

# The ARDL Approaches to the Analysis of Level Relationship between Inflation and Exchange Rates in Tunisia

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**Abstract:** *This paper investigates the relationship between inflation and exchange rate in Tunisia. However, inflation is just one factor among many that combine to influence a country's exchange rate. To this aim we use a time series data focus specifically in annual data during the period 1984-2018. To understand more this relationship, we choose to use the Auto Regressive Distributive Lag model to explain the direct relationship between inflation and exchange rate.*

**Keywords:** *inflation, exchange rate, time series, ARDL model*

## 1. INTRODUCTION

The relationship between inflation and exchange rate has always been one of the importing subjects for economist. This subject has an importance especially in emerging economies where the volatility of the nature of prices is a major source of concern in all countries since 1970s<sup>1</sup>. In County like Tunisia, exchange rate fluctuations can significantly affect the general level of the prices.

Dornbush (1976) defined the exchange rate as the rate of change between two national currencies and their increasing will be exist in the overall level of prices. Therefore, in developing countries, it is necessary to implement real exchange rate policies to take domestic inflation into account in and to maintain stability in national production and international competition without falling into the foreign exchange bottleneck (Monfared and Akin 2017).

## 2. RELATIONSHIP BETWEEN INFLATION AND EXCHANGE RATE

A higher inflation rate will tend to reduce the value of the national currency. In fact, inflation means that goods increase in price quicker than other goods

in other country and goods become less competitive. Also, demand for exports will down. Therefore, the demand for national currency will be less<sup>2</sup>.

In this case, consumers will find it more attractive to buy imported goods this means that costumer tends to supply more of national currency to be able to buy an international one and international imports and this fact decreases the value of national money. Therefore, the relative change of the inflation rates in the long term should lead to another change in the exchange rates too (Gopinath 2015).

Competitive industry could be a solution of high inflation rate. Indeed, if a country product and manufacture goods, the demand supply will rise and national money will appreciate so the inflation will fall (Amadeo 2019)<sup>3</sup> like the example of United Kingdom and Germany in the post-war period when the Pound Sterling depreciated against the German Mark because German industry had been become more competitive than UK industry<sup>4</sup>.

Therefore, future inflation can be anticipated by financial markets if they see a policy causes inflation like cutting interest rates. The depreciation of exchange rate is likely caused increasing inflation which Import prices will be more expensive. However, appreciating exchange rate will tend to reduce inflation which Import prices will be cheaper (Monfared and Akin 2017).

The relationship between exchange-rate fluctuations and inflation varies considerably from country to other (Gopinath 2015). When a currency is used frequently to set the international prices, an asymmetric effect on exchange-rate fluctuations pass through to domestic prices. In this case, the rate of inflation will be more strongly affected by exchange-rate fluctuation. The relationship between exchange rate and inflation is explained for the first time by Dornbusch (1976) who is talked about market density, import volume, import substitute and domestic production channels (Monfared and Akin 2017).

The major transmission mechanisms mentioned by Monfared and Akin (2017) took the subject how exchange rate fluctuations affect inflation.

- The open economies which can affects the prices directly by the substitution between the price of imported substitute goods and the price of goods subject to trade, and indirectly by the augmentation of the price of the final goods through imported input prices.
- Fluctuation in the exchange rate is one of the transmission mechanisms which make uncertainties in foreign currency prices.

This fact affects domestic price makers and increase domestic prices.

- Exchange rate fluctuations can affect inflation by increasing prices by the means of wages (Milligan 2015)<sup>5</sup>.

### **3. INFLATION TENDENCY IN TUNISIA: GLOBAL OVERVIEW**

In Tunisia, the period 1963-1972 is characterized by a relatively weak rhythm of inflation and the first time when inflation accelerated in Tunisia is only in 1973 (the oil shock). This acceleration of the inflation rate is generated by the climb of the world prices following the increasing of the oil price. This augmentation decreased the demand and deteriorated the economic growth. To set a front of inflation, the authorities makers increased the currency offer and consequently the wages increased. However, this politics dragged an economic growth and aggravated the inflation.

The following period (1976 -1978), inflation in Tunisia decreased substantially and the GDP continued to grow following the enhancement of the products exported and the intervention of the General Case of Compensation (CGC).

The period 1979-1982 presented the second oil shock, inflation took an evolutionary tendency. This acceleration of the inflation was accompanied by an unfavorable economic conjuncture. During the period (1982-1986) inflation is characterized by a light deceleration. The next period (1987-1990) has been characterized by a stabilization of inflation rate. This result is due to an efficient management policy of the interior demand which based on a compression of the public expenses, a prudent salary politics and to the meandering of the inflation level in the countries partners.

During the period (1991-1994), inflation decreased and this decrease referred to the restraining budgetary and monetary policies. But, the increase of prices of consumption during the years 1993 and 1994 made inflation hary until 1995.

The period of 1996 to 2002 knew an important deceleration of the inflation rate. Among the factors that helped to master the general level of the prices is the pursuit of a rigorous monetary politics which assure a careful evolution of liquidities in conformity with the rhythm of creation of wealth (Mhamdi 2013).

To conclude, in Tunisia there are two main regimes of inflation:

- The first identified a low and stable inflation regime. This regime is over the period 2001–2009.

- The second regime associated a high level of inflation during 2009-2017.

The increase of inflation is alimeted by the climb of the prices of food products across of all product groups. In particular, on 2012, inflationary pressure has become inertial. To front of this issue, policy makers incited a new strategy in 2013 based on a neutral intervention strategy with the evolution of autonomous liquidity factors. Until 2015, Inflation has increased speedily. The depreciation of the national currency against the euro and the insufficient control of distribution circuits aggravated the situation. All of that reasons shows a sign of weakness of the economic system and the urgent need for monetary authorities to continue its efforts to liberalize prices (Loukil 2017).

Otherwise, inflation remains the main threat to the Tunisian economy. It stood at 7.5% for the whole year of 2018 against 6.4% in 2017, 4.2% in 2016 and 4.1% in 2015. To fight against inflation it is necessary to make control on the budget and on the currency (Mohsen 2019).

#### **4. EMPIRICAL RESULTS: AUTO REGRESSIVE DISTRIBUTIVE LAG (ARDL) METHODS**

Hendry is the closest method to classical research methods. He has presented a general specific modeling method inspired by Sargan (1964). To examine the relationship between inflation and exchange rate, we use for this aim the following model:

$$INF = \alpha + \beta EXR + \xi_t$$

This equation will be converted to double-log for the purpose of E-Views.

$$\text{Log INF} = \alpha + \beta \text{log EXR} + \xi_t$$

Here INF is the variable of annual inflation rate (2010=100) presented by Price Consumer Index during the period 1984-2018. EXR is the exchange rate presented annually by the variable the Exchange Rate. All data are explored by the World Bank Group. Therefore, economic expectation will increase the inflation rate when the exchange rate increases.

In fact, tests of stationary were done before predict the model. In this study, the ADF (Argumented Dikey Fuller) test was used to test whether the data contains unit root. The results are given in table 1.

Dickey and Fuller test use three equations (intercept, trend and intercept none)

$$\Delta y_t = \beta_1 + ZY_{t-1} + ai + \xi_t \quad (1)$$

$$\Delta y_t = \beta_1 + \beta_2 t + ZY_{t-1} + ai + \xi_t \quad (2)$$

$$\Delta y_t = ZY_t - 1 + ai + \xi_t \quad (3)$$

The hypotheses in this test are

$$\begin{cases} H_0 : \text{variable is not stationary} \\ H_1 : \text{variable is stationary} \end{cases}$$

**Table 1**  
**Stationary test results**

<i>Variable</i>	<i>Prob</i>	<i>ADF</i>	<i>Critical value</i>
Log INF	0%	7.945	2.954
Log Ex rate	0.02%	5.165	2.954

*Note:* Critical values indicate a level of significance of 5%. Values are t-statistic

As Table 1 shows, both of variable are significant and stationary at the first level. So, they are integrated in the same order I(1). But, the cointegration is not available because we don't have an efficient result to identify the number of cointegrated equation. So for this reason we use the ARDL model to show the level of relationship between inflation and exchange rate.

By the way, we remark that  $t_{stat} < 5\%$  and both of ADF are more than critical value. As a result, we cannot accept  $H_0$  rather we accept  $H_1$  meaning that variables are stationary and they don't have a unit root.

We must now identify the number of lag by using features of AIC and SIC criteria as the table 2 below shows:

**Table 2**  
**Stationary test results**

<i>Lag</i>	<i>AIC</i>	<i>SIC</i>
Lag 6	-1.19	-0.47
Lag 4	-1.22	-0.71
Lag 2	-1.38	-1.06

*Source:* E-views 8

These results show that the appropriate lag for testing the model is 2 which presents a low value of AIC and SIC criteria.

**Table 3**  
**Estimated General Model Result**

<i>Variable</i>	<i>Coefficient</i>	<i>t-statistic</i>
C	-0.020	-0.178
D(log-Inf(-2))	-0.505	-1.950
D(log-Ex rate(-1))	-0.207	-0.847
D(log-Ex rate(-2))	-1.217	-1.254
Log-Inf(-1)	0.807	0.993
Log-Ex rate(-1)	-0.013	-0.082
R <sup>2</sup> : 0.3413	AIC: -1.38	SIC: -1.06
Fstat: 2.15	DW: 2.08	

The ARDL model must have not serial correlation and must be stable. Our model hypothesis

$$\begin{cases} H_0 : \text{the ARDL model has not serial correlation if } P > 5\%. \\ H_1 : \text{the ARDL model has a serial correlation if } P < 5\%. \end{cases}$$

To test the ARDL model nicely, we must apply for Breusch-Godfrey test which can we help to identify the existence of serial correlation or not.

Effectively, the Breusch Godfrey test (table 4) mentions that the probability of Fstat is more than 5% so we can not reject H<sub>0</sub> rather we accept the null hypothesis.

**Table 4**  
**Breusch-Godfrey Test**

<i>Fstat</i>	<i>Prob</i>
0.812	0.455

We assume that our variables don't have a serial correlation so it is useful to know that the chosen model is stable or variant. Applying the Cusum test, we found that our model is stable (figure 1).

By the consequence, the result of our model is significant and we can apply for the Bound test (Table 5). This test studies if the ARDL model has a long run association ship between variables meaning inflation rate and Exchange rate.

The hypotheses in this test are

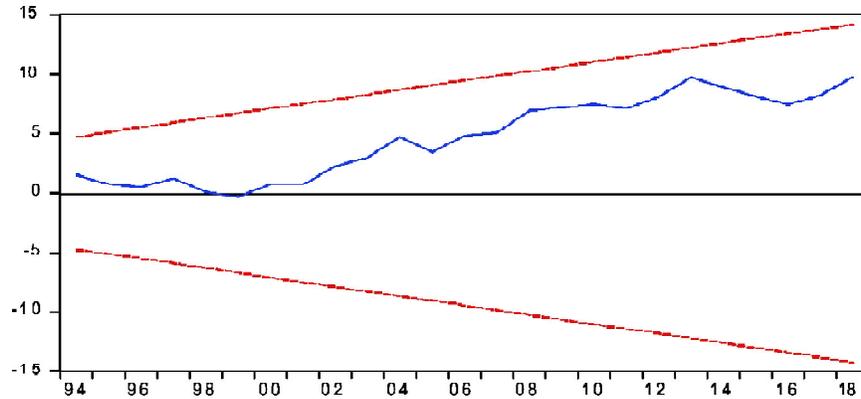


Figure 1: Stability test of inflation and exchange rate

$$\begin{cases} H_0 : C(6) = C(7) = 0 \\ H_1 : C(6) = C(7) \neq 0 \end{cases}$$

The null hypothesis means that the variables have not a long run associationship however the alternative hypothesis. In this test we should compare Fstat with the Pesaran critical value and 5%.

As the table shows, at the level of 5% the lower bound value is 3.79 and the upper bound value is 4.85.

The result shows that  $Fstat > 5\%$ , so we can reject the null hypothesis and this means that inflation and exchange rate move together and they have a long run relationship.

