Journal of Economics and Public Finance
ISSN 2377-1038 (Print) ISSN 2377-1046 (Online)
Vol. 11, No. 4, 2025
www.scholink.org/ojs/index.php/jepf

Original Paper

Dynamic Links between Exchange Rate, Inflation and Economic Growth in Tunisia

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Abstract

This paper investigates the dynamic links between the exchange rate (T), the inflation (I) and the economic growth measured by (GDP) in Tunisia, using annual data during the period 1998–2014. First, we implement unit root analysis to test the stationary. The study makes use of both primary and secondary data and VAR Granger Causality/Block Exogeneity Wald Tests was adopted as the estimation techniques. Granger causality results reveal that there is a bidirectional causal link between the inflation and economic growth and a unidirectional causal link running from the inflation to the exchange rate. This study provides some implications regarding potential constraints on monetary policy.

Keywords

exchange rate, inflation, economic growth, Granger causality, Tunisia

1. Introduction

The choice of exchange rate regime and its effect on economic performance is among the most contentious issues in economic policy. In fact, according to Rodrik (2008), economists have long known that poorly managed exchange rates can be disastrous for economic growth. The exchange rate channel of monetary policy is important for many developing countries as Tunisia. According to the seminal work by Meese and Rogoff (1983), the underlying economic fundamentals often fail to explain short-term volatility in exchange rates.

Over the period 1980-2014, the Tunisian economy has undergone many transformations and shock. The early of eighties marked by a reduction in income transfers from Tunisian workers abroad, a decline of agricultural production due to the drought and the production of hydrocarbons as well as by a fall their price. The wave of economic and corporate reform with the introduction of the structural adjustment program (SAP) in 1987, the real exchange rate has depreciated sharply over the period 1986-1988. From the second half of the eighties and during the ninety years, the tradable sector recorded a net increase of productivity, while the sheltered sector experienced a less pronounced growth. This increase in

productivity in the tradable sector was accompanied by a steadier growth of wages in this sector. Finally, over the same period the real exchange rate has been appreciated. Starting at 2011, the Tunisian economy has been known by an exceptionally and difficult environment, both in terms of the internal situation after the Revolution of January 14, which was marked by strikes and social demands, and externally due to the impact of public debt crisis in the euro zone and the Libyan revolution, particularly on exports and tourism. Thus, the decline in activity in most sectors, especially mining, processing phosphate, oil, tourism and transport, has resulted in negative economic growth, or -1.8% against 3 % in 2010. Compared to the end of 2010 and through December 2011, the dinar exchange rate on the interbank market has known a down of 9.7% on the Japanese yen by 4.1% with respect the US dollar, 1.6% against the Moroccan dirham and 0.8% against the euro. This monetary deterioration engenders a price increase. In fact, the inflation rate rose in May 2014 standing at 5.4% against 5.2% in April and 5% in March, according to statistics from the National Institute of Statistics (INS).

Most economics researchers agree that inflation rate has consequences for economic growth (Boschi & Cirardi, 2007, Barro, 2013 and Jalil et al., 2014). In fact, numerous studies in the literature have shown that mild and stable inflation makes it easier for the policy makers and businesses to make investment decisions and for wages to rise. In fact, numerous studies in the literature have revealed that weak and stable inflation makes it easier for the policy makers and businesses to make investment decisions and for wages to rise. In addition, the case for supporting stock market development for the sake of fostering economic growth has been stated in the literature on economic growth and development (Arestis et al., 2001; Domac & Yucel, 2005; Enisan & Olufisayo, 2009; Hou & Cheng, 2010).

This paper aims to explore the causal relationships between the three key variables in our analysis: economic growth, inflation, and exchange rate for Tunisia. Unlike other studies, which consider possible links between two of these variables at a time, we investigate the possible nexus between all three using a trivariate framework. Furthermore, and contrary to earlier work, this paper reports on the causal relationships among the three variables by using the VAR Granger causality/block exogeneity Wald tests. Our estimation method allows for more robust estimates by utilizing variation between all variables well as variation over time.

The remainder of this paper is organized into five sections. Section 2 introduces the used model and describes the data used in the empirical analysis. In the section 3, we analyses the stationary of the variables. In Section 4, we report the main empirical findings based on the granger causality results. Section 5 gives conclusions and discussion.

2. Data and Method Specification

The objective of present study is to investigate the linkages between exchange rate, Inflation and economic growth in case of Tunisia using annual data over the period of 1980–2014. The data were drawn from the International Monetary Fund (IMF) and, International Financial Statistics (IFS).

- E: Real effective exchange rate index (2010 = 100)
- I: Inflation, average consumer prices; Units: Index
- GDP: Gross domestic product, current prices; Units U.S. dollars (Billions)

Table 1 summarises the descriptive statistics associated with the studied variables. The empirical study is based on 35 quarterly observations. We find that inflation, exchange rate and economic growth are normally distributed. It is confirmed by findings of the Jarque–Bera normality test.

We applied thevector autoregressive (VAR) model to examine the relationship between inflation, exchange rate and real GDP. This technique was popularized by Sims (1980). The VAR model provides a multivariate framework where changes in a particular variable are related to changes in its own lags and the lags of other variables. This is a reduced-form of VAR since the dependent variable is expressed in terms of predetermined lagged variables. The advantage of VAR approach is that unknown relationships between variables are considered as endogenous in the system as the variables relationship is simultaneously determined. The VAR model could be simplified as follows:

$$y_t = \beta + A_1 y_t + \cdots + A_p y_{t-p} + Bz_t + \varepsilon_t$$

Where (y_t) is a vector of endogenous variables, (β) is an intercept, (z) is a vector of exogenous variables, (A_1) and (B) are coefficient matrices, (p) is the lag length and (ε_t) is an unobservable zero-mean white noise.

Table 1. Summary of Descriptive Statistics for Each Series

Variables	I	E	GDP
Mean	23.77737	2989.754	67.44849
Median	21.28300	125.5860	70.34900
Maximum	48.63300	100000.0	120.7760
Minimum	8.900000	94.95400	22.21700
Std. Dev.	13.50257	16880.06	27.24873
Skewness	0.594616	5.659401	0.052695
Kurtosis	1.948283	33.02903	2.065226
Jarque-Bera	3.675558	1501.876	1.290492
Probability	0.159171	0.000000	0.524534
Sum	832.2080	104641.4	2360.697
Sum Sq. Dev.	6198.863	9.69E+09	25244.78
Observations	35	35	35

3. Unit Root Test

The first step was to determine whether the selected variables are stationary and integrated of the same order. Thus, a unit root test—namely, the augmented Dickey Fuller (ADF) unit root test initially

introduced by Dickey and Fuller, 1979 and Dickey and Fuller, 1981—was used. Unit root tests are generally employed in order to identify the variables that belong to a stationary series. The null hypothesis of the test is that the variables have a unit root. To test the unit root hypothesis, the following regression of the ADF test was utilized (Jääskelä & Jennings, 2011):

$$\Delta x_t = (\rho - 1)x_{t-1} + \sum_{i}^{n} \varphi_i \Delta x_{t-i} + \mu_t$$

where x_t is the variable in period t; Δ denotes the first difference; μ_t is the disturbance term with a mean 0 and a variance σ^2. The null hypothesis is H_0: $\rho = 1$; when $\rho = 1$ cannot be rejected, we can identify that the series is non-stationary.

the second test is a number of Phillips-Perron Unit root tests (PP) which developed by Phillips and Perron (1988) and that have become popular in the analysis of financial time series. The (PP) differ from the Dickey–Fuller (ADF) tests of mainly in how they deal with serial correlation and heteroskedasticity in the errors. In particular, where the Dickey–Fuller ADF tests use a parametric autoregressive to approximate the ARMA structure of the errors in the test regression, the Phillips-Perron tests ignore any serial correlation in the test regression. The test regression for the PP tests is:

$$\Delta x_t = \beta' D_t + \pi x_{t-1} + \mu_t$$

Where μ_t is $I(0)$ and may be heteroskedastic.

We conduct tow different unit root tests, namely augmented Dickey–Fuller (ADF) and Phillips-Perron (PP), and the ADF and PP tests suggest stationarity at least at the 5 % significance level. According to these results, it was assumed that all the time series are stationary after one differentiation. Table 2 shows that for all variables, we cannot reject the unit root test. Thus, they are integrated with order one (I (1)) and stationary in first difference. Following these results, we can use the VAR model, which deals the short-term relationship, (Ben Mbarek et al., 2015). The optimal lag length of the VAR model was examined by the information criterion of Akaike (AIC), Schwartz (SIC), Likelihood Ratio (LR) and Hannan-Quinn (HQ) which is equal to one.

Table 2. Unit Root Test (ADF and PP)

variables	level			1st Difference		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
ADF Test						
I	4.179771	1.338329	-1.974680	-3.415838***	-4.658805***	-4.974879***
E	-5.732796***	-5.835106***	-6.056863***	-9.797936***	-9.643629***	-9.489934***
GDP	1.757535	2.359445	1.281071	-2.294196***	-4.335558***	-4.619334***
Phillips–Perron test						
I	4.179771	1.338329	-1.974680	-3.393975***	-4.658805***	-4.943304***
E	-5.732796***	-5.835691***	-6.353018***	-33.12145***	-32.40720***	-31.69057***

GDP	6.887828	1.207969	-0.801858	-3.715674***	-4.245012***	-4.510412***

(i): Without intercept, (ii): with an intercept, and (iii): with an intercept and trend. ***, ** and *: asterisks mean a p-value less than 1%, 5% and 10%. Critical levels in the model: (i) −2.60 (1%), −1.95 (5%) and −1.61 (10%). Critical levels in: (ii) −3.51, −2.89 and −2.58.Critical levels in: (iii) −4.04, −3.40 and −3.15.

