Do Tunisian Risk to Go Towards a Second Revolution? Element of Response from Consumption Behavior

NEIFAR, MALIKA

IHEC UNIVERSITY OF SFEX

10 February 2023

Do Tunisian Risk to Go Towards a Second Revolution?

Element of Response from Consumption Behavior

Malika NEIFAR

New economic department, IHEC- University of Sfax
Email: malika.neifar@ihecs.usf.tn

Abstract

The present paper aims to explore the Keynesian consumption-income relationship using Tunisian yearly time series data for the period 1970 to 2019. As in some economies, consumption expenditure is the largest component of the Gross Domestic Product (GDP) of Tunisian economy. For empirical investigation, the NARDL specifications of (Shin et al., 2014), is used to show that output have asymmetric effects once we introduce nonlinearity in the long run as well as in the short run through partial sum concept. The estimated model provides strong evidence for long-run asymmetric co-integration relationship between consumption and GDP changes (expansion and depression). In the short-run, consumption-output relation is found to be significant only in period of expansion, while *in the long-run,* consumption-output relationship in both recession and expansion period is highly significant suggesting that each of the partial sum of GDP changes leads to an *increase* in Tunisian consumption. Then Tunisians make optimistic expectations and even in bad economic condition they do not reduce their consumption spending in the long-run. This paper attempt to add some fresh empirical evidence to the debate about consumption function. It contributes to the existing macro-economic literature in many ways. First, it investigates a new specification of Keynesian consumption equation by adding expansion and depression dynamic to the linear static model. Secondly, it analyzes the consumption function by using NARDL bound testing approach for co-integration between the consumption and its determinants. Thirdly, it reconsider the stability question of the consumption function in Tunisia over time. Before any politic towards alleviation of the compensation fund, Tunisian government has interest to create a stable political and economic climate to encourage new investments, increase exports, and reduce imports, and have to decide urgently the promotion of renewable energies production to face bad news of rising oil price and exchange rate fluctuations which are ones of the important causes of high inflation. Otherwise, Tunisian risk to go towards a second revolution.

Key words: Tunisia, Consumption, GDP, Augmented Keynesian model, NARDL model.
Jel classification: E21, E12, C22.
Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
Disclosure statement: No potential conflict of interest was reported by the author(s).

I. Introduction

In his book "General Theory of Employment, Interest and Money", John Maynard (Keynes, 1936) postulated that aggregate consumption (one of the major components of an economy's aggregate demand) is a function of aggregate current disposal income. He add that this relationship is reasonably stable, and in case of a high level of national income, consumption as well as saving increased in levels. The consumption function has been a topic of considerable debate in the field of economics and econometric modelling as well, where consumption is the total amount of goods and services that people in the economy desire to buy for immediate consumption.

The consumption function is perhaps one of the areas in economics which has received no greatest attention. Identifying variables other than income, testing for integrating properties of the relevant variables, establishing cointegrating properties of the variables, and testing for stability of the consumption function are some of the important aspects of the literature upon which researchers have concentrated.

Many earlier studies verified empirically the income-consumption relationship for different countries during different periods of time [1]. Given the lack of theoretical consensus on a particular form, our approach in this paper will be different from previous research on Tunisia. This article aims to have a better understanding of the nature of the consumption-income relationship in Tunisia by testing the existence of a possible asymmetry and nonlinearity in this relationship.

Total consumption expenditure in Tunisia was estimated at 99.95 percent of the GDP in 2018-19 and it was 100.042 percent of the GDP in 2017–18. The figure is relatively higher than Pakistan, the United States, and the India's consumption estimated at 80%, 70 % and 60 % of their economy respectively (Khan et al., 2014).

The increase in consumption expenditure might be a positive thing if consumption is diverted to investment expenditure. However, Private investment as well as public investment witnessed a contraction since Tunisian revolution of 2011, period of social and political instability. From 2011, no devotion was present for production to build a strong economy. In the air of democracy building (during 10 years), UGTT the biggest unit of worker organization had organized more than 30.000 strikes despite the well known rising budget deficit and the alarming growing of foreign debt [2]. Only one clear objective was in the first line for all sectors (medicine, administration, education, …), it is the more wealth in term of higher salary. However, most of the Tunisian's population suffer from an absolute decline in their living standards even more than before 2011 the first Arab revolution date.

The main objective of this study is to empirically explore both the long-term and short-run effect of income changes on consumption in the context of Tunisian economy. Yearly data are used in applying the non-linear autoregressive dynamic approach (NARDL). We examine the long-run asymmetric co-integration between income *changes* (both expansion and depression) and consumption in Tunisia during 1970–2019.

This paper is organized as follows. After a brief introduction (Section I), Section II discusses a review of relevant theoretical and empirical literature. Section III deals with the methodology (subsection A and subsection B), data analysis (subsection C) and empirical results (subsection D). Section IV summarizes and concludes the paper.

