflation in Burundi between 1990 and 2022 shows several periods marked by economic and political crises. After moderate inflation in the 1990s, a peak of 32.40% was reached in 1994 due to the internal crisis. Increases occur until 1998 (14-16%) due to the civil war, and another peak of 24.22% occurs in 2001. Inflation remains high (20-25%) between 2003 and 2005, before falling after 2009 to reach 5% in 2010. It remains moderate between 2011 and 2013, but increases to 16% in 2017. After years of stability, a high rate of 18.33% is observed in 2022, linked to the COVID-19 pandemic and its effects on global supply chains and commodity prices. The analysis suggests a trend towards increasing inflation, linked to Burundi's increasing dependence on imports and the availability of global prices.

As noted above, understanding the economic factors underlying inflationary dynamics in such a context is therefore essential for the development of effective economic policies. Burundi suffers from an economy vulnerable to inflation due to several structural characteristics. Dependence on imports, meaning that the country must buy more goods than it sells, makes the country sensitive to fluctuations in international prices. In addition, problems such as corruption and non-payment of taxes complicate the management of public finances, leading to pressure on prices.

The devaluation of the Burundian franc against the dollar, partly linked to the unification of exchange rates, has made imports even more expensive, especially essential food products. The agricultural sector, which employs nearly 90% of the population, remains poorly productive and vulnerable to climatic conditions, thus limiting production to meet internal needs and exports. As a result, this structural weakness of the domestic supply translates into an accumulated dependence on imports, which reinforces inflation. External events, such as the war in Ukraine, increased inflation in Burundi by increasing the prices of raw materials and food products, which has a direct impact on the cost of living. These combined factors make inflation management particularly complex for Burundi.

While studies have been conducted on the causes of inflation in some African economies, little empirical research has specifically analyzed the explanatory factors of inflation in Burundi using advanced econometric models. This gap motivates the use of an ARDL (Auto-Regressive Distributed Lag) model, making it possible to examine the long- and short-term relationships between inflation and its determinants over the period 1990-2022.

Thus, this study seeks to answer the following question: What are the economic factors explaining inflation in Burundi and how do they interact in the short and long term? The main objective of this article is to analyze the economic factors explaining inflation in Burundi between 1990 and 2022 using the ARDL model. By providing a better understanding of inflationary dynamics in Burundi, this study aims to enrich the existing economic literature and provide decision-makers with robust analytical tools for more effective management of price stability.

2. Theoretical and empirical literature

Inflation corresponds to a general, sustainable and self-sustaining increase in prices, becoming uncontrollable when it accumulates (Ndiaye and Badji, 2008). However, a simple increase in prices, such as an oil shock, is not enough to qualify it as inflation if it remains sectoral. It should be emphasized that to be qualified as inflation, the increase in prices must be general (it affects all goods and services in the economy, and not just a particular sector), sustainable (it is not limited to a temporary variation in prices, but persists over a prolonged period) and self-sustaining (once triggered, inflation tends to maintain and amplify, creating a vicious circle).

Inflation is mainly measured by the Consumer Price Index (CPI), which estimates the average change in the prices of goods consumed by households. Its evolution is expressed by the inflation rate, distinguishing latent inflation (3-4% per year), open inflation (5-10% with peaks at 20%) and galloping inflation (higher than 50% per month according to Cagan) (Razafimanantena and Rajamarison, 2013), cited by Ouafâa, MEHYAOUI (2018).

The origin of inflation is a matter of debate. The classicists and monetarists, following the quantity theory of money, attribute it to an excessive issue of money relative to production,

according to the adage of the leader of the monetarists Milton Friedman (1912-2006): « inflation is always and everywhere a monetary phenomenon ». In this perspective, an increase in the money supply, if it is not accompanied by a corresponding increase in the production of goods and services, inevitably leads to an increase in prices. Excessive money issue generates inflationary pressure, because there is more money to buy the same quantity of goods.

The quantity theory of money is often formalized by the equation of Irving Fisher (1867-1947): MV = PY where M represents the money supply, V the velocity of circulation of money, P the general price level, Y the volume of production (or real product). In this equation, the relationship between the money supply and the price level is clear: an increase in M (money supply) without a proportional increase in Y (production), while keeping the velocity of circulation V constant, will lead to an increase in P, or inflation. This implies that the increase in money in circulation, without adjustment in the supply of goods and services, causes upward pressure on prices.

Keynesians, led by the English economist John Maynard Keynes (1883-1946), explain inflation by excess demand ("demand-pull inflation"). Indeed, Keynesians explain inflation by an excess of aggregate demand relative to the available supply in the economy. This phenomenon occurs when the demand for goods and services in an economy exceeds its production capacity at a given time. According to Keynesian theory, inflation essentially results from an imbalance between demand and supply in an economy where aggregate demand exceeds potential production. In this context, when the economy is close to full employment or maximum production capacity, any further increase in demand can only be met by an increase in prices, which leads to inflation because producers cannot quickly increase production to keep up with pent-up demand. In other words, if aggregate demand (i.e. consumption, investment, government spending, and exports) increases too quickly relative to the supply of goods and services, the prices of goods and services will increase.