Table 5  
Wald test

Test stat	Value	Probability
Fstat	1.664	0.209

Source: Eviews 8

After testing the stability, trusting that all variables don't have a serial correlation and having a long run association ship, we can test the whole model by examining the Error Correction Term (ECT) (Table 6).

The current table shows that the value of ECT is negative and significant with a probability = 1.86% < 5%. This result allows to sum up that ARDL model is good to know the level of relationship between inflation and exchange rate in Tunisia.

**Table 6**  
**Test of the long run relationship of ECT**

<i>Variable</i>	<i>Coefficient</i>	<i>Probability</i>
C	-0.016	0.482
D(log_inf(-1))	0.434	0.239
D(log_inf(-2))	0.261	0.276
D(log_ex (-1))	-0.476	0.525
D(log_ex(-1))	1.641	0.023
ECT(-1)	-1.003	0.0186

Source: Eviews 8

In fact, the ECT presents the speed of adjustment in the long run back to the equilibrium. In this model, the speed of adjustment in the long run to back to the equilibrium is 100.3%.

Before testing the stability of ECT we need to show the test of Breusch-Godfrey (Table 7).

**Table 7**  
**Breusch-Godfrey test of ECT**

<i>F stat</i>	<i>Probability</i>
0.044	0.957

Source: Eviews 8

ECT has a  $P > 5\%$  meaning that the residual term hasn't a serial correlation. About stability we need to identify the cusum trend figuring in the figure bellow.

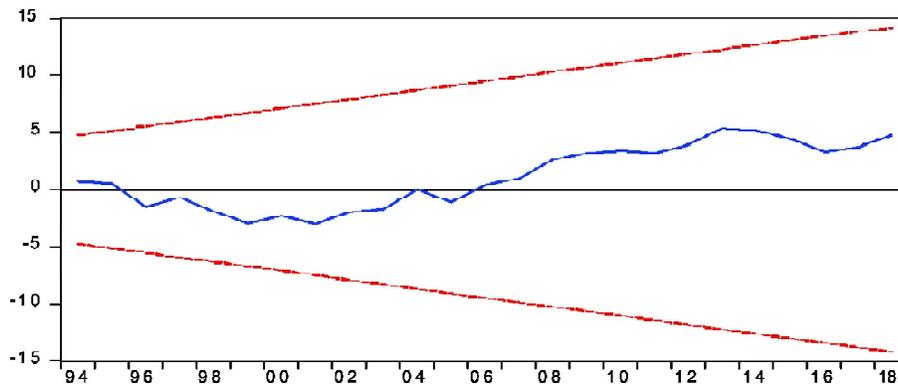


Figure 2: Stability test of ECT

Certainly, the ARDL model with lag=2 is the best one for testing the level of relationship between inflation and exchange rate. The stability of the model also the variables give a reasonably and significant.

Even though, the Error Correction Term is significant and stable. This term effectively presents the speed of adjustment of the whole system back to the equilibrium in the long run. The value of speed is shown very important and that means that exchange rate is the first responsible of grumping price and inflation in Tunisia.

## 5. CONCLUSION AND RECOMMENDATIONS

The purpose of this study is to investigate the relationship between the inflation and the exchange rate in the Tunisian Economy. For this aim, the relationship between inflation and exchange rate has been researched using the ARDL. According to the results, inflation and exchange rate have a strongly association ship in the long run. In Tunisia, inflation and exchange rate move together meaning that exchange rate effects positively the inflation in the long run and we assume that inflation in Tunisia is largely due to importation.

For these reasons we must act against this mainly source of inflation by improving productivity and encourage national production, acting on the interest rate, intensifying border control to fight against smuggling, illegal export and wild import briefly reducing parallel economy.

## NOTES

1. Web site visited <http://economics.fundamentalfinance.com/exchange-rate-and-inflation-in-pakistan.php> on 28/07/2019
2. Information traited by the web site <https://www.investopedia.com/articles/forex/080613/effects-currency-fluctuations-economy.asp> visited on 28/07/19
3. Web site <https://www.thebalance.com/causes-of-inflation-3-real-reasons-for-rising-prices-3306094> visited on 28/07/2019
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