SAVING, DEBT INFLOWS, AND GROWTH NEXUS IN TUNISIA

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Abstract

*This paper investigates the causality links among domestic saving, external debt inflows, and economic growth in Tunisia over the period 1970-2008. The Autoregressive Distributed Lag (*ARDL*) approach proves cointegration relationships between the variables of interest and justifies the use of a Vector Error Correction framework to make Granger causality tests. In the short-run, we find bi-directional causality between private debt inflows and saving, and one-way causalities running from these inflows to growth and from the latter to saving. In the long-run, saving and growth Granger-cause private debt inflows, whereas public debt inflows Granger-cause saving. These results suggest some economic policies for Tunisia.*

Keywords: *debt-inflows, domestic saving, economic growth, Tunisia.*

JEL Classification: *C32, E21, F43, O55.*

1. INTRODUCTION:

Various causality interactions between economic growth, domestic saving, and foreign inflows are possible. Indeed, while economic growth may cause domestic saving and/or foreign inflows, causality can also run from each of the two latter variables to economic growth. In addition, the domestic saving-led foreign inflows as well as the foreign inflows-led domestic saving hypotheses have their theoretical and empirical support.

The hypothesis of saving-led growth is at the core of the traditional theory of economic growth. The model of Solow (1956), for example, suggests that the latter is a result of capital accumulation, which in turn is determined by domestic saving. This hypothesis has been challenged by several authors. For instance, Feldstein and Horioka (1980) argue that in a context of perfect

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world capital mobility there is little or no relation between the domestic investment and the amount of savings[2], whereas Blomstrom, Lipsey, and Zejan (1993) found more evidence that increases in growth precede rises in rates of capital formation than that increases in capital formation precede increases of growth.

Furthermore, a causality running from growth to domestic saving was frequently observed in empirical research (Carroll and Weil, 1993; Sinha and Sinha, 1998; Agrawal, 2001; Anoruo and Ahmad, 2001; Baharumshah and Thanoon, 2006; Mohan, 2006; Odhiambo, 2009; Abu, 2010; and Abdelhafidh, 2012). The empirical evidence supporting the conventional wisdom of a causality running from domestic saving to growth is rather scarce, and the results of Alguacil, Cuadros, and Orts (2004) for Mexico and of Katircioglu and Naraliyeva (2006) for Kazakhstan are exceptions.

In line with the traditional theory of growth, some development economists of the 1960s shared the idea that foreign capital is a key factor for developing countries to bridge their gap between domestic investment and domestic saving (e.g. Rosenstein-Rodan, 1961; Chenery and Strout, 1966). Hence, foreign capital should not only complement domestic resources, but also lead to further growth. The foreign capital-led growth hypothesis was empirically tested for different types of inflows and samples, but no general result has emerged. It was supported for Kazakhstan (Katircioglu and Naraliyeva, 2006) and for a panel of Asian countries (Baharumshah and Thanoon, 2006) in the case of foreign direct investment (*FDI*), and for a panel of Pacific island countries in the case of external debt (Jayaraman and Lau, 2009). This hypothesis was, however, rejected by Mah (2010) for China and Odhiambo (2009) for South Africa. Indeed, they provide evidence that causality runs from growth to *FDI* and from growth to total inflows, respectively.

The conclusion of mixed causality links between domestic saving and foreign inflows on the one hand, and economic growth on the other hand, is also observed among domestic saving and foreign inflows. Specifically, results provided by the literature show that causality may run from domestic saving to foreign inflows, from foreign inflows to domestic saving, or be bi-directional. The latter two-way causality was observed in the short-run for Tunisia (Hachicha, 2003) and both in the short and in the long-run for South

[2] This is particularly true for a small, open economy. In this case, the saving retention coefficient β estimated on the basis of the equation $(I/Y) = \alpha + \beta\ (S/Y) + \varepsilon$ where (I/Y) and (S/Y) are the investment and saving ratios respectively and ε is the error term should be close to zero (Bangake and Eggoh, 2011. p. 940).

Africa (Odhiambo, 2009a). In the long-run, Hachicha (2003) found only a one-way causality running from domestic saving to capital inflows.

The literature suggests that causality relationships between foreign inflows and domestic saving depend on the type of inflows. Bowles (1987) provided evidence that the causality running from domestic saving to foreign aid was more frequently observed in developing countries where the proportion of multilateral to total foreign aid was higher. The hypothesis of domestic saving-led foreign capital was supported by Gruben and Mcleod (1998) for *FDI* and portfolio flows, but rejected by Baharumshah and Thanoon (2006) for long-term debt. Furthermore, while a two-way causality was observed between *FDI* and domestic saving in Kazakhstan (Katircioglu and Naraliyeva, 2006) and Pakistan (Shahbaz, Awan and Ali, 2008), any causality between domestic saving and each of *FDI* and short-term debt was found in a sample of Asian countries (Baharumshah and Thanoon, 2006).

This paper aims to contribute to the literature on the domestic saving, foreign inflows and economic growth causality links in several ways. First, unlike most authors cited above, we employ a trivariate framework in which the three variables are endogenous. Hence, we avoid the problem of misleading causality links associated with bivariate frameworks (Odhiambo, 2009b). Second, we focus on long-term debt inflows as a measure of foreign inflows and we distinguish between those that are from private sources and those that are from public sources[3]. To the best of our knowledge, only Abdelhafidh (2012) has made this distinction. Third, we rely on bounds testing approach of Pesaran, Shin and Smith (2001) to test for long-term relationships among the variables of interest. This approach is more appropriate for small samples over other alternatives and permits to test cointegration between variables with different order of integration (Ibrahim, 2009). Fourth, we study the causality links between domestic saving, long-term debt inflows, and economic growth for the period 1970-2008 in the case of Tunisia, which has received little attention in the empirical literature (Abu-Alful, 2010; Abdelhafidh, 2012). Abu-Alful (2010) found only a short-run causality from domestic saving to economic growth, but he employed a bivariate framework. Abdelhafidh (2012) focused on the causality links between potential financing sources and economic growth and concluded that the latter variable is a Granger cause of domestic saving in Tunisia. His results show

[3] Long-term debt inflows from private sources and long-term debt inflows from public sources refer to what is called by the World Bank 'Public and Publicly Guaranteed (*PPG*) debt from private creditors' and 'PPG debt from official creditors', respectively. For further details, see Appendix 2.

also a one-way causality from public loans to domestic saving and a bi-directional causality between the latter variable and private loans. However, he did not employ the bounds testing approach for cointegration and his Granger causality tests were based on a standard vector autoregressive (*VAR*) framework. The increase of deficits and the decrease of growth in Tunisia after the fall of Ben Ali's dictatorship on 14 January 2011, added to the lion's share of loans in foreign inflows, strengthen the choice of this country to study the causality relationships among debt inflows, domestic saving and growth.

The rest of the paper is organized as follows: Section 2 provides a first look at the data. Section 3 describes the empirical methodology we adopt to detect the causality relationship between long-term debt inflows, domestic saving and economic growth in Tunisia. The econometric results and their policy implications are presented and discussed in Section 4. Section 5 concludes.

2. DATA: A FIRST LOOK

Our data are collected from the World Bank World Development Indicators online data base for gross domestic product (*GDP*), per-capita *GDP*, domestic investment, and domestic saving, and from the World Bank Global Development Finance online data base for capital inflows. Table 1 shows that Tunisia has attained an average real growth rate of per-capita *GDP* (*growth*) of 3.3 percent from 1970 to 2008. The higher (15.8 percent) and lower (-4.5 percent) rates were reached in 1972 and 1986, respectively[5].

As seen in figure 1, the weaker growth performance was observed in the 1980s. Fortunately, the economic reforms adopted within the structural adjustment plan in 1986 seem to have produced positive effects few years later. Indeed, since 1989, the economic growth rates have become always positive and were higher than 5 percent in 1990, 1992, 1996, 2004 and 2007. Still, these reforms have not succeeded in bridging the gap between investment and saving. Specifically, figure 2 shows that since 1975, and except in 1986 and 1987, investment rates (*ivr*) have been higher than saving rates (*dsr*). Hence, Tunisian economy was structurally characterized by a saving gap over 1970-2008, which was filled by foreign capital (*fcr*). Table 1 provides evidence that

[4] Press release of the Central Bank of Tunisia Executive Board meeting held on 1 December 2011. www.bct.org.

[5] Per-capita *GDP* is in constant U.S dollar (base year: 2000).

Figure 1: Real per-capita GDP growth rate (%)

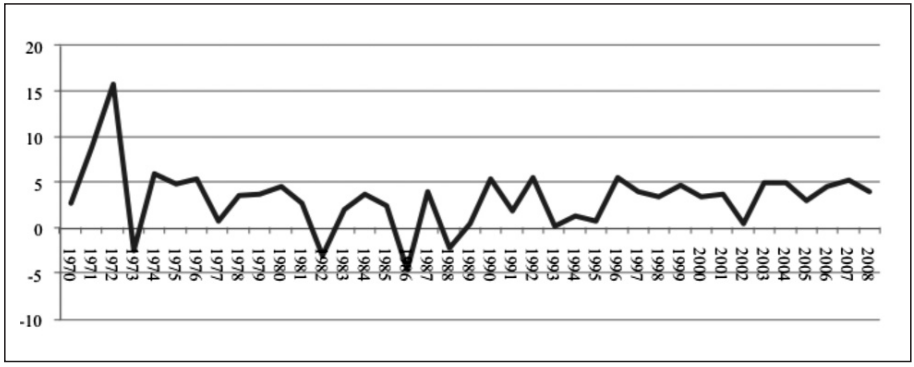
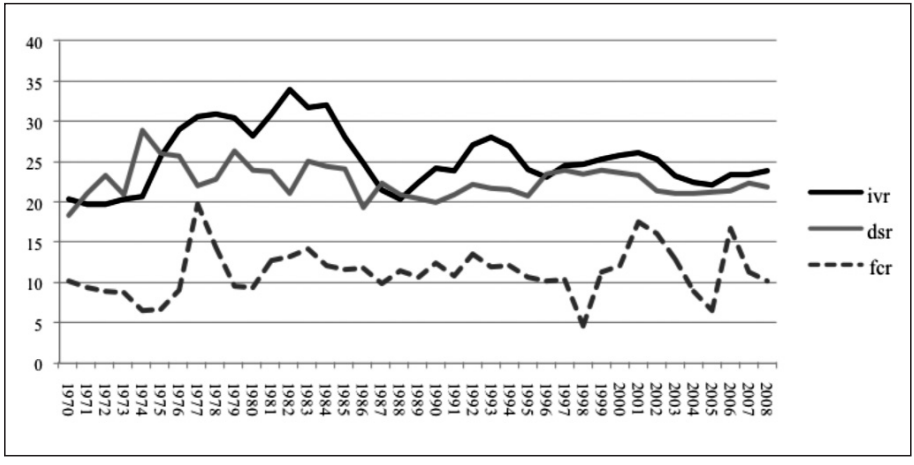


Figure 2: Investment, domestic saving and foreign capital rates (in % of GDP)



the latter has not served, however, only for investment purposes. On average, investment rates (25.5 percent) were in fact lower than the sum of domestic saving (22.7 percent) and foreign inflows (11.4 percent).

External debt inflows (*loa*) were the main component of external finance mobilized by Tunisian authorities. Indeed, with an average amount of 8.1 percent of *GDP*, they were largely higher than the sum of *FDI* (2.3 percent), grants (*grn*) (0.7 percent), and portfolio investment (*pi*) (0.2 percent). Table 1 shows also that external debt flows were all public and publicly guaranteed (*ppgl*), were mainly contracted for long-term (*ltl*), and were contracted from public sources (*ofl*) followed by private sources (*pvl*).

Table 1: Descriptive statistics (1970-2008)

	Mean	Max	Min	Std-dev	Obs
growth	3.27	15.83	-4.50	3.42	39
ivr	25.48	34.03	19.77	3.77	39
dsr	22.65	28.96	18.4	2.08	39
fcr	11.39	19.81	4.64	3.06	38
FDI	2.27	10.69	0. 6	1.8	38
grn	0.72	2.96	0.22	0.5	39
pi	0.18	1.25	-0.1	0.3	39
loa	8.08	17.36	0.74	3.04	39
ltl	7.46	15.25	2.69	2.39	39
ppgl	7.46	15.25	2.69	2.39	39
ofl	4.36	7.01	2.07	1.17	39
pvl	3.1	8.24	0.62	1.83	39

Source: Author's calculations.

3 EMPIRICAL METHODOLOGY

Our empirical methodology follows three steps. In the first one, we conduct unit root tests to examine the order of integration of the variables of interest. In the second step, the Autoregressive Distributed Lag (*ARDL*) approach is used to test cointegration among them. In the third step, Granger causality tests are employed in a trivariate framework to check for causality links among domestic saving, a measure of long-term external debt inflows (public sources or private sources), and economic growth.

3.1. Unit root tests

We perform stationarity tests for two reasons. First, these tests are necessary to make sure that none of the variables of interest is integrated of order higher than 1. Indeed, critical values of the bounds testing approach are calculated for I(0) or I(1) variables. Second, the variables of interest need to be stationary to avoid spurious regressions and obtain reliable results from Granger causality tests (Granger and Newbold, 1974). For robustness pur-

pose, we employ both the Augmented Dickey-Fuller (*ADF*, 1979), Phillips-Perron (*PP*, 1988), and Kwiatkowiski-Phillips-Schmidt-Shin (*KPSS*, 1992) tests to check the time series properties of the variables of interest[6].

3.2. Cointegration tests

Cointegration tests are conducted to ensure that the Granger causality tests lead to unbiased results. According to Engle and Granger (1987), if the variables of interest are cointegrated, Granger causality tests should be based on an error correction framework rather than on a first difference Vector Autoregressive framework.

We employ the bounds testing approach developed by Pesaran, Shin and Smith (2001) to test the existence of a level relationship between economic growth, domestic saving, and long-term debt inflows. This approach has several advantages over alternative techniques of cointegration tests such as those of Engle and Granger (1987) and Johansen and Juselius (1990). Mainly, it has superior properties in finite samples and it is applicable irrespective of whether the underlying regressors are purely I(0), purely I(1) or mutually cointegrated (Ibrahim, 2009).

The bounds testing approach to cointegration involves the estimation of the following unrestricted error correction model (*UECM)*:

$$[1]\ \Delta gdp_{(t)} = \mu_1 + \sum_{i=1}^{p1} \beta_{1i}\Delta gdp_{(t-i)} + \sum_{i=0}^{q1} \beta_{2i}\Delta ds_{(t-i)} + \sum_{i=0}^{r1} \beta_{3i}\Delta loa_{j(t-i)} + \gamma_1 gdp_{(t-1)} + \gamma_2 ds_{(t-1)} + \gamma_2 loa_{j(t-1)} + \varepsilon_{1(t)}$$

$$[2]\ \Delta ds_{(t)} = \mu_2 + \sum_{i=1}^{p2} \beta_{4i}\Delta ds_{(t-i)} + \sum_{i=0}^{q2} \beta_{5i}\Delta gdp_{(t-i)} + \sum_{i=0}^{r2} \beta_{6i}\Delta loa_{j(t-i)} + \gamma_4 gdp_{(t-1)} + \gamma_5 ds_{(t-1)} + \gamma_6 loa_{j(t-1)} + \varepsilon_{2(t)}$$

$$[3]\ \Delta loa_{j(t)} = \mu_2 + \sum_{i=1}^{p3} \beta_{7i}\Delta loa_{j(t-i)} + \sum_{i=0}^{q3} \beta_{8i}\Delta gdp_{(t-i)} + \sum_{i=0}^{r3} \beta_{9i}\Delta ds_{(t-i)} + \gamma_7 gdp_{(t-1)} + \gamma_8 ds_{(t-1)} + \gamma_9 loa_{j(t-1)} + \varepsilon_{3(t)}$$

[6] Whereas the *KPSS* tests the null hypothesis of a stationary series against the alternative hypothesis that it has a unit root, *ADF* and *PP* test the null of a unit root against the alternative of stationary.

Where Δ is the first difference operator, and *gdp*, *ds*, and *loa* are real per-capita gross domestic product, domestic saving, and long-term debt inflows, respectively. The latter two variables are expressed in percentage of gross domestic product and all variables are in logarithm. β_{1i},… β_{9i}, are short run dynamic coefficients; γ_1, … γ_9 are long run coefficients; μ_1, μ_2, μ_3 are intercepts; and ε_{1t}, ε_{2t}, and ε_{3t} are white noise errors. The subscript j attached to the variable *loa* refers to long-term debt inflows from public creditors or to those from private creditors. Thus, we estimate cointegration relationships between domestic saving, debt inflows and economic growth separately for external public loans and external private loans.

The lag lengths, p_1, p_2, p_3, q_1, q_2, q_3, r_1, r_2, and r_3 are based on the Akaike Information Criterion (*AIC*) and the Schwartz Bayesian Criterion (*SBC*). In line with the recommendation of Pesaran and Shin (1999) for annual dataset, we choose a maximum lag length of 2 periods.

The bounds test of a long-term relationship is an F-test of the null hypothesis of no cointegration against the alternative hypothesis of cointegration. The null hypotheses in equations [1], [2], and [3] are ($\gamma_1 = \gamma_2 = \gamma_3 = 0$), ($\gamma_4 = \gamma_5 = \gamma_6 = 0$), and ($\gamma_7 = \gamma_8 = \gamma_9 = 0$). The computed F-statistics for testing these hypothesis are denoted as F($gdp \mid ds$, loa_j), F($ds \mid gdp$, loa_j), and F($loa_j \mid gdp$, ds), respectively.

Two sets of F-statistic critical values are provided by Pesaran, Shin and Smith (2001) for a sample size of 1000 observations, by Narayan (2004, 2005) for a sample ranging from 30 to 80 observations, and by Shahbaz, Tang and Shabbir (2011) for a small sample of 39 observations. The first set assumes that all variables are I(0), whereas the second set assumes that they are all I(1). These two sets define respectively a lower and upper bounds. The decision rules of the bounds test are as follows: (i) the null hypothesis of no cointegration is rejected if the computed F-statistic is higher than the upper bound; (ii) the null of no cointegration is not rejected if the computed F-statistic is less than the lower bound; (iii) the decision is inconclusive if the computed F-statistic falls within the two bounds.

3.3. Granger causality tests

Granger (1969) causality tests are employed to ascertain the causal relationships between domestic saving, long-term external debt inflows, and economic growth in Tunisia. These tests are based on a Vector Error Correction Model (*VECM*) when a cointegration relationship is detected between the three variables. Hence, our framework to testing causality is as follows:

$$[4]\quad \Delta gdp_{(t)} = \beta_0 + \sum_{i=1}^{p} \beta_{1i}\Delta gdp_{(t-i)} + \sum_{i=1}^{p} \beta_{2i}\Delta ds_{(t-i)} + \sum_{i=1}^{p} \beta_{3i}\Delta loa_{j(t-i)} + ECT_{(t-1)} + \mu_{1(t)}$$

$$[5]\quad \Delta ds_{(t)} = \gamma_0 + \sum_{i=1}^{p} \gamma_{1i}\Delta ds_{(t-i)} + \sum_{i=1}^{p} \gamma_{2i}\Delta gdp_{(t-i)} + \sum_{i=1}^{p} \gamma_{3i}\Delta loa_{j(t-i)} + ECT_{(t-1)} + \mu_{2(t)}$$

$$[6]\quad \Delta loa_{j(t)} = \delta_0 + \sum_{i=1}^{p} \delta_{1i}\Delta loa_{j(t-i)} + \sum_{i=1}^{p} \delta_{2i}\Delta gdp_{(t-i)} + \sum_{i=1}^{p} \delta_{3i}\Delta ds_{(t-i)} + ECT_{(t-1)} + \mu_{3(t)}$$

Where *ECT* is the error correction term, which will be included only if a cointegration is detected. As for cointegration tests, optimal lag *p* is selected from a maximum of two lags using the *AIC* and the *SBC*. The other variables are the same as those defined in the precedent paragraph. The causality tests are conducted separately in two trivariate frameworks, each one of them using a measure of foreign debt inflows depending on the nature of creditors, public or private.

In the presence of a cointegration among the variables of interest, the Granger representation theorem states that at least a one-way causality would be observed. For the long-run, the causality exists when the *ECT* coefficient is negative and the t-test proves that it is statistically significant. Short-run causality between each couple of growth, domestic saving, and debt inflows measures are checked through the test of the joint significance of the coefficients of the lagged first-differenced exogenous variables in each equation[7].

4 RESULTS

4.1. Stationarity tests

The results of unit root tests are reported in table 2 below. They suggest that the application of both the bounds tests of cointegration and the

[7] These are Wald tests of the following null hypothesis:
H_{01}: $\beta_{2i} = 0$ for all i: *ds* does not Granger cause *gdp*;
H_{02}: $\beta_{3i} = 0$ for all i: loa_j does not Granger cause *gdp*.
H_{03}: $\gamma_{2i} = 0$ for all i: *gdp* does not Granger cause *ds*.
H_{04}: $\gamma_{3i} = 0$ for all i: loa_j does not Granger cause *ds*.
H_{05}: $\delta_{2i} = 0$ for all i: *gdp* does not Granger cause loa_j.
H_{06}: $\delta_{3i} = 0$ for all i: *ds* does not Granger cause loa_j.

Granger causality tests is appropriate to ascertain the short and long-run causalities among domestic saving, debt inflows, and economic growth in Tunisia. Indeed, the three unit root tests strongly show that (i) none of the variables of interest is I(2), confirming that the bounds testing approach is applicable; (ii) these variables are stationary in level (domestic saving, external public loans[8], and external private loans) or in first difference (gross domestic product), legitimating the use of this approach of cointegration tests over other alternatives in which the mixture of I(0) and I(1) variables is not possible; and (iii) all the variables of interest are stationary in first difference at 1 percent statistical significance level, ensuring that Granger causality tests lead to unbiased results.

Table 2: Unit root tests

Variable	*ADF* test. H0: the variable has a unit root.	Stationary status.	*PP* test. H0: the variable has a unit root.	Stationary status.	*KPSS* test. H0: the variable is stationary.	Stationary status.
gdp	-0.895[0]	I(1)	-0.893[2]	I(1)	0.762***[5]	I(1)
Δgdp	-6.239***[0]		-6.287***[2]		0.226[2]	
ds	-3.008**[5]	I(0)	-4.441***[1]	I(0)	0.202[3]	I(0)
Δds	-2.858*[5]		-17.333***[36]		0.5**[37]	
ofl	-2.185[1]	I(1)	-3.067**[1]	I(0)	0.248[4]	I(0)
Δofl	-8.365***[0]		-11.228***[14]		0.366*[23]	
pvl	-3.383**[0]	I(0)	-3.442**[2]	I(0)	0.111[3]	I(0)
Δpvl	-8.060***[0]		-11.394***[15]		0.5**[37]	

Notes: *Δ* is the first difference operator.
ADF: the Augmented Dickey-Fuller test; *PP*: the Phillips-Perron test; and *KPSS*: the Kwiatkowski-Phillips-Schmidt-Shin test. Critical values are from McKinon (1996) for the *ADF* and *PP* tests and from Kwiatkowiski et al (1992, table 1) for the *KPSS* test. Optimal lag lengths of respective tests are in brackets. The optimal lags for the *ADF* tests are selected based on the *AIC*, whereas *PP* and *KPSS* tests use the Newey-West Bandwidth.
Unit root tests are applied to models with a drift and without a trend.
***, **, *: significant at the 1 percent, 5 percent, and 10 percent level, respectively. The orders of integration are in parenthesis.

[8] For this variable, whereas the *ADF* test shows that it is I(1), the *PP* and *KPSS* tests show that it is I(0). We adopt the result of the *PP* test as it is particularly powerful when low frequency data are used (Choi and Chung, 1995).

4.2. Cointegration tests

As noted in the precedent section, our selected *ARDL* models are based on the lags which minimize the *AIC* and *SBC*. The results (table 3) show that these models give satisfactory values for traditional test criteria-goodness-of-fit (the values of R^2, adjusted-R^2 and F-statistic) and pass a series of diagnostic tests. Indeed, the Jarque-Bera test of normality, the Breusch-Godfrey LM test of correlation, the autoregressive conditional heteroskedasticity (*ARCH*) LM test, and the Ramsey (1969) Regression Specification Error Test (*RESET*) prove that the estimated equations respect the assumptions of the Least Squares technique to obtain consistent and robust estimators. Specifically, the Jarque-Bera statistic is not significant, failing to reject the null hypothesis of normally distributed errors. The null hypothesis of no serial correlations of order 1 and 2 is not rejected by the Breusch-Godfrey LM test. The Engle test (Engle, 1982) for autoregressive conditional heteroskedasticity shows that the residual of all estimated equations are free from this problem. The F-statistic of the Ramsey *RESET* is not statistically significant at the 5 percent level. Thus, it fails to reject that the residuals are independent and identically distributed, and confirms that there are no specification errors related to omitted variables, functional forms, and/or correlations between the regressors and the residuals. Finally, the cumulative sum (*CUSUM*) and the cumulative sum of squares (*CUSUMQ)* tests of Brown, Durbin, and Evans (1975) suggest that the coefficients and the residual variances are stable over the sample period for most of the equations. Indeed, the plots of these two tests over the period of estimation are generally within the 5 percent significance lines (figures 3 and 4 in Appendix 1).

The results of cointegration tests are reported in table 4. The computed F-statistic is higher than the upper bound critical value at the 1 percent significance level when domestic saving is the dependent variable and external long-term debt inflows refer to loans from public sources. However, it is less than the lower bounds critical values at the commonly accepted significance levels when *gdp* and loans from public sources are the dependent variables. Hence, a long-run equilibrium relationship is observed among domestic saving, external public loans, and economic growth, but only when the domestic saving is the dependent variable.

When debt inflows refer to external loans from private sources, the computed F-statistic is higher than the upper bound critical values in the 5 percent and in the 1 percent significance levels in the equations where domestic saving and those loans are respectively the dependent variables. Our results show also that a long-term relationship is observed when growth is the de-

Table 3: *ARDL* estimations

External debt inflows	Loans from public sources			Loans from private sources		
Dependent variable	*Δgdp*	*Δds*	*Δofl*	*Δgdp*	*Δds*	*Δpvl*
μ	-0.535**	0.464***	0.222**	-0.461***	0.294***	-0.076
Δgdp(0)		0.265***	-0.003		0.367**	-0.077
Δgdp(1)	-0.014	-0.106		-0.067	-0.092	
Δgdp(2)		0.069		-0.108	0.144**	
Δds(0)	1.287***		-0.327**	1.259***		-0.062
Δds(1)		0.063			0.156	-0.798***
Δds(2)						-0.605***
Δofl(0)	-0.078	-0.245				
Δofl(1)	-0.228		-0.127			
Δofl(2)	-0.676*					
Δpvl(0)				-0.19	0.08	
Δpvl(1)						0.062
Δpvl(2)						0.283*
gdp(1)	0.048**	-0.036***	-0.018**	0.042***	-0.023***	-0.003
ds(1)	0.945**	-0.855***	-0.273	0.932***	-0.696***	0.635***
ofl(1)	0.388	-0.73***	-0.699**			
pvl(1)				-0.198	0.1	-0.893***
Goodness-of-fit						
R^2	0.583	0.808	0.403	0.543	0.740	0.692
Adjusted-R^2	0.459	0.751	0.283	0.429	0.663	0.585
F-statistic	4.722**	14.23***	3.379**	4.756***	9.617***	6.496***
Diagnostic tests						
Jarque-Bera normality test	1.441	1.001	0.559	0.155	0.188	0.069
Breusch-Godfrey serial	0.514[1]	0.228[1]	0.046[1]	0.252[1]	2.106[1]	2.441[1]
correlation LM test	0.302[2]	0.127[2]	0.067[2]	0.177[2]	1.319[2	1.808[2]
ARCH LM test	0.748[1]	0.187[1]	1.473[1]	1.173[1]	0.0006[1]	0.013[1]
Ramsey *RESET*	3.313*[1]	2.404[1]	0.842[1]	3.675*[1]	1.063[1]	1.281[1]

Notes: *Δ* is the first difference operator and *μ* is the intercept.
***, **, *: significant at the 1 percent, 5 percent, and 10 percent level, respectively. The lag lengths of the variables and the orders of the diagnostic tests are in parentheses and brackets, respectively.

pendent variable at the 10 percent level of significance according to the critical values of Pesaran et al (2001). Therefore, at least two long-run equilibrium relationships are observed in the model including economic growth, domestic saving, and external private loans.

Table 4: Cointegration tests

External debt inflows	Loans from public sources			Loans from private sources		
Dependent variable	Δgdp	Δds	Δofl	Δgdp	Δds	Δpvl
Computed F-statistics	F($gdp \mid ds, ofl$) 3.1**	F($ds \mid gdp, ofl$) 12.171***	F($ofl \mid gdp, ds$) 2.793*	F($gdp \mid ds, pvl$) 4.496***	F($ds \mid gdp, pvl$) 6.893***	F($pvl \mid gdp, ds$) 13.541***
Cointegration critical values	Shahbaz et al. (2011, P. 3535)			Pesaran et al. (2001). P. 300. Table CI(iii). Case III: Unrestricted intercept and no trend		
	Lower bounds I(0)	Upper bounds I(1)		Lower bounds I(0)	Upper bounds I(1)	
1% level	7.397	8.926		5.15	6.36	
5% level	5.296	6.504		3.79	4.85	
10% level	4.401	5.462		3.17	4.14	

Note: ***, **, *: significant at the 1 percent, 5 percent, and 10 percent level, respectively.

4.3. Causality tests:

Having found that the variables of interest are cointegrated, causality tests were conducted separately within two trivariate *VECM*, each one of them employing, in addition to domestic saving and economic growth, a specific measure of external debt inflows (loans from public or loans from private sources). The results of these tests are in table 5.

In the *VECM* including public loans as a measure of external debt inflows, significant causalities are observed only in the equation where domestic saving is the dependent variable. According to the Wald-test, the null hypothesis that growth does not Granger-cause domestic saving is rejected at the 5 percent level of significance, implying a one-way short-run causality from growth to domestic saving. The negative sign and the statistical significance of the one-period lagged error correction term confirm the results of the bounds test for cointegration and provide evidence of a long-term Granger causality from public loans and growth to domestic saving.

In the *VECM* including loans from private sources as a measure of external debt inflows, the result of a one-way causality from growth to saving is

strongly confirmed in the short-run, but not in the long-run. Indeed, the hypothesis that growth does not Granger-cause domestic saving is rejected at the 1 percent level and the error correction term is statistically insignificant when domestic saving is the dependent variable. In this model, the hypotheses that private loans do not Granger-cause growth, private loans do not Granger-cause domestic saving, and domestic saving does not Granger-cause private loans are also rejected at the 10 percent, 5 percent, and 1 percent levels, respectively. Therefore, in the short-run, a one-way causality from external private loans to growth and a bi-directional causality between external private loans and domestic saving are observed in Tunisia over the period 1970-2008. The cointegration relationship provided by the bounds test is confirmed only in the equation where external private loans are the dependent variable, suggesting that, in the long-term, domestic saving and growth Granger-cause external private loans.

Table 5: Causality tests

External debt inflows	Loans from public sources			Loans from private sources		
Dependent variable	*Δgdp*	*Δds*	*Δofl*	*Δgdp*	*Δds*	*Δpvl*
Wald-Statistic H0:*ds* does not Granger cause *gdp*	0.321			1.571		
Wald-Statistic H0: *loa* does not Granger cause *gdp*	2.687			4.824* *loa→gdp*		
Wald-Statistic H0: *gdp* does not Granger cause *ds*		6.566** *gdp→ds*			10.338*** *gdp→ds*	
Wald-Statistic H0: *loa* does not Granger cause *ds*		0.227			6.351** *loa→ds*	
Wald-Statistic H0: *gdp* does not Granger cause *loa*			1.294			0.509
Wald-Statistic H0:*ds* does not Granger cause *loa*			1.558			33.252*** *ds→loa*
ECTt-1	-0.005 [-0.266]	-0.950*** [-4.002] *gdp→ds* *loa→ds*	0.187 [1.067]	0.0005 [0.333]	-0.208 [-1.311]	-0.811*** [-6.162] *gdp→loa* *ds→loa*

Notes: : causality-way
***, **, and * denote statistical significance at 1 percent, 5 percent, and 10 percent level, respectively.
[ ]: t-statistic.

5. POLICY IMPLICATIONS

Our results suggest causality interactions among external private loans, economic growth, and domestic saving in the short-run. Specifically, they suggest that a greater mobilization of external private loans should enhance growth, which should cause domestic saving. The latter should have a positive effect on the mobilized amount of private loans, which should be, in turn, a cause of further domestic saving and economic growth. Hence, if their goal is to achieve higher rates of economic growth in the short-run, Tunisian authorities would have to focus both on the domestic saving as well as on foreign loans from private sources. The dynamisation of the financial market through the introduction of more State-owned enterprises into the stock market and the diversification of financial instruments are example of means to attain more saving. This should also positively strengthen the perception of international capital market of the commitment of Tunisian authorities to market reforms, leading to more access to external private lending.

Noticeably, the results do not show any long-run causality running from domestic saving, external public loans, and external private loans to economic growth. This might suggest that long-term economic growth in Tunisia is rather a result of real and/or institutional factors than financial factors such as domestic saving or debt inflows. Consequently, the post-revolution political authorities should promote factors such as human capital and governance to achieve higher economic growth in the long-run. These factors have proved their positive long-run effects on economic growth in other countries (e.g. Mankiw, Romer and Weil, 1992; Keun and Kim, 2009). Higher long-term economic growth should enhance domestic saving in the short-run and the amount of external private loans in the short as well as in the long-run.

Finally, external public loans to Tunisia seem not to be a consequence of domestic saving and economic growth, both in the short and in the long-term. This result advocates that this type of debt inflows is determined by other variables than those related to macroeconomic performance in terms of domestic saving and/or economic growth. The promise of the 2011 G8 meeting in Deauville in France to mobilize an amount of more than 20 billion dollars to Tunisia and Egypt over the period 2011-2013 through bilateral and multilateral cooperation suggests that public inflows are mainly motivated by political factors[9]. Indeed, the Tunisian and Egyptian political revolutions

[9] Source: http://www.lemonde.fr/international/article/2011/05/27/le-g8-propose-40-milliards-de-dollars-pour-le-printemps-arabe_1528473_3210.html.

and the hope of a new era of democracy in the Arab region are the factors that have motivated such a promise. Hence, the success of Tunisia in its transition to democracy is a crucial factor to mobilize further public debt inflows to cover its external financial needs and to enhance, as suggested by our results, domestic saving in the long-run[10].

6. CONCLUSION

In this paper we have investigated the causality relationships between domestic saving, long-term external debt inflows, and economic growth in Tunisia over the period 1970-2008. We have relied on the *ARDL* approach to test cointegration and on the Granger causality tests to investigate the nature and the direction of the causalities among the three variables. As a measure of long-term external debt inflows, we have employed separately inflows from public creditors and inflows from private creditors.