This form of inflation is therefore directly linked to the pressure that excess demand exerts on the limited resources of an economy. According to Keynesians, to control this inflation, it is necessary to reduce aggregate demand, generally through restrictive monetary policies or more prudent fiscal policies.

While other Keynesians talk about cost-push inflation, which occurs when production costs increase, which pushes companies to increase their prices to maintain their profit margins. According to this theory, companies pass on the increase in their production costs to consumers, thus leading to a generalized increase in prices. This type of inflation is often associated with rising wages (more expensive labor), rising commodity prices (increases in the price of raw materials, such as oil, metals, or food products), increasing taxes or fiscal burdens (an increase in taxes or social security contributions on companies or employees), supply shocks (geopolitical crises, natural disasters, or shortages of labor or raw materials). Finally, imported inflation leads to international shocks when the increase in the prices of imported goods or the depreciation of the national currency increases the cost of foreign products, which is passed on to the national economy and affects households and businesses (Bezbakh, 2024). To mitigate the effects of imported inflation, several strategies related to monetary, fiscal, and trade policies are necessary to limit its impact on economic stability and the purchasing power of populations. These include stabilizing the exchange rate, diversifying sources of supply (reducing dependence on a single supplier or country), developing local production (encouraging national

production to substitute certain imports), reducing taxes on essential imported products (temporarily lowering customs taxes on certain strategic goods can help reduce price increases on the domestic market).

A great deal of research has been conducted to identify the factors responsible for inflation around the world. These studies, applied to various economic contexts, highlight various determinants.

Dahal et al. (2024) analyze the impact of remittances and economic growth on inflation in the member nations of the South Asian Association for Regional Cooperation (SAARC). According to their results, a 1% increase in gross domestic product (GDP) leads to a 0.3405% increase in long-run inflation. The error correction term reveals a negative and statistically significant relationship, indicating that about 65.14% of the imbalance is adjusted in each period. Furthermore, lagged GDP growth in the current year has a negative and significant effect on economic growth. A 1% increase in GDP thus led to a 0.3308% reduction in short-run inflation in SAARC countries. Akpan and Udo (2023) studied the relationship between exchange rate and inflation in Nigeria from 1981 to 2021 using the ARDL model. Their results showed that both exchange rate and real GDP positively and significantly influence inflation. Moreover, the Granger causality test revealed that fiscal deficits, money supply, and real GDP are causal determinants of inflation.

Putri Marasanti and Verico (2024) conducted a study using annual data from 2015 to 2019 for all ASEAN member states. They applied the World Uncertainty Index (WUI) as a proxy for global uncertainty. The results indicate that in the short run, both uncertainty and GDP have a positive and significant impact on inflation, while in the long run, only GDP influences inflation, with uncertainty having no significant effect.

Sumantri and Fadli (2022) found that money supply has a positive relationship with inflation, but its impact remains insignificant. Stylianou et al. (2024) studied the relationship between money supply and inflation in Pakistan from 1981 to 2021 using ARDL bounds tests. The results revealed short-run and long-run cointegration between the variables. Money supply has positive and significant effects on inflation, manifesting consistently in both the short and long run. Sarah et al. (2024) examined the effects of fuel prices and money supply on inflation in Medan from January 2018 to December 2022 by applying the autoregressive distributed lag (ARDL) model. The study concluded that the increase in money supply contributed positively to inflation in Medan city.

Tahir et al. (2023) analyzed the impact of trade openness on China's inflation rate using the ARDL model with data from 1987 to 2019. The results indicate that trade openness has a negative impact on inflation in China, suggesting that it could be an effective tool to combat rising prices. Conversely, Embergenov et al. (2022) examined the relationship between trade openness and inflation in Uzbekistan and found that overall trade openness increases inflation. The study shows that import openness is responsible for the increase in inflation, while export openness helps to mitigate it.

The literature review reveals that the majority of studies on the factors influencing inflation use the ARDL model to analyze their relationship. In this perspective, our research also adopts this econometric model, because it offers the possibility of simultaneously examining the long-term determinants and the short-term adjustments of inflation in Burundi.

3. Methodological framework

The objective of this analysis is to explore the economic drivers of inflation using the ARDL (Auto Regressive Distributed Lag) model. This model has several advantages over VAR and VECM models, particularly for the study of dynamic economic relationships, especially when dealing with time series with varied integration characteristics. These advantages are:

- ✓ **Flexibility of variable integration:** ARDL is distinguished by its ability to integrate variables of different integration orders (I (0) and I (1), but not I (2)), thus offering more flexibility than traditional models such as VAR and VECM, which require the same integration order.
- ✓ **Efficiency with small samples:** ARDL is ideal for small samples, producing robust results even with limited data, unlike other methods that require larger samples to be reliable.
- ✓ **Non-homogeneous dynamic lags:** ARDL allows for assigning distinct lags to each variable, thereby capturing complex dynamic relationships and modeling specific time effects between variables.
- ✓ **Identifying long-run and short-run relationships**: The ARDL model distinguishes between short-run effects and long-run relationships, allowing for the analysis of immediate adjustments as well as long-run equilibrium relationships between variables.