II. Econometric Models, Data Analysis, and Empirical results

A. Model specifications

To understand some contemporary consumption research, we present a selection of the essential hypothesis for fundamental theories of consumptions from (Keynes, 1936)'s Absolute Income Hypothesis to (Modigliani, 1986)'s Life Cycle Hypothesis:

i) (Keynes, 1936)'s Absolute Income Hypothesis (AIH):

Under Absolute Income Hypothesis, aggregate consumption (C) may be a stable, but not necessarily linear function of disposable income (Y). Keynes postulated that, on average, an economic agent tends to increase his consumption as his income rises, but the rise in consumption is not as much as the increase in his income (marginal propensity to consume MPC = $\frac{\partial C}{\partial Y}$ < 1).

ii) (Brown, 1952)'s Habit Persistence Hypothesis (HPH):

To represent the slowness in the response of consumer demand to the changes in income, Brown used lag consumption (C_{-1}) as one of the independent variables.

iii) (Friedman, 1957)'s Permanent Income Hypothesis (PIH):

Friedman assumed that income "Y" has two components: a permanent component (Y^P) and a transitory component (Y^T). Consumers plan to maximize their lifetime utility by using a permanent component of income. (Friedman, 1957) argued that consumption is a function of permanent income (Y^P)

$$LC_t = \beta_1 + \beta_2 \, LY^P_t + u_t.$$

Since LY^P_t is not directly observable, we need to specify the mechanism that generates permanent income. Using the *adaptive expectations* hypothesis specified as follow

$$LY^P_t - LY^P_{t-1} = (LY_t - LY^P_{t-1}).$$

and simplifying, we obtain the following consumption function of permanent income (ARDL(1, 0))

$$LC_t = \alpha_1 + \alpha_2 \, LY_t + \alpha_3 \, LC_{t-1} + v_t \qquad (1)$$

where $\alpha_1 = \gamma\beta_1$, $\alpha_2 = \gamma\beta_2$, $\alpha_3 = (1-\gamma)$, $v_t = [u_t - (1-\gamma)\, u_{t-1}]$. As it is know, $\beta_2 = \gamma\beta_2/\gamma = \frac{\alpha_2}{1-\alpha_3}$ gives the mean response of consumption to a 1 Tunisian dinar (TD) increase in *permanent* income, whereas α_2 gives the mean response of consumption to a 1 TD increase in *current* income.

iv) (Hall, 1978)'s Random Walk Hypothesis (RWH):

(Hall, 1978) argued that consumption is a random walk (I(1)), and income changes cannot determine consumption evolution.

v) (Modigliani, 1986)'s Life Cycle Hypothesis (LCH):

For life cycle hypothesis side, the average propensity to consume (APC = C/Y) is larger among young households and in older people since young people run their lives on borrowing and old households more on their life saving. However, middle aged people do reach their position earning of high income with higher saving and lower consumption.

Even there are several factors that may affect consumption as argued by John Maynard Keynes, this study is concerned only about the relationship between consumption and income. The simple static linear Keynesian model as used in several studies can be written as [3]:

$$LC_t = \alpha_1 + \alpha_2 \, LY_t + u_t \qquad (2)$$

where LC_t and LY_t are respectively consumption and income in log. (Keynes, 1936) postulated that marginal propensity to consume (MPC) α_2 is positive but less than 1.

If LC_t and LY_t are integrated I(1), the long run cointegration relationship (2) exists if $u_t \sim I(0)$. One can estimate an ECM using the residual from the long run equation (2);

$$u_t = LC_t - (\alpha_1 + \alpha_2 LY_t).$$

Several critic can be stated on static linear model:

(i) First, equation (2) is a contemporaneous relation, which may not be plausible theoretically and inadequate empirically owing to the omission of short-run dynamics. Following (Hendry et al., 1984), we consider the dynamic linear Keynesian ARDL model:

$$LC_t = \alpha + \sum_{i=0}^{m} \theta_i LY_{t-i} + \sum_{i=1}^{m} \delta_i LC_{t-i} + \varepsilon_t.$$

The contemporaneous (short-run) effect of output on consumption can be measured by the coefficient θ_0 (θ_i), while the long-run effect (MPC) will be measured by the coefficient, φ given by $\varphi = \frac{\sum_{i=0}^{m} \theta_i}{1-\sum_{i=1}^{m} \delta_i}$.

For non cointegration hypothesis within ARDL approach, the appropriate test is the Bounds Test developed by (Pesaran, Shin, & Smith, 2001) whish can be applied irrespective of the order of integration of considered variables. The Bounds Test involves estimating in first step the following Error Correction Model (ECM) [4]:

$$\Delta LC_t = \alpha_0 + \alpha_1 LC_{t-1} + \alpha_2 LY_{t-1} + \sum_{i=1}^{n} \beta_i \Delta LY_{t-i} + \sum_{i=1}^{n} \pi_i \Delta LC_{t-i} + \varepsilon_t.$$

Then, an F-test can be used for investigating long-run relationship from the following null hypothesis of no cointegration [5]:

$$H_0: \alpha_1 = \alpha_2 = 0 \text{ vs } H_1: \alpha_1 \neq 0 \text{ and/or } \alpha_2 \neq 0.$$

(ii) Second, the static linear model (2) is a weak investigation of the Keynesian model since there is no any consideration for asymmetries. Most of the empirical literature dealing with Keynesian theory tends to focus on the lack of robustness without questioning the linear nature of the relationship. The nonlinear long run static asymmetric regression of the Keynesian model can then be written as:

$$LC_t = \beta^+ LY_t^+ + \beta^- LY_t^- + v_t \quad (3)$$

where LY_t^+ and LY_t^- are the partial sum process of the positive and negative changes in LY_t defined as:

$$LY_t^+ = \sum_{j=1}^{t} \Delta LY_j^+ = \sum_{j=1}^{t} max\,(\Delta LY_j, 0) \text{ and } LY_t^- = \sum_{j=1}^{t} \Delta LY_j^- = \sum_{j=1}^{t} min\,(\Delta LY_j, 0),$$

where β^+ and β^- are the related asymmetric long run parameters. If u_t is stationary, then LC_t and LY_t are said to be 'asymmetrically cointegrated. Symmetry hypothesis (cointegration): $\beta^+ = \beta^-$ can be tested by Wald statistic. However, the OLS estimator of equation (2) can be poorly estimated in finite samples, and the hypothesis test cannot be carried out without removing an eventual serial correlation. Thus, equation (2) also can be extended into the following nonlinear Keynesian ARDL(p, q, q) model:

$$LC_t = \sum_{i=0}^{m} (\theta_i^{\,+} LY_{t-i}^+ + \theta_i^{\,-} LY_{t-i}^-) + \sum_{i=1}^{m} \delta_i LC_{t-i} + \varepsilon_t,$$

$\varepsilon_t \sim WN(0, \sigma^2)$, δ_i is the autoregressive parameter, θ_i^+ and θ_i^- are the asymmetric distributed-lagged parameters. The error correction model (ECM) associated with the asymmetric cointegration form can be rewritten as the so known Nonlinear ARDL model (NARDL):

$$\Delta LC_t = \rho v_{t-1} + \sum_{i=0}^{m} (\theta_i^{\,+} \Delta LY_{t-i}^+ + \theta_i^{\,-} \Delta LY_{t-i}^-) + \sum_{i=1}^{m} \delta_i \Delta LC_{t-i} + \varepsilon_t, \quad (4)$$

or

$$\Delta LC_t = \rho\, LC_{t-1} + \theta^+ LY_{t-1}^+ + \theta^- LY_{t-1}^- +$$

$$\sum_{i=0}^{m}\left(\theta_i^{+}\Delta LY_{t-i}^{+} + \theta_i^{-}\Delta LY_{t-i}^{-}\right) + \sum_{i=1}^{m}\delta_i\,\Delta LC_{t-i} + \varepsilon_t, \quad (5)$$

where

$$v_t = LC_t - (\beta^{+}LY_t^{+} + \beta^{-}LY_t^{-})$$

ρ, θ^{+} and θ^{-} are the long run parameters, θ_i^{+} and θ_i^{-} are the short run parameters, and $\beta^{+} = \frac{-\theta^{+}}{\rho}$ and $\beta^{+} = \frac{-\theta^{-}}{\rho}$ are the asymmetric long run parameters

B. Related inference for NARDL model

1. Boud-Test for no contegration

We need to test whether the two variables are cointegrated or not to a further look into the nature of the NARDL version of Keneysian model. If $\rho = 0$, equation (4) reduces to the linear regression involving only first differences, thus implying that there is no long run relationship between the levels of LC_t, LY_t^{+} and LY_t^{-}. We can consider three testing procedures: with **two** of them are based on the error correction model (3). (Banerjee et al., 1998) propose the use of the t-statistic testing $H_0: \rho = 0$ against $H_a: \rho < 0$, while (Pesaran et al., 2001) propose an F-test of the joint null,

$$H_0: \rho = \theta^{+} = \theta^{-} = 0 \qquad \text{Against } H_a: \rho \neq 0 \cup \theta^{+} \neq 0 \cup \theta^{-} \neq 0$$

in model (5). These tests are based on t_{BDM} and F_{PSS} statistics respectively as denoted in (Shin et al., 2014). Based on the (Pesaran et al., 2001) bounds testing approach, rejection of the H_0 suggests the existence of long run asymmetric relationship.

Following (Engle & Granger, 1987) (EG), the third test is a two-step residual-based approach proposed by (Shin et al., 2014). The first stage involves the estimation of model (3) by OLS, while in the second stage, one tests for a unit root on the resulting residuals by t-statistic denoted by t_{EG}.

2. Wald-Tests for symmetry vs asymmetry

In practice, four distinct cases may be identified as follows: an unrestