Short and long-run determinants of inflation in Tunisia

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Abstract

The depreciation of the national currency, the higher wage costs passed on to prices and the growing external debt, has characterized the Tunisian economy for almost a decade. In this context we investigate its inflation dynamics to understand which variables affects it in the short and the long run. We apply the Autoregressive Distributed-lagged model over quarterly data from 2010 to 2019 alongside the bound testing approach. Our results suggest a significant impact of external debt and loans on inflation in the short and long run, while GDP growth affects inflation only in the long run.

Keywords: Inflation, ARDL, Tunisia.

JEL classification: C01, E31

1. Introduction

Inflation hardens the condition of market financing because creditors require a high risk premium which increases the interest rate at which the country can borrow. Bildirici and Ersin (2007) state that increasing debt to GDP ratios lead economies with high inflation to borrow at higher cost and with low maturity. According to the economic literature the growth of debt is inflationary when the majority of that debt is external. Kwon et al (2006) investigate the relationship between debt and inflation for a panel of countries and found that an increase in debt leads to inflation in highly indebted countries. Kannan and Singh (2009) found a negative impact of debt on inflation and output in India. Reinhart and Rogoff (2009) and Reinhart and Rogoff (2010) find a relation between high government debt ratios and inflation among emerging economies who suffer from a growing debt ratio. For African countries, Lopes and al. (2015) found that debt has a positive impact on inflation. But even if the debt is meant to finance development projects, part of it finances consumption. Household favors present consumption on future consumption which encourages them to ask for loans, firms use debt, which cost has been reduced by inflation, to increase their investment capacity.

If inflation finds some of its roots in debt; according to Blanchard (1986) it can be fed by the wage price spiral through both an increase in the real wage demanded by workers and firms efforts to increase mark-up profits. But for the case of developing countries, the results are controversial, while some found a significant relationship between wage and consumer prices, others like Dornbusch and Wolf (1990) and Moser (1995) did not. Inflation also increases the real exchange rate of a currency, which penalizes the competitiveness of the economy due to a deterioration of its trade balance. Hossain (2002) and Cerisola and Gelos (2009) found evidence of a negative correlation between exchange rate and inflation for developing economies and emerging countries respectively.

In this paper we use Autoregressive Distributed-lagged model (ARDL) to analyze Tunisian public debt impact on inflation using quarterly data over the last decade. ARDL model was introduced by Pesaran and al. (2001) and it's preferable when variables are integrated in different order.

The paper is organized as follows. Section 2 presents the model. Section 3 details the results, while Section 4 contains the concluding remarks.

2. The model

Data are collected from the international monetary fund (real effective exchange rate), the national institute of statistics of Tunisia (inflation, wage and gdp growth) and the central bank of Tunisia (loans and external debt). We estimate the following $ARDL$ specification:

$$\boldsymbol{p_t = \theta_0 + \sum_{i=1}^{m} \zeta_i lp_{t-i} + \sum_{i=1}^{n} \xi_i ld_{t-i} + \sum_{i=1}^{o} \varsigma_i lw_{t-i} + \sum_{i=1}^{p} \tau_i ll_{t-i} + \sum_{i=1}^{q} \psi_i le_{t-i} + \sum_{i=1}^{r} \varrho_i lg_{t-i} + u_t} \quad (1)$$

All variables are in Log, with: p, d, w, l, e and g respectively inflation, external debt, wage, loans, real effective exchange rate and GDP growth. The number of lags (m,n, o, p, q) is determined by selection criteria.

After the estimation of the $ARDL$ (m, n, o, p, q, r) specification and the calculation of the associated long-run multipliers, the final step is the estimation of the short-run dynamic coefficients via the following error correction model:

$$\boldsymbol{\Delta p_t = \alpha_1 + \sum_{i=1}^{m} \delta_i \Delta p_{t-i} + \sum_{i=1}^{n} \kappa_i \Delta d_{t-i} + \sum_{i=1}^{o} \varpi_i \Delta w_{t-i} + \sum_{i=1}^{p} \chi_i \Delta l_{t-i} + \sum_{i=1}^{q} \omega_i \Delta e_{t-i} + \sum_{i=1}^{r} \beta_i \Delta g_{t-i} + \lambda ECM_{t-1} + \vartheta_t} \quad (2)$$

Let $\boldsymbol{ECM_{t-1}}$ be an error correction term resulting from the long-run equilibrium relationship and $\boldsymbol{\lambda}$ a parameter of the speed of adjustment to the equilibrium level after a shock.

$$\boldsymbol{\Delta x_t = \varphi + \sum_{i=1}^{n} \Phi_i x_{t-i} + \lambda ECM_{t-i} + \epsilon_t} \quad (3)$$

Let $\boldsymbol{x_t}$ be the 6×1 vector variables$(\boldsymbol{p, d, w, l, e, g})$, $\boldsymbol{\varphi}$ a 6×1 vector of constant terms, $\boldsymbol{\Phi_i}$ is a 6×6 matrices including the interaction coefficients of the variables, $\boldsymbol{\lambda}$ a 6×1 vector of coefficients for the error correction terms and $\boldsymbol{\epsilon_t}$ a vector of disturbance terms.

3. Results

In the case of ARDL models, it is important that no series is integrated of order two or higher. Therefore we apply the Augmented Dickey-Fuller (1979) test to make sure the variables in our sample are at most integrated of order one and to avoid wrong specification and spurious estimation.

Table n°1: Unit root test

	Level			1st difference		
	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None
inf	-1.338	-0.905	-1.315	-5.040	-5.288	-5.169
	(0.593)	(0.939)	(0.169)	(0.001)	(0.002)	(0.000)
debt	-1.597	-2.674	0.0897	-4.724	-5.471	-5.541
	(0.471)	(0.254)	(0.703)	(0.001)	(0.001)	(0.000)
wage	-2.570	-3.077	-0.225	-8.104	-7.910	-8.273
	(0.112)	(0.134)	(0.595)	(0.000)	(0.000)	(0.000)
loan	-1.421	-0.138	-1.642	-3.864	-4.584	-3.758
	(0.555)	(0.991)	(0.094)	(0.007)	(0.0066)	(0.001)
reer	-1.649	-2.171	0.216	-3.546	-3.619	-3.524
	(0.445)	(0.486)	(0.742)	(0.014)	(0.047)	(0.001)
gdp	-1.754	-3.399	-0.376	-5.715	-5.721	-5.946
	(0.393)	(0.075)	(0.538)	(0.000)	(0.001)	(0.000)

The results of unit root tests show that all series are stationary processes in first difference. Now we check optimal lag order for each variable considered, the result in Table 1 indicate that one maximum lag is the optimal choice based on the Final prediction error (FPE), the Akaike information criterion (AIC), the Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ).

Table 2 Lag Length Selection

Lag	LogL	FPE	AIC	SC	HQ
0	-336.5752	1707.139	24.46965	24.75513	24.55693
1	-236.3509	18.53939*	19.88221*	21.88051*	20.49311*

The results in the table above indicate that the optimal choice for all series is one lag at most. Next we check the cointegration between the variables in our model in the short run using the Granger (1969) causality test.

Table 3 Granger causality test

Null Hypothesis	F-Stat	Prob	Null Hypothesis	F-Stat	Prob
wage does not cause inf	2.502	0.126	inf does not cause wage	0.220	0.643
loan does not cause inf	1.398	0.248	inf does not cause loan	4.305	0.048
debt does not cause inf	1.735	0.199	inf does not cause debt	0.496	0.488
reer does not cause inf	3.542	0.072	inf does not cause reer	0.724	0.403
gdp does not cause inf	0.143	0.709	inf does not cause GDP	2.127	0.157
loan does not cause wage	1.695	0.205	wage does not cause loan	0.945	0.340
debt does not cause wage	0.818	0.374	wage does not cause debt	0.138	0.713
reer does not cause wage	0.033	0.858	wage does not cause reer	0.088	0.769
gdp does not cause wage	0.058	0.812	wage does not cause gdp	0.171	0.683
debt does not cause loan	3.336	0.080	loan does not cause debt	0.146	0.706
reer does not cause loan	0.099	0.754	loan does not cause reer	0.111	0.742
gdp does not cause loan	8.001	0.009	loan does not cause gdp	0.005	0.942
reer does not cause debt	0.757	0.392	debt does not cause reer	0.431	0.518
gdp does not cause debt	0.099	0.755	debt does not cause gdp	0.563	0.460
gdp does not cause reer	0.032	0.859	reer does not cause gdp	0.085	0.773

The results in the Table above show the existence of a causal relation for all variables except from inflation to loan and from GDP to loan at 5% and 1% level respectively. To check cointegration in the long run we use the johansen (1991, 1995) cointegration test.