In the light of the results of cointegration tests, the Granger causality tests were conducted within vector error correction models. In the short-term, Granger causality tests strongly (i) did not support the traditional growth theory that domestic saving is a cause of economic growth, (ii) supported the foreign capital-led growth hypothesis for private debt inflows, but not for public debt inflows, and (iii) provided evidence of a two-way causality among external private debt inflows and domestic saving. In the long-term, we found that the causality runs from growth and domestic saving to private debt inflows and from public debt inflows to domestic saving. The long-term causality running from growth to saving was not robust to the measure employed for debt inflows. Specifically, it was observed in the model including external loans from public creditors, but not in the model including those that are from private creditors.

Therefore, the results highlight the distinction made among external debt inflows by creditor. They suggest that private debt inflows should be mobilized for both further economic growth and more domestic saving in the short-run, whereas public debt inflows should be searched for more saving in the long-run.

Still, according to the World Bank (Appendix 2), long-term private debt inflows include bonds that are either publicly issued or privately placed;

[10] External financial needs are estimated to 25 billion dollars over the next five years. Source: http://www.lemonde.fr/international/article/2011/05/27/le-g8-propose-40-milliards-de-dollars-pour-le-printemps-arabe_1528473_3210.html.

commercial bank loans from private banks and other private financial institutions; and other private credits from manufacturers, exporters, and other suppliers of goods, and bank credits covered by a guarantee of an export credit agency. Public debt inflows include loans from international organizations and loans from governments. Thus, causality interactions between each type of these inflows in a one hand, domestic saving, and economic growth in another hand may be different. This suggests that further disaggregation of external private and public debt inflows is needed to better understand their nexus with domestic saving and economic growth.

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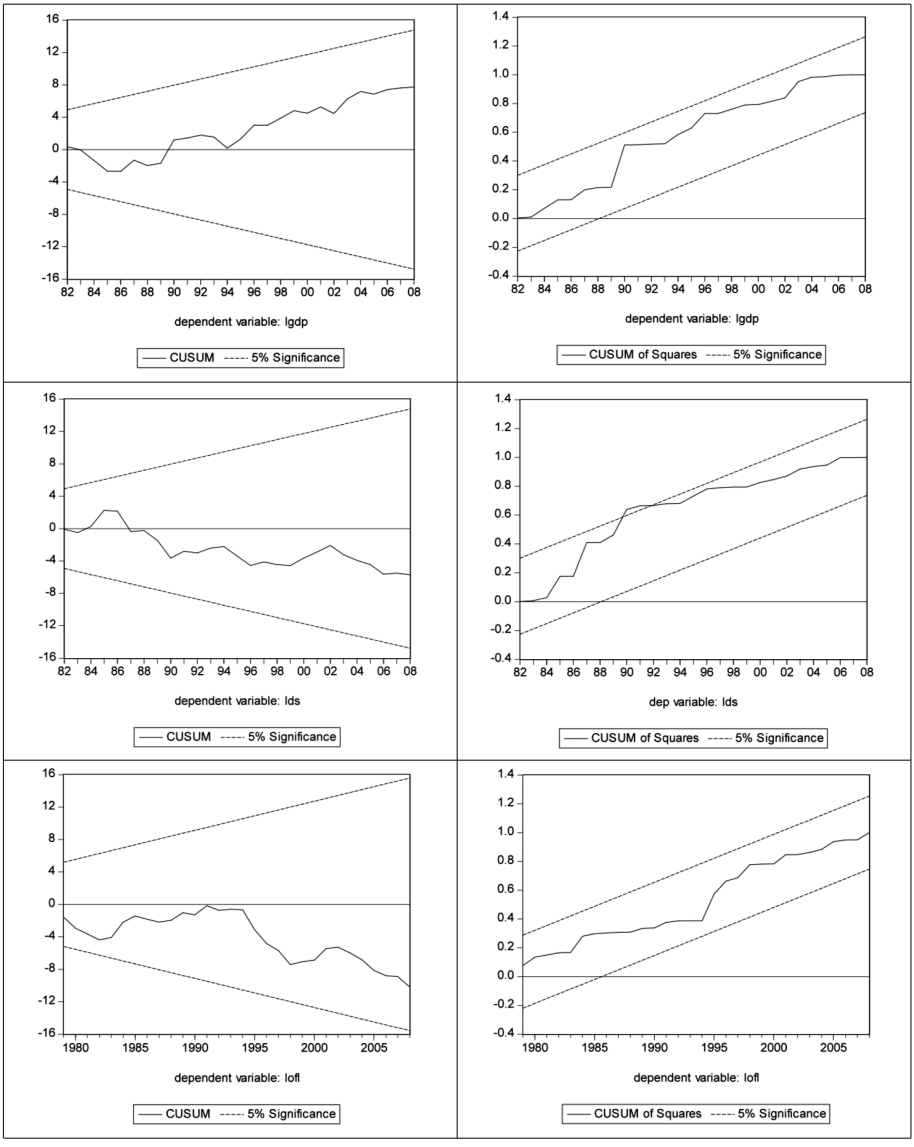
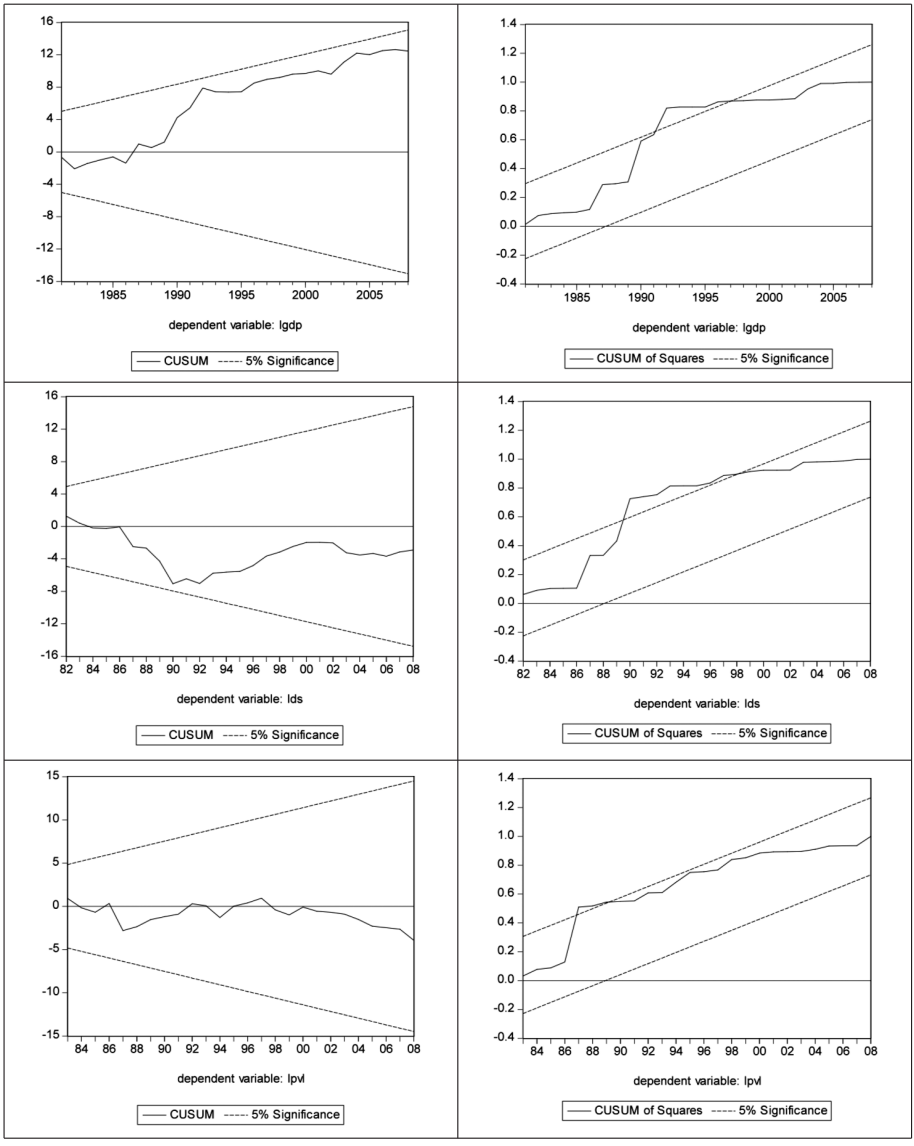
Appendix 1: *CUSUM* and *CUSUM* of Squares stability tests.

Model 1 (external debt inflows: loans from public sources)



Note: The straight lines represent critical bounds at 5% significance level.

Model 2 (external debt inflows: loans from private sources)



Note: The straight lines represent critical bounds at 5% significance level.

Appendix 2: Definitions of the variables
(Source: World Bank World Development Indicators and World Bank Global Development Finance online data bases)

Public and publicly guaranteed (*PPG*) long-term debt: Public debt is an external obligation of a public debtor, including the national government, a political subdivision (or an agency of either), and autonomous public bodies. Publicly guaranteed debt is an external obligation of a private debtor that is guaranteed for repayment by a public entity. Disbursements are drawings by the borrower on loan commitments during the year specified. Long-term external debt is defined as debt that has an original or extended maturity of more than one year and that is owed to non-residents by residents of an economy and repayable in foreign currency, goods, or services.

***PPG* debt from official creditors:** *PPG* debt from official creditors includes loans from international organizations (multilateral loans) and loans from governments (bilateral loans). Loans from international organization include loans and credits from the World Bank, regional development banks, and other multilateral and intergovernmental agencies. Excluded are loans from funds administered by an international organization on behalf of a single donor government; these are classified as loans from governments. Government loans include loans from governments and their agencies (including central banks), loans from autonomous bodies, and direct loans from official export credit agencies. Net flows (or net lending or net disbursements) received by the borrower during the year are disbursements minus principal repayments.

***PPG* debt from private creditors:** *PPG* debt from private creditors includes bonds that are either publicly issued or privately placed; commercial bank loans from private banks and other private financial institutions; and other private credits from manufacturers, exporters, and other suppliers of goods, and bank credits covered by a guarantee of an export credit agency. Net flows (or net lending or net disbursements) received by the borrower during the year are disbursements minus principal repayments.

Foreign Direct Investment (*FDI*): *FDI* (net) shows the net change in foreign investment in the reporting country. *FDI* is defined as investment that is made to acquire a lasting management interest (usually of 10 percent of voting stock) in an enterprise operating in a country other than that of the investor (defined according to residency), the investor's purpose being an ef-

fective voice in the management of the enterprise. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments.

Grants: Grants are defined as legally binding commitments that obligate a specific value of funds available for disbursement for which there is no repayment requirement.

Portfolio equity flows: They are the sum of country funds, depository receipts (American or global), and direct purchases of shares by foreign investors.

Gross domestic saving (% *GDP*): It is calculated as *GDP* less final consumption expenditure (total consumption).

Gross fixed capital formation (% *GDP*): Gross fixed capital formation (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation.

Gross domestic product (*GDP*) (constant 2000 US$): *GDP* at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Dollar figures for *GDP* are converted from domestic currencies using 2000 official exchange rates.

***GDP* per-capita:** *GDP* per-capita is gross domestic product divided by midyear population.

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LES LIENS DE CAUSALITÉ ENTRE ÉPARGNE, FLUX D'ENDETTEMENT ET CROISSANCE ÉCONOMIQUE EN TUNISIE

Résumé

Ce papier examine les liens de causalité entre épargne domestique, flux d'endettement externe, et croissance économique en Tunisie durant la période 1970-2008. L'approche *ARDL* prouve que ces variables sont cointégrées et justifie la conduite des tests de causalité au sens de Granger dans le cadre d'un vecteur à correction d'erreurs. Dans le court terme, nous trouvons une causalité bidirectionnelle entre flux privés d'endettement et épargne, et des causalités unidirectionnelles allant de ces flux vers la croissance et de cette dernière vers l'épargne. Dans le long terme, l'épargne et la croissance causent les flux privés, alors que les flux publics causent l'épargne. Ces résultats suggèrent certaines politiques économiques pour la Tunisie.

Mots-clés: Flux d'endettement, épargne domestique, croissance économique, Tunisie.