4. Causality Links between E, I and GDP

Angle and Granger showed that if the series X and Y (for example) are individually I(1) then there would be a causal relationship at least in one direction. Granger-causality test is a convenient approach for detecting causal relationship between two or more variables. A time series (X) is said to Granger-cause another time series (Y) if the prediction error of current Y declines by using past values of X in addition to past values of Y.

The equation of conventional Granger test could be written as

$$Y_t = \gamma + \sum_{i=1}^{m} \alpha_i Y_{t-i} + \sum_{j=1}^{n} \beta_j X_{t-j} + \varepsilon_t$$

To detect the causal relationship between exchange rate (E) and GDP is defined as follows:

$$GDP_t = \gamma + \sum_{i=1}^{m} \alpha_i E_{t-i} + \sum_{j=1}^{n} \beta_j GDP_{t-j} + \varepsilon_t$$

$$E_t = \gamma + \sum_{i=1}^{m} \alpha_i E_{t-i} + \sum_{j=1}^{n} \beta_j GDP_{t-j} + \varepsilon_t$$

From the aforementioned Granger causality representations, it seems that:

(a) There is a unidirectional causality from E to GDP if:

$$\sum_{i=1}^{m} \alpha_i \neq 0 \text{ and } \sum_{i=1}^{n} \beta_j = 0$$

(b) Quite the reverse, a unidirectional causality from GDP to E will be found if:

$$\sum_{i=1}^{m} \alpha_i = 0 \text{ and } \sum_{i=1}^{n} \beta_j \neq 0$$

(c) There will be bi-directional causality or feedback between GDP and E if both the condition:

$$\sum_{i=1}^{m} \alpha_i \neq 0 \text{ and } \sum_{i=1}^{n} \beta_j \neq 0$$

(d) GDP and E will be determined independently and not statistically significant if:

$$\sum_{i=1}^{m} \alpha_i = 0 \text{ and } \sum_{i=1}^{n} \beta_j = 0$$

It is the absence of a causal relationship between the two variables.

We apply a standard Granger causality test looking at whether there is any causal relation between the inflation, the exchange rate and real GDP. The Granger causality tests in Table 3 shows that the evidence of a causal relationship between the three variables. In fact, the feedback hypothesis is confirmed for Tunisia, showing that there is a bidirectional causality between the inflation and the economic growth.

Result chow that there is a unidirectional relationship running from inflation to exchange rate. This result is important for the policy makers in Tunisia and the government, because it has not set any specific targets for the exchange rate. The exchange rate changes become relevant for monetary policy only if they influence inflation for Tunisia.

Table 3. VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: GDP			
Excluded	Chi-sq	df	Prob.
I	8.481387	1	***0.0036*****
E	0.329869	1	0.5657
All	8.484612	2	***0.0144*****
Dependent variable: I			
Excluded	Chi-sq	df	Prob.
GDP	2.886497	1	***0.0893****
E	0.088516	1	0.7661
All	2.891836	2	0.2355
Dependent variable: E			
Excluded	Chi-sq	df	Prob.
GDP	1.313009	1	0.2519
I	2.727251	1	***0.0986****
All	4.402606	2	0.1107

significance of each other lagged endogenous variables in that equation. The statistics in the last column is the chi-square statistics for joint significance of all other lagged endogenous variables in the equation. ***, **,* significant at 1%, 5% and 10%.

5. Conclusion and Recommendations

This paper has investigated the possibility of causality links between the exchange rate, the inflation and the economic growth measured by the GDP for Tunisia. The inflation is more frequently observed to Granger cause the economic growth at the 1% significance level. Bidirectional links between inflation and growth, while the inflation leads economic growth in the short run. Our findings also imply some help for economic policy-makers in Tunisia in their quest for economic growth and stability. The undesirable impacts of inflation in decreasing the growth in the country could neutralize interest of policy makers in seeing higher rate of growth in Tunisia as this would positively impact their economic development. The empirical results show also that the degree of exchange rate pass-through is affected by the inflationary environment (at 10% of significance level), since the exporting firms face in Tunisia in a non linear way. The decline of exchange rate pass-through is in close links to the observed low

inflation regimes in Tunisia after the revolution of january 14. Nevertheless, a coordinated effort is required for central bank policy makers before employing both instruments simultaneously, in order to avoid sending mixed signals to economic agents about its monetary policy stance, and endanger the achievement of its inflation target. In the context of policy implications, the government of Tunisia must take immediate initiatives to control inflation not only because it is detrimental to economic growth but also because of its adverse effects on the exchange rate and the policy stability.

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