

The Nature of Inflation-Growth Nexus in Tunisia: Empirical Study with ARDL Approach

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Abstract: *This paper examines the impact of inflation on economic growth between 1970 and 2020 using ARDL model. The results confirm a negative relationship between inflation and economic growth both in the short-term and in the long-term. We also found that money supply negatively affects economic growth in the long-term while it is fragile in the short-term. However, the exchange rate has a negative and insignificant impact on economic growth both in the short-run and in the long-run. Therefore, it is necessary to apply some recommendations to fight inflation by trying to moderate it which increases productivity and consequently affects economic growth positively.*

Keywords: *Economic growth; inflation; short and long-term analysis; ARDL; Tunisia.*

JEL Classification: *O11 ; E31 ; C22 ; O55*

1. Introduction

Over the past decades, macroeconomists, policymakers, and central banks in developed and developing countries have shown great interest in the link between inflation and economic growth. In particular, the question of whether inflation is necessary or detrimental to economic growth has sparked theoretical debates.

This question has its origin in the Latin American context of the 1950s, which provoked a debate between monetarists who believe that inflation is detrimental to economic growth and structuralists who believe that inflation is essential for economic growth.

Since 1960, different theoretical and empirical studies have showed that the relationship between inflation and economic growth may be positive (Mundell (1963), Tobin (1965), Rapach (2003), Benhabib and Spiegel (2009)), negative (Friedman (1956, 1977), Lucas (1973), Stockman (1981), Körmendi

and Menguire (1985), Orphanides and Solow (1990), Wang and Yip (1992), Cozier and Selody (1992), De Gregorio (1993), Motley (1994), Roubini and Sala-i-Martin (1995), Andres and Hernando (1997), Gillman et al. (1999, 2004), Gokal and Hanif (2004), Saeed (2007)) or neutral Wai (1959), Dorrance (1963, 1966), Sidrauski (1967)).

In the past decade, such empirical studies analysed the nature of the relationship between inflation and economic growth. Then, Vaona (2011) examined an endogenous growth version of the New Keynesian model with sticky wages and showed that the effect of inflation on growth can be either negligible or sufficiently negative depending on the elasticity of the labour supply.

Bittencourt (2012) examined the relationship between inflation and economic growth by using time series data about four Latin American countries between 1970 and 2007. He found that it had a negative effect in the region.

Barro (2013) examined the simultaneous effects of inflation on a large sample of countries and found that the inflation level had a negative and significant impact on growth. Furthermore, Hussain and Saeed (2014) studied the relationship between inflation and economic growth in Qatar from 1980 to 2011 using co-integration test and ECM. Their results found that inflation negatively affected the economic growth in the long-run (Umi & Izuchukwu 2016).

Mohseni and Jouzarayan (2016) examined the role of inflation on economic growth in Iran over the period from 1966 to 2012 using ARDL model and argued that inflation significantly and negatively affected economic growth. Similarly, Taiba, Karaachira and Bougersi (2021) tested the effect of inflation on GDP in Algeria using the ARDL model over the period 1980-2018. They showed that that inflation had a negative and significant effect on GDP in the long-run.

In Tunisia, the inflation-growth relationship between 1970 and 2010 was characterised by disturbances due to the main shocks recorded in this period such as the oil shock of 1973 and 1979, the debt crisis of 1982, the crisis of 1986 and the terrorist attacks of September 2001.

Because of these shocks, the Tunisian economy recorded high inflation rates with two historical rates since its independence in 1956 (14.9% in 1974 and 15.4% in 1982) with low economic growth rates recorded (-0.49% in 1982 and -1.44% in 1986).

Since the 2011 revolution, the macroeconomic management of the Tunisian economy has resulted in the decline in average economic growth

of 4.6% during the period between 2001 to 2010, to 1.5% over the period 2011-2019, with a deterioration of macroeconomic fundamentals such as inflation, which recorded very high rates especially in the post-revolutionary period compared to 2001-2010.

Also, the situation became worse with the COVID-19 pandemic. In 2020, despite the deceleration of inflation compared to 2019, the Tunisian economy recorded a low growth rate of -8.8% that represents the historical low growth rate in Tunisia since 1956. In that context, we attempt to answer the following issue: what is the nature of the relationship between inflation and economic growth? So, the aim of this article consists in analysing this relationship between 1970 and 2020 using the econometric technique of the Autoregressive Distribution Lag (ARDL) suggested by Pesaran et al. (2001).

The main sections in this article are divided as follows: In section 2, we present the methodology that was used to present our results in the section 3. Section 4 represents discussion and analysis of results. Finally, Section 5 offers conclusion and some policy implications.

2. Methodology

The economic literature interested on studying the nature of inflation effect on economic growth, has particularly favoured GDP growth as a reliable measure of growth. Then, we will use the growth rate of GDP as an indicator that measures economic growth.

The purpose of this study is to determine the nature of the relationship between economic growth and inflation. Thus, we will study this relationship in the Tunisian context between 1970 and 2019 using the Autoregressive Distributed Lag (ARDL) proposed by Pesaran et al. (2001) to overcome the limits associated with the methods proposed by Engle and Granger (1987) and Johansen (1991).

The most important advantage of this technique is that the limit test method is applicable for regressors of either pure I(0), pure I(1) or mixed cointegration. Therefore, this avoids the potential biases associated with unit root and cointegration tests.

The data of the variables considered in this study were taken from the World Bank Group for the period between 1970 and 2020 and are particularly for the case of Tunisia. Then, we considered the following specification:

$$\text{Growth}_t = \beta_0 + \beta_1 \text{INF}_t + \beta_2 \text{MS}_t + \beta_3 \text{EXR}_t + \varepsilon_t \quad (1)$$

where Growth represents the GDP growth rate, INF represents the inflation rate measured by CPI, MS represents the ratio between money

supply and gross domestic product, EXR describes the exchange rate on average against USD and ε_t is a random variable assumed as in the usual fashion to be serially uncorrelated with zero mean and constant variance. The parameters of the model measure the sensitivity of the variables to the economic growth.

In the first step, we used a unit root test and we chose the test of Dickey-Fuller (1979, 1981). The main objective of this test was to ensure that the variables were not I(2) in order to avoid erroneous results.

In the second step, we used the cointegration tests of Pesaran et al. (2001) and Narayan (2005). If the calculated F-statistic of these tests remained below the lower bound, we would conclude that the variables were I(0), so no cointegration was possible and if the statistic F-exceeded the upper limit, we would conclude that we had cointegration.

The ARDL procedure classifies variables as either dependent or explanatory. So, in this case, the error correction representation of the ARDL specification model for Eq. (1) is given by:

$$\Delta \text{Growth}_t = \delta_0 + \delta_1 \text{Growth}_{t-1} + \delta_2 \text{INF}_{t-1} + \delta_3 \text{MS}_{t-1} + \delta_4 \text{EXR}_{t-1} + \sum_{i=1}^p \beta_{1i} \Delta \text{Growth}_t + \sum_{i=0}^q \beta_{2i} \Delta \text{INF}_{t-i} + \sum_{i=0}^q \beta_{3i} \Delta \text{MS}_{t-i} + \sum_{i=0}^q \beta_{4i} \Delta \text{EXR}_{t-i} + \varepsilon_t \quad (2)$$

where Δ denotes the first difference operator, δ_0 is the drift component and ε_t is the usual white noise residual. The variables Growth, INF, MS and EXR are as defined earlier.

Thereby, the ECM model can be presented as follow:

$$\Delta \text{Growth}_t = \rho_0 + \rho_1 v_{t-1} + \sum_{i=1}^p \alpha_{1i} \Delta \text{Growth}_t + \sum_{i=0}^q \alpha_{2i} \Delta \text{INF}_{t-i} + \sum_{i=0}^q \alpha_{3i} \Delta \text{MS}_{t-i} + \sum_{i=0}^q \alpha_{4i} \Delta \text{EXR}_{t-i} + \xi_t \quad (3)$$

where ρ_1 represents error correction term coefficient. It measures the speed of correction of the model.

Finally, we applied diagnostic tests such as Breusch-Pagan-Godfrey test of Heteroskedasticity, ARCH test, Serial correlation LM test and Ramsey test to check the validity of our model and we examined the stability of the parameters in the models known as cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ). If the plots remain within the critical links of a 5% significance level, the null hypothesis of all coefficients in the given regression is stable and cannot be rejected.

3. Empirical results

We began firstly by testing the stationarity of variables. The results obtained in table (1) below show that the variables Growth and INF variables are stationary at level and that the variables MS and EXR are stationary at first difference. Therefore, these results confirm the adequacy and the application of the ARDL approach.

Table 1: ADF unit root test

ADF test	At level		At first difference	
	Constant	Constant and trend	Constant	Constant and trend
Growth	-5.259***	-7.105***	-11.750***	-11.663***
INF	-3.968***	-4.693***	-10.638***	-10.522***
MS	1.168	-0.607	-4.629***	-4.790***
EXR	2.768	0.068	-4.403***	-4.838***

Note: *** indicates significance at 1%

Table 2: Cointegration test

F-statistic: 17.156***

	Pesaran <i>et al.</i> (2001)		Narayan (2005)	
	I(0)	I(1)	I(0)	I(1)
10%	2.37	3.2	2.538	3.398
5%	2.79	3.67	3.048	4.002
2.5%	3.15	4.08	-	-
1%	3.65	4.66	4.188	5.328

Note: *** indicates significance at 1%

After testing the stationarity of variable, the ARDL bound test was used to examine the existence of a long-term relationship between variables. Then, the results in table (2) above show F-statistic is higher than the I(1) bound of Pesaran *et al.* (2001) and Narayan (2005) at 1% level and therefore there is a long-run cointegration relationship between variables in this model.

We now turned to the main objective of determining the nature of relationship between inflation and economic growth in Tunisia between 1970 and 2020 using the ARDL approach. Indeed, the results show that the effective model was presented by an ARDL (1,0,1,0).

The results of the short-run estimation in the table (3) below show that inflation has a negative and significant impact on economic growth. Also, the money supply has a negative and significant effect on economic growth but positive at first lag. Finally, the exchange rate has a negative but insignificant impact on economic growth.

Besides, the estimated coefficient of ECT_{t-1} is -1.259 which implies that the results support the existence of a long-run relationship between variables and that the deviation from the long-term growth path due to a certain shock is adjusted by 125.9% each year.

The long-run estimation represented in table (4) below show that inflation has a negative and significant effect on the economic growth with an elasticity equal to -0.350, which implies that a 1% increase of inflation decreases economic growth by 0.35%.

In addition, an increase of 1% in money supply decreases the economic growth by 0.163%. However, the exchange has negative and insignificant impact on economic growth.

Table 3: Short-run estimation

<i>Variables</i>	<i>Coefficient</i>	<i>Standard Error</i>	<i>T-Statistic</i>	<i>Probability</i>
Constant	19.238	3.473	5.538	0.000
Δ Growth _{t-1}	-0.259	0.138	-1.870	0.068
Δ INF _t	-0.441	0.145	-3.045	0.003
Δ MS _t	-0.756	0.135	-5.577	0.000
Δ MS _{t-1}	0.551	0.173	3.185	0.027
Δ EXR _t	-0.146	1.514	-0.096	0.923
$\rho_1(ECT_{t-1})$	-1.259	0.130	-9.673	0.000
R ²	0.73			

Table 4: Long-run estimation

<i>Variables</i>	<i>Coefficient</i>	<i>Standard Error</i>	<i>T-Statistic</i>	<i>Probability</i>
Constant	15.278	2.211	6.907	0.000
INF _t	-0.350	0.109	-3.216	0.002
MS _t	-0.163	0.063	-2.580	0.013
EXR _t	-0.116	1.203	-0.096	0.923

Table 5: diagnostic tests

<i>Tests</i>	<i>F-test</i>	<i>Probability</i>
Breusch-Pagan-Godfrey test	2.341	0.057
ARCH test	0.899	0.413
Serial correlation LM test	0.584	0.562
Ramsey test	0.155	0.877

The diagnostic tests results are illustrated in the table (5) above. It was validated that the error terms of the short-run model are free of heteroscedasticity, have no serial correlation and do not have a specification error.

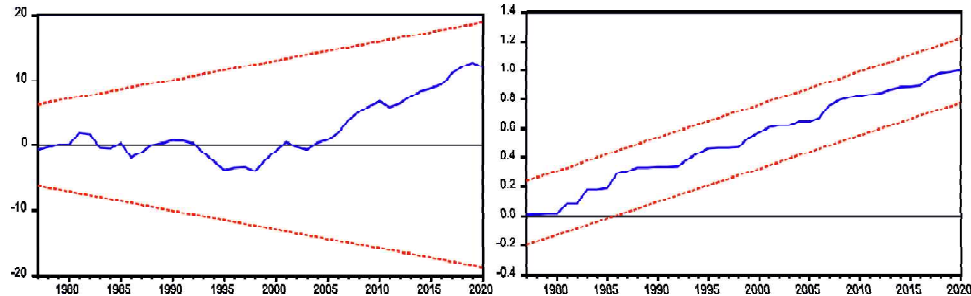


Figure 1: Plot of CUSUM and CUSUMSQ tests

Finally, we tested the stability of the long-term relationship between inflation and economic growth by relying on the CUSUM and CUSUM squared tests proposed by Brown, Durbin and Evans (1975). If the plot of the CUSUM and CUSUMSQ statistics remains within the 5% significance level then the model is stable. As can be seen in Figures (1), the CUSUM plot and the CUSUM squared statistics plot remain within the critical limits indicating the stability of the coefficients over the sample period.

4. Discussion

Our results are in agreement with the results of Cozier and Selody (1992), Wang and Yip (1992), Fisher (1993), De Gregorio (1993), Motley (1994), Roubini and Sala-i-Martin (1995), Andres and Hernando (1997), Gillman et al. (1999, 2004), Ahmed and Mortoza (2005), Vaona (2011), Bittencourt (2012), Barro (2013), Hussain and Saaed (2014), Umi and Izuchukwu (2016), Mohseni and Jouzarayan (2016), Taiba, Karaachira and Bougersi (2021)) as they all found a negative link between inflation and growth.

Contrarily, our results of the relationship between inflation are in opposition with the results of Dotsey and Sarte (2000) who argued that the relationship between inflation and economic growth is positive in the short-run and negative in the long-run. Also, our results are in contradiction to the results of Mallik and Chowdhury (2001), Rapach (2003), Benhabib and Spiegel (2009)) who found a positive relationship between inflation and economic growth.

Before COVID-19 and particularly between 2011 and 2019, inflation was characterised by higher rates through money creation against non-productive credits and BTA guarantee, inflation by wage costs because of the vicious circle of price increase, social demands and upward adjustment of wages not indexed to productivity, an imported inflation due to the sharp drop in the Dinar which leads to the rise in prices of raw materials and

therefore in the price of the final product, financial inflation where companies pass on the increase in the interest rate to the prices of their products and a structural inflation due to intermediation, speculation and inefficient distribution channels.

These factors lead to a considerable deterioration of the purchasing power of households. In addition, inflation harms the competitiveness of the Tunisian economy and it also harms savings by leading to a loss in the value of saving and reduced rate of return.

In 2020, inflation had been on a downward trend, going from 5.9% in January 2020 to 5.8% in February, followed by a transitory rebound to 6.3% during the months of sanitary confinement due to the Covid-19 pandemic. Then, there was a gradual decline from 5.4% from August to October to 4.9% in November and December.

However, the decline of GDP by -8.8% in 2020, after an increase of 1% in 2019, which was due to the general decline in economic activity and the tightening of the financial conditions put in place to fight inflation which was due to three main factors. Firstly, a negative supply shock that had a direct impact on the activity of several sectors. This shock was transmitted to other sectors causing indirect effects through a drop-in demand addressed to these sectors as intermediate consumption. Secondly, a reduction in household consumption due to confinement and the drop-in income for many of them. Thirdly, a reduction in external demand for certain exporting sectors due to the fact that the COVID-19 pandemic had also impacted Tunisia's main trading partners. These factors can explain the high negativity of Inflation-Growth relationship.

For the relationship between money supply and economic growth, our results comply with the results of Adeyeye et al. (2006), Suleiman (2010), Adusei (2013), Gatawa, Abdulgafar and Olarinde (2017) who empirically showed a significant and negative impact on economic growth.

In contrast, our results are not in confirmation with those of Chipote and Palesa (2014) where they used error correction model and Johansen cointegration test to examine the impact of monetary policy on economic growth and found an insignificant influence on economic growth in South Africa.

The results show that money supply has a negative impact on economic growth. This may prove that increasing the money supply "money creation" through credit targets consumption rather than investment which is the normal engine of economic growth. Also, the huge sums of liquid liabilities in Tunisia which reflect the high intensity of the banking system have a negative effect on economic growth.

In the case of exchange rate-growth relationship, our results are in confirmation with the results of Levy-Yeyati and Sturzenegger (2003), Reinhart and Rogoff (2004), Husain, Mody, and Rogoff (2004), Miles (2006) and Ziadi and Abdallah (2007)) as they found no significant impact on growth for developing countries.

Contrarily, our results do not confirm with the results of Aloui and Sassi (2005) who found that exchange rate regimes with an anchor point for the conduct of monetary policy, whether they are fixed or floating exchange rate regimes or intermediate regimes, exert a positive influence on the growth.

Also, our results contrast with Rabhi and Haoudi (2020) who studied the effects of the exchange rate on economic growth in Morocco during the period between 1988 and 2016 using the ARDL method and concluded that the real exchange rate may have a negative effect in the short-term but do not have an impact in the long-run.

Our results show that the exchange has an indirect and negative effect on economic growth and this direct effect is transmitted to prices in short and long-run. In other words, the short- and long-term effects of the exchange rate on economic growth and prices have shown that through import prices, the strong effect of the transmission of the exchange rate is reflected in the first step on domestic prices, that is to say that the depreciation of the domestic currency generates an increase in the price level which subsequently influences economic growth in Tunisia (Helali & Kalai 2015).

5. Conclusion and policy implications

This paper examines the relationship between inflation and economic growth in Tunisia between 1970 and 2020 using ARDL model. The results showed the existence of a long-run relationship between variables and confirmed the negative relationship between inflation and economic growth in short and long-run in Tunisia. Also, we found that in the long-run, money supply influences economic growth negatively. Nevertheless, the exchange rate has negative and an insignificant impact on economic growth.

So, to avoid the negativity of the relationship between inflation and economic growth, the monetary authorities and government must apply such reforms to fight inflation and avoid it in order to realise an economic recovery. Firstly, the Central Bank must increase interest rate so that people would prefer to save rather than invest and the money supply in circulation is reduced.

Secondly, the government must reduce public expenditures especially functional expenditures to avoid inflationary pressures and apply fiscal reforms that can boost investment. Further, a stable and healthy environment is needed to increase productivity.

In addition, the inflation in Tunisia has structural reasons linked to the existence of a large parallel economy. So, it is necessary to ensure a rapid upgrade of the distribution channels to guarantee the supply of the markets under normal conditions of regularity through the official channels and intensify border controls to fight smuggling, illegal exports and illegal imports.

Furthermore, small and medium-sized businesses must be encouraged to help them repay their credits by giving them grace periods for repayment because the COVID-19 pandemic has affected this type of businesses and many have gone bankrupt.

Also, inflation targeting question must be asked to decrease inflation pressures with an improvement of its communication policy and to set achievable targets that increase its credibility and give confidence to economic agents.

We propose as a research perspective to study the inflation-growth relationship in the case of the Maghreb countries or MENA region.

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