Table n°4: Johansen cointegration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.
None *	0.797512	124.4239	95.75366	0.0001
At most 1 *	0.787259	81.30291	69.81889	0.0046
At most 2	0.492643	39.51557	47.85613	0.2403
At most 3	0.329219	21.19500	29.79707	0.3456
At most 4	0.288887	10.41355	15.49471	0.2503
At most 5	0.043776	1.208594	3.841466	0.2716
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.
None *	0.797512	43.12098	40.07757	0.0220
At most 1 *	0.787259	41.78734	33.87687	0.0046
At most 2	0.492643	18.32058	27.58434	0.4686
At most 3	0.329219	10.78145	21.13162	0.6691
At most 4	0.288887	9.204955	14.26460	0.2695
At most 5	0.043776	1.208594	3.841466	0.2716

The results displayed in the table above prove the existence; at 5% level, of two long run relationship in our set of variables according to both the Trace and the Max-eigenvalue tests.

Now that we have confirmation about the existence of long run cointegration, we proceed to the bound testing approach.

Table 5 Results of the ARDL cointegration and diagnostic tests

Lag order	F-stat	Critical values	Lower bound	Upper bound	χ^2NORMAL	χ^2SERIAL	χ^2ARCH
(1, 0, 1, 1, 0, 1)							
	7.97	10%	2.08	3	0.032	0.792	0.752
		5%	2.39	3.38	(0.984)	(0.387)	(0.668)
		2.5%	2.7	3.73			
		1%	3.06	4.15			

The F-statistic exceeds the upper bound for all critical values as expected, since the null hypothesis of no conintegration has been already rejected by the Johansen cointegration test. The normality behavior is confirmed by the Jarque–Berra test. The null hypothesis H_0 for both Breusch-Godfrey serial correlation LM and the ARCH tests are rejected at 5% level, which means the absence of serial correlation and heteroskedasticity in our estimation.

Table 6 The results of the short run and long run

inf	debt	wage	loan	reer	gdp	ECT (− 1)
			Short-run results			
-	0.111 (0.000)	-	-0.125 (0.006)	-	0.102 (0.135)	-0.974 (0.000)
			Long-run results			
-	0.045 (0.065)	0.248 (0.442)	-0.224 (0.017)	-0.0246 (0.191)	-0.146 (0.027)	

Neither real effective exchange rate nor wage growth affects inflation directly. The External debt and loans have a significant impact on inflation, at 1% level in the short run; 10% and 5% respectively in the long run. The gdp growth only affects significantly inflation, at 5% level, in the long run. The bounds test results are in accordance with the johansen cointegration test done previously, which confirmed the existence of two long run relationships at 5% level.

4. Conclusion

Inflation rises in the presence of upward pressure on wages or when economic growth is higher than its sustainable rate, which happens if aggregate demand rises faster than aggregate supply. But inflation also happens despite low economic growth when production costs are higher. The Tunisian economy faced both demand and cost push shocks in the last decade, significant rise in wages and a depreciation of the national currency in a context of rising debt. In this paper we focused on the dynamic of inflation, we used quarterly data in a sample from 2010Q4 to 2019Q4 to determine which variables affect it on the long run. We employed the Autoregressive Distributed-lagged model (ARDL) and Bounds Test; the specification ARDL (1, 0, 1, 1, 0, 1) fits better the data. We confirm that in in the short run inflation is determined by both loans and external debt evolutions. We also found that loans and GDP growth had a significant impact on inflation on the long run at 5% level, while external debt affected inflation with a 10% level of significance.

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