In a dynamic framework, the dependent variable (Y_(t)) can be explained by several components. These include:

- ✓ Its own lagged values: A model that relies solely on past values of the dependent variable is called an autoregressive (AR) model;

$$Y_t = a_0 + a_1 Y_{t-1} + \cdots + a_p Y_{t-p} + \varepsilon_t$$

Or, compactly:

$Y_t = a_0 + \sum_{i=1}^{p} a_i Y_{t-i} + \varepsilon_t$ …… **(1)**

- ✓ Present and past values of the explanatory variables **(X_{t-i})**: when we include the current and time-lagged values of the explanatory variables, we speak of distributed lag (DL) models;

$$Y_t = \beta + b_0 X_t + \cdots + b_q X_{t-q} + \varepsilon_t$$

Or, in a condensed form:

$Y_t = \beta + \sum_{j=0}^{q} b_j X_{t-j} + \varepsilon_t$ …… **(2)**

A combination of the two previous ones: when we combine the lagged values of the dependent variable (Y_t), the current values of the explanatory variables (X_t) and their lagged values, we obtain an autoregressive distributed lag (ARDL) model.

$$Y_t = \alpha + a_1 Y_{t-1} + \cdots + a_p Y_{t-p} + b_0 X_t + \cdots + b_q X_{t-q} + \varepsilon_t$$

Or, in a more concise form:

$Y_t = \alpha + \sum_{i=1}^{p} a_i Y_{t-1} + \sum_{j=0}^{q} b_j X_{t-j} + \varepsilon_t$ …… **(3)**

The coefficient $b_0$represents the short-term effect of X_t on Y_t . To determine the long-term effect (δ) of X_t on Y_t , we start from the following long-term equilibrium relationship:

$Y_t = k + \delta X_t + u$, we will do:

$$\delta = \sum b_j \Big/ (1 - \sum b_i)$$

3.1. Data source and presentation of model variables.

The study is based on annual data extracted from the World Bank database (WDI) and the "Perspective Monde, 2024" website. The observation period extends from 1990 to 2022, covering a total of 33 years. The table below presents the different variables used in the analysis.

Table n°1: Presentation of the model variables

Variable retained	Description	Expected sign	Data source
INFL	Inflation, GDP deflator (annual %)		World Bank, 2024
COR	Commercial opening rate	-/+	Perspective Monde, 2024
GFCF	Gross fixed capital formation (% of GDP)	-/+	World Bank, 2024
GDPCG	GDP per capita growth (annual %)	-/+	World Bank, 2024
MS	Money supply (% of GDP)	-/+	World Bank, 2024

- ✓ **Inflation (INFL)**, measured by the annual growth rate of the GDP deflator, reflects the rate of change of prices in the economy. The deflator is the ratio of GDP in current local currencies to GDP in constant local currencies (World Bank, 2024);
- ✓ **Money supply (MS)** includes non-bank currency in circulation, demand deposits (excluding central government), time savings deposits, foreign currency deposits of residents (excluding central government), bank checks, certificates of deposit, and commercial paper (World Bank, 2024).
  According to the monetarist school, an increase in the money supply leads to an increase in aggregate spending in the economy, which increases aggregate demand and ultimately pushes prices up.The money supply (MS) is a key indicator of the country's monetary policy, and in the context of Burundi, expansionary monetary policies or the accumulation of liquidity by the government can cause inflation, especially if they are not accompanied by a corresponding increase in output.
- ✓ **Commercial openness ratio (COR)** is the sum of exports and imports of goods and services, expressed as a percentage of GDP. A higher percentage indicates a more open economy (World Outlook, 2024).
  Commercial openness (COR) measures the share of the economy that is exposed to international trade. High trade openness means that the economy is more vulnerable to changes in world prices. If Burundi relies heavily on imports, an increase in world prices can translate directly into an increase in domestic prices. The commercial openness ratio (COR) is a key variable for understanding the impact of international prices on inflation in Burundi. A high openness ratio, combined with a weak local

currency, can lead to a direct transmission of increases in world prices to the domestic economy, hence the importance of this variable in explaining inflation.

- ✓ **Gross fixed capital formation (GFCF)** (formerly called gross domestic fixed investment) includes improvements to land (fences, ditches, drains, etc.), plants, machinery, equipment, infrastructure, and buildings (schools, hospitals, etc.), as well as net acquisitions of high-value assets (World Bank, 2024).
  According to Keynesians, gross fixed capital formation (GFCF) stimulates aggregate demand and can have a direct impact on inflation. When firms invest in infrastructure and equipment, demand for goods and services increases, which can lead to inflationary pressure if production is inadequate. Gross fixed capital formation (GFCF) is essential to assess investment in the economy. In Burundi, where investment in sectors such as agriculture and infrastructure is crucial, increased investment could lead to increased demand and, consequently, pressure on prices, especially in the absence of sufficient production capacity.
- ✓ **The annual growth rate of GDP per capita (GDPCG)** measures the change in GDP per capita, adjusted to constant local currencies, without deductions for depreciation or loss of natural resources, expressed in constant 2010 dollars (World Bank, 2024). Strong economic growth (measured by GDP per capita) reduces inflationary pressure because it leads to an increase in the production and supply of goods and services. If growth is faster than the growth in demand, inflation can be contained. Conversely, growth that is too weak can lead to imbalances and inflationary pressures. The GDP per capita growth rate (GDPCG) represents the capacity of the economy to produce more goods and services per capita. In the case of Burundi, this variable can explain the evolution of inflation, especially when production stagnates or does not keep up with demand.

3.2. Model specification

If we aim to examine the economic determinants of inflation in Burundi, both in the short and long term, the ARDL representation is expressed as follows:

$$\Delta INFL_t = \beta_0 + \sum_{i=1}^{p} \alpha_1 \Delta \boldsymbol{INFL}_{t-1} + \sum_{j=0}^{q} \alpha_2 \Delta \mathbf{COR}_{t-1} + \sum_{j=0}^{q} \alpha_3 \Delta \mathbf{GFCF}_{t-1} + \sum_{j=0}^{q} \alpha_4 \Delta \mathbf{GDPCG}_{t-1} + \sum_{j=0}^{q} \alpha_5 \Delta \mathbf{MS}_{t-1} + \varphi_1 \boldsymbol{INFL}_{t-1} + \varphi_2 \mathbf{COR}_{t-1} + \varphi_3 \mathbf{GFCF}_{t-1} + \varphi_4 \mathbf{GDPCG}_{t-1} + \varphi_5 \mathbf{MS}_{t-1} + \varepsilon_t$$

Δ: Represents the first difference operator; β_0: Constant term; α_1,…,α_5: Coefficients measuring the effect of explanatory variables on short-term inflation; φ_1,…,φ_5: Parameters capturing the long-term dynamics of the model; ε~iid(0,δ): error term (white noise).

3.3. Stationarity test

Before estimating the ARDL model, it is imperative to check the stationarity of the time series. The most commonly used tests to check stationarity are the Augmented Dickey-Fuller (ADF) test or the Phillips-Perron (PP) test. If the series is stationary at level (I (0)), it can be directly included in the ARDL model. If the series is non-stationary but becomes stationary at first

difference (I (1)), it can also be included, but it cannot be used when it is integrated of order 2 (I (2)).

3.4. Selecting the optimal number of lags in an ARDL model

The selection of lags p and q for variables X_(t)and Y_(t)is a key step in the estimation of the ARDL model. The most used criteria for this selection are:

- ✓ **Akaike Information Criterion (AIC):**

AIC= − 2ln (L)+2 k

Where L is the likelihood of the model and k is the number of estimated parameters. AIC favors more complex models if the improvement in likelihood is significant.

- ✓ **Schwarz-Bayesian Information Criterion (BIC or SBC):**

BIC = − 2ln (L)+k ln(n)

Where n is the number of observations. BIC is stricter than AIC because it penalizes the addition of lags more, favoring more parsimonious models.

- ✓ **Hannan-Quinn information criterion (HQIC):**

HQIC = − 2ln (L)+2 k ln (ln(n))

HQIC is between AIC and BIC in terms of severity of the penalty.

It should be noted that we select the model with the weakest AIC, BIC or HQIC criterion. AIC tends to select more lags, which can be useful for capturing complex dynamics. BIC and HQIC select simpler models, leading to overfitting.

3.5. The Pesaran et al. (2001) cointegration test or bounds test

The Pesaran et al. (2001) cointegration test, called the bounds test, is used to check whether there is a stable long-term relationship between variables. This test is particularly useful in the ARDL model because it allows testing cointegration even when the variables are of mixed order (I (0) and I (1)).

In the context of our study, this model will take the following form:

$$\Delta INFL_t = \beta_0 + \sum_{i=1}^{p} \alpha_1 \Delta \boldsymbol{INFL}_{t-1} + \sum_{j=0}^{q} \alpha_2 \Delta \mathbf{COR}_{t-1} + \sum_{j=0}^{q} \alpha_3 \Delta \mathbf{GFCF}_{t-1} + \sum_{j=0}^{q} \alpha_4 \Delta \mathbf{GDPCG}_{t-1} + \sum_{j=0}^{q} \alpha_5 \Delta \mathbf{MS}_{t-1} + \boldsymbol{\theta u_{t-1}} + \varepsilon_t$$

In an error correction model (ECM), the term u_(t-1) represents the equilibrium error of the previous period. It therefore allows us to assess the extent to which the variable moves away from its equilibrium level over time. While the coefficient θ measures the speed of adjustment towards the long-term equilibrium or it indicates how quickly the dependent variable returns to its equilibrium level after a shock (after a disturbance). The Fisher test is applied to assess

the existence of a cointegration relationship between the variables in the model. Normally, the hypotheses are formulated as follows:

H_0 : b_(1)= …= b_(5)= 0: Existence of a cointegration relationship

H_1 : b_(1)≠… 〖≠b〗 _(5)≠ 0 : Absence d'une relation de cointégration

The test approach is based on the comparison of the Fisher statistic obtained with the critical values simulated by Pesaran et al. (2001). These critical values are classified into two categories:

- ✓ Lower bound: Corresponds to cases where the variables are stationary in level, i.e. integrated of order I (0);
- ✓ Upper bound: Represents situations where the variables are integrated of order I (1).

The test is interpreted as follows:

- ✓ If the Fisher statistic is greater than the upper bound, we conclude that cointegration is present;
- ✓ If the Fisher statistic is less than the lower bound, we reject the cointegration hypothesis;
- ✓ If the Fisher statistic is between the two bounds, the test is indeterminate and no conclusion can be drawn.

3.6. ARDL model estimation

The ARDL model estimation allows to simultaneously analyze the short- and long-term effects of the explanatory variables on the dependent variable. In the short term, the coefficients associated with the lagged variables reveal the adjustment dynamics and the immediate impact of economic shocks. In the long term, the equilibrium equation allows to identify the stable relationship between the variables, thus capturing the persistent effects of structural changes.

It should be recalled that the interpretation of the results of the short- and long-term adjustment model is based on the analysis of the coefficients and their significance.

3.7. Verification of the validity and robustness of the model

To ensure the validity and robustness of the results of the ARDL model, several diagnostic tests are performed:

- ✓ **Breusch-Godfrey error autocorrelation test:** This test examines the presence of autocorrelation of the residuals. An autocorrelation indicates that the errors are not independent over time;
- **Hypotheses and interpretation:**
  H0: No autocorrelation of errors.
  H1: Presence of autocorrelation of errors.
  If the p-value < 5%, there is autocorrelation of errors.
  If the p-value > 5%, absence of autocorrelation of errors.
- ✓ Breusch-Pagan homoscedasticity test: This test evaluates whether the variance of the residuals is constant (homoscedasticity) or variable (heteroscedasticity).
- **Hypotheses and interpretation:**
  H0: Homoscedasticity (constant variance of errors).

H1: Heteroscedasticity (variable variance of errors).
If the p-value < 5%, there is heteroscedasticity
If the p-value > 5%, the homoscedasticity hypothesis is accepted.

- ✓ **Shapiro-Wilk normality test:** This test checks whether the model residuals follow a normal distribution.

- **Hypotheses and interpretation:**
  H0: The errors follow a normal distribution.
  H1: The errors do not follow a normal distribution.
  If the p-value < 5%, the hypothesis of normality of the errors is rejected
  If the p-value > 5%, the errors are normal and the statistical tests remain valid.

- ✓ **Ramsey Model Specification Test RESET** (Regression Equation Specification Error Test): This test checks whether all relevant variables are included in the model. In other words, the test checks whether there are likely important variables that have been omitted.

- **Hypotheses and interpretation:**
  H0: The model is correctly specified.
  H1: The model is misspecified.
  If the p-value ≤ 5%, you will reject H0, which means that the model is misspecified.
  If the p-value > 5%, you accept H0, which means that the model is correctly specified.

- ✓ **Multicollinearity:** Multicollinearity occurs when some explanatory variables are highly correlated with each other.

- **The Variance Inflation Factor (VIF)** measures the inflation of the variance of a coefficient due to multicollinearity.
- A high **VIF (> 10)** indicates a collinearity problem that can bias the interpretation of the model.

- ✓ **CUSUM test of squares** (Cumulative Sum of Squares) and **CUSUM:** This test evaluates the stability of the model over time. It thus offers a more precise measure of structural stability.

- **Hypotheses and Interpretation:**
  H0: The model is stable.
  H1: The model is unstable.
  If the curve remains within the 5% confidence band, the model is stable.
  If the curve goes out of the limits, there is a structural change

4. Results of model estimations and discussions

Table n°2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
INFL	33	10.48199	7.324677	-2.850859	32.39779
COR	33	32.47064	8.340211	20.964	47.2
GFCF	33	11.26713	4.294404	2.781138	18.37487
GDPCG	33	-1.427048	3.244311	-13.29593	2.913068
MS	33	25.68959	9.617054	15.77853	56.62064

Source: Authors, from results obtained with STATA 16.

Graph n°2: Joint evolution of inflation and explanatory variables

Source: Authors, with STATA 16, from World Bank data (2024)

Table n°3: Dickey-Fuller Augmented (ADF) test results

Variable	Level		First difference		Integration degree
	t-statistic	p-value	t-statistic	p-value	
INFL	-3.572	0.0001*	-	-	I (0)
COR	-2.980	0.2153	-2.983	0.0000*	I (1)
GFCF	-2.980	0.3320	-2.983	0.0000*	I (1)
GDPCG	-2.980	0.0028*	-	-	I (0)
MS	-2.980	0.9989	-3.576	0.0004*	I (1)

Source: Authors, based on STATA 16 estimations

Table n°4: Results of the test for selecting the number of optimal lags

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-453.975				3.8e+07	31.6534	31.7273	31.8892
1	-382.29	143.37	25	0.000	1.6e+06	28.4338	28.8768	29.8482*
2	-360.555	43.469	25	0.012	2.3e+06	28.659	29.4711	31.2521

3	-339.699	41.713	25	0.019	5.1e+06	28.9447	30.126	32.7166
4	-275.804	127.79*	25	0.000	1.2e+06*	**26.2623***	27.8128*	31.2129

Source: Authors, from results obtained with STATA 16.

According to the table above, lag 4 is the one that minimizes the AIC (26.2623), making it the most suitable. This optimal lag choice was retained in order to reduce the forecast error while maintaining a simplified model and suitable for a limited sample size.

Table n°5: Results of the Bounds Cointegration test (Pesaran et al., 2001)

F-statistic = 32.832 *k= 4*		
Significant level	**I (0)**	**I (1)**
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06
t-statistic = -3.517 *k= 4*		
Significant level	**I (0)**	**I (1)**
10%	-2.57	-3.66
5%	-2.86	-3.99
2.5%	-3.13	-4.26
1%	-3.43	-4.60

Source: Authors, from results obtained with STATA 16.

Since 32.832 is greater than 4.01, the null hypothesis (H0) is rejected. The results show that there is a significant long-term relationship between the variables at the 5% level.

Table n°6: Long-term and short-term ARDL model estimations

ARDL (3,4,4,4,1) regression
R-squared = 0.9864
Adj R-squared = 0.9524

D.INFL	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. Interval]**	
Adjustment						
INFL						
L1.	-0.7310458	0.2078633	-3.52	0.008	-1.210379	-0.2517122
Long-run						
COR	0.8954909	0.4874652	1.84	0.104	-.2286059	2.019588
GFCF	-1.393789	0.8383269	-1.66	0.135	-3.326975	0.5393959
GDPCG	-3.352496	1.092573	-3.07	0.015	-5.871974	-0.8330174
MS	0.6659325	0.3285603	2.03	0.077	-0.091729	1.423594

Short-run						
INFL						
LD.	-0.3716592	0.1612988	-2.30	0.050	-.7436149	.0002965
L2D.	-0.360651	0.1064926	-3.39	0.010	-.6062234	-.1150786
COR						
D1.	-0.2946596	0.2505788	-1.18	0.273	-.8724953	.2831761
LD.	-0.9474833	0.2338998	-4.05	0.004	-1.486857	-.4081094
L2D.	-0.2089282	0.1777217	-1.18	0.274	-.6187552	.2008987
L3D.	0.2186201	0.1330783	1.64	0.139	-.088259	.5254992
GFCF						
D1.	2.023257	0.5347179	3.78	0.005	.7901955	3.256319
LD.	1.480155	0.4270167	3.47	0.008	.4954531	2.464858
L2D.	-0.901165	0.3710933	-2.43	0.041	-1.756908	-.0454222
L3D.	2.132689	0.2426954	8.79	0.000	1.573032	2.692345
GDPCG						
D1.	1.018129	0.3278646	3.11	0.015	.2620714	1.774186
LD.	1.987927	0.300186	6.62	0.000	1.295697	2.680157
L2D.	0.4032928	0.260272	1.55	0.160	-.1968955	1.003481
L3D.	0.8408569	0.2019048	4.16	0.003	.3752636	1.30645
MS						
D1.	-1.83618	0.2621882	-7.00	0.000	-2.440787	-1.231572
Cons	-16.67934	7.883418	-2.12	0.067	-34.85854	1.49985

Source: Authors, from results obtained with STATA 16.

In light of the table presented above, the coefficient of determination (R2) is equal to 0.9864, which means that 98.64% of the variation in inflation is explained by the independent variables used in the model (trade openness rate, gross fixed capital formation, GDP growth per capita, money supply). As the R2 is high and very close to 1, the model has a very strong explanatory capacity, which suggests that inflation in Burundi is strongly influenced by the economic factors studied, so policymakers could use these variables to better control inflation. In our model, the inflation adjustment coefficient is negative and significant (-0.7310, p = 0.008), which indicates a convergence towards long-term equilibrium after a shock. In other words, if inflation increases or decreases by 1%, the model estimates that 73.10% of the inflation imbalance is corrected each year. This adjustment speed is high, suggesting that the Burundian economy quickly corrects inflation gaps through market mechanisms or economic policies, particularly monetary and fiscal.

The results of this study first show the long-term relationships between inflation (INFL) and the explanatory variables: trade openness rate (COR), gross fixed capital formation (GFCF), GDP growth per capita (GDPCG) and money supply (MS).

The results reveal that a 1% increase in GDP per capita (i.e., the growth of wealth per person in the economy) would lead to a 3.35% reduction in inflation in the long term. Concretely, when Burundi's economy grows, income increases, which allows the population to consume more. This increases the supply of goods and services and could reduce inflationary pressures, hence a negative effect on inflation. A growing economy tends to reduce prices by improving productivity.

Money supply is significantly positive at 10%. The results indicate that a 1% increase in money supply (the amount of money in the economy) would lead to a 0.67% increase in inflation.

When money supply increases (if, for example, the Bank of the Republic of Burundi (BRB) prints more money), this can lead to inflation.

A 1% increase in the trade openness rate leads to a 0.90% increase in inflation in the long run, but this effect is not statistically significant ($p = 0.104$). In principle, trade openness can either reduce inflation (via the import of cheaper goods) or increase it (if the country is dependent on imports and vulnerable to fluctuations in world prices). In Burundi, the inflationary effect could be explained by a strong dependence on imports that exposes the country to international price shocks, a frequent depreciation of the Burundian franc (BIF) that increases the cost of imports and a structural trade deficit limiting the disinflationary effect of international competition. A 1% increase in gross fixed capital formation (GFCF) reduces inflation by 1.39% in the long run. However, this effect is not statistically significant ($p = 0.135$) at the 5% threshold. In Burundi, investment in infrastructure and productive capital can boost aggregate supply, thereby limiting inflationary pressures.

We also examine the short-run results of the model, taking into account Burundi's economic context.

A 1% increase in inflation in the previous period reduces current inflation by 0.37%. Similarly, a 1% increase in inflation two periods ago reduces current inflation by 0.36%. This suggests a self-correcting mechanism. The Bank of the Republic of Burundi (BRB) could respond to high past inflation by tightening its monetary policy (increasing policy rates or reducing the money supply), which slows inflation in subsequent periods. The market can also adjust prices downward if demand falls after a price spike. In other words, high inflation can reduce the demand for goods and services, thereby slowing price growth.

An immediate 1% increase in the trade openness rate reduces inflation by 0.29%, but this effect is not significant. In contrast, a 1% increase in the trade openness rate in the previous period lowers current inflation by 0.95%. This shows that the anti-inflationary effect of trade openness occurs with a lag. The Burundian economy, dependent on imports (food, fuel, manufactured goods), can see its prices fall thanks to the increase in the supply of cheaper goods. However, in the short term, this effect is mitigated by exchange rate fluctuations and high logistics costs.

A 1% increase in productive investments (GFCF) leads to an increase in inflation of 2.02% immediately, and of 1.48% in the following period. Paradoxically, after two periods, the effect becomes negative: a 1% increase in investments reduces inflation by 0.90%. Then, after three periods, the effect becomes strongly inflationary again (+2.13%). Public investments (roads, infrastructure, agricultural projects) are often financed by debt or budget deficits, which injects liquidity into the economy and stimulates demand, thus increasing prices in the short term before having disinflationary effects in the long term. After two periods, some of the projects begin to increase the supply of goods and services, which can calm inflation. In the long term, if these investments are not accompanied by increased productivity or increased production capacity, inflationary pressures return, especially in a country like Burundi where projects can be poorly managed or delayed.

A 1% increase in GDP per capita leads to an immediate increase in inflation of 1.08% and 1.99% in the following period. After three periods, the effect remains inflationary but more moderate (+0.84%). Growth in GDP per capita in the Burundian context can stimulate domestic demand (more income implies more consumption), but if supply does not increase sufficiently,

it pushes prices up. Since Burundi's productive structure is fragile and highly dependent on imports, this increase in demand mainly leads to imported inflation, as the country struggles to produce enough to meet domestic demand.

A 1% increase in the money supply reduces short-term inflation by 1.84%. This result may seem counterintuitive, since according to the quantity theory of money (MV = PY), an increase in the money supply should increase inflation. However, several explanations can justify this negative effect in the short term. An increase in the money supply reduces interest rates, stimulating investment and production, which can limit inflationary pressures. The improvement in credit conditions encourages companies to invest rather than increase prices immediately. Furthermore, if the injected money is saved rather than spent, the velocity of circulation decreases, reducing inflationary pressures. However, if this money creation becomes excessive without increasing production, this could eventually fuel inflation.

Table n°7: Test of normality of residuals, absence of autocorrelation, homoscedasticity and specification of the model

Hypothesis	***Test***	***Statistic***	***Probability***	***Remarks***
Normality	Shapiro-Wilk normality test H0: normality	1.244	0.10667	Normally distributed residuals
Serial correlation (LM)	Breusch-Godfrey H0: no serial correlation	3.642	0.0563	No serial correlation
Heteroskedasticity	Breusch-Pagan H0: Constant variance	0.04	0.8483	homoscedasticity
Specification error	Ramsey H0: model has no omitted variables	0.80	0.7356	The model has no omitted variables

Source: Authors, from results obtained with STATA 16.

We can conclude that the null hypothesis is accepted for all tests because, according to the above-mentioned results, their probabilities are greater than the 5% threshold.

Table n°8: Multicollinearity test results

Variable	**VIF**	**1/VIF**
FBCF	2.22	0.451372
TO	1.84	0.543453
MM	1.24	0.804971
CPIBH	1.14	0.874774
Mean VIF	1.61	

Source: Authors, from results obtained with STATA 16.

From the table above, all variables have a VIF (Variance Inflation Factor) less than 5 or 10. This suggests that there is no correlation between the explanatory variables retained by the

model. Thus, it becomes easy to isolate the effect of each explanatory variable on the dependent variable.

Graph n°3: Model stability tests

Source: Authors, obtained with STATA 16.

According to the graphs presented above, the curve remains confined within the control limits (critical boundaries), which attests to the stability of the ARDL model (3,4,4,4,1) over the entire period of analysis. This indicates that the results can be defined as reliable and generalizable to different periods. Therefore, if the model shows signs of instability, this calls into question the ability of the model to provide consistent forecasts or analyses over time. The developed model offers a faithful and robust representation of the economic dynamics studied, best reflecting the underlying economic reality.

In short, the results of the various tests carried out in Table n°7 and Graph n°5 suggest that the null hypothesis (H0) is accepted for all tests, because, according to the results above, their p-values are all greater than the 5% threshold. Therefore, we can conclude that the model presents normally distributed residuals, without autocorrelation, with a constant variance (homoscedasticity). The model is also correctly specified and stable, strengthening the validity of our estimates and the integrity of the econometric model used.

5. Conclusion

In this study, we explored the explanatory factors of inflation in Burundi using the ARDL model for the period from 1990 to 2022. The analysis produced significant and relevant results for understanding inflationary dynamics in the country. The main objective of this study was to examine the long-term and short-term relationships between inflation and several economic variables, including money supply, trade openness, gross fixed capital formation, and GDP per capita growth. The results show that inflation in Burundi is strongly influenced by these economic factors.

The coefficient of determination (R2) high at 0.9864 indicates that 98.64% of the variation in inflation is explained by the independent variables of the model, which confirms the strong explanatory capacity of our model and suggests that policymakers can use these variables to better control inflation.

The inflation adjustment coefficient is negative and significant (-0.7310, p = 0.008), indicating a rapid correction of inflationary imbalances in the long run. This suggests that the Burundian economy responds effectively to inflationary shocks, with 73.10% of the imbalance corrected

each year. This self-correcting mechanism is a positive sign of the economy's adjustment capacities through economic policies and market mechanisms.

The results of the study show several important relationships between inflation and the economic variables studied. A 1% increase in GDP per capita would lead to a 3.35% reduction in inflation in the long run, indicating that economic growth contributes to reducing inflationary pressures, due to an increase in income and the supply of goods and services. In contrast, a 1% increase in the money supply would lead to a 0.67% increase in inflation, suggesting that inflation may be fueled by excessive monetary expansion.

Trade openness showed a long-term inflationary effect, although this effect was not statistically significant, with a 1% increase in the openness rate leading to a 0.90% increase in inflation. This dynamic could be linked to Burundi's dependence on imports, thus exposing the economy to fluctuations in world prices.

Gross fixed capital formation showed a long-term disinflationary effect (-1.39%), but this effect did not reach a statistically significant threshold, suggesting that the impact of capital investment on inflation depends on the efficiency of investment projects and productivity improvement in the economy.

Short-term results also show interesting adjustments, with immediate and delayed effects of the variables studied. A 1% increase in productive investments (GFCF) leads to an immediate increase in inflation of 2.02%, but the effect becomes negative after two periods, suggesting that investments can have short-term inflationary effects before generating long-term disinflationary benefits. Similarly, an increase in the money supply reduced short-term inflation by 1.84%, which could be due to a strategic use of liquidity to finance deficits or urgent imports, but this policy carries long-term inflation risks if poorly managed. In sum, this study highlights that inflation in Burundi is strongly influenced by several economic factors. Burundian policymakers could use these results to adjust monetary and fiscal policies, including by controlling the money supply, supporting economic growth, and managing investments to minimize short-term inflationary effects. Prudent management of budget deficits and trade openness could also play a crucial role in stabilizing prices in the long term, while supporting the country's economic growth.

Although this study provides valuable insights into the determinants of inflation in Burundi, it has some limitations that should be highlighted. Although the ARDL model is appropriate for analyzing short- and long-term relationships, it does not necessarily capture non-linear effects or major structural changes that may have affected the Burundian economy, such as political crises or exogenous shocks. A complementary approach, such as a structural VAR model, could be considered.

The study focuses mainly on economic variables, but other dimensions, such as institutional factors (quality of governance, political stability) and external shocks (variations in commodity prices, regional crises, etc.), could also play a determining role in the evolution of inflation.

In light of these limitations, several avenues of research can be considered. It would be better to conduct a more in-depth analysis of structural changes in the Burundian economy, for example by integrating structural break variables, allowing to examine whether certain periods (such as financial or political crises) have had a significant impact on inflation. It would be relevant to examine in more detail the interactions between monetary policy and fiscal policy,

for example by assessing how the management of public deficits influences inflation through indebtedness or monetary financing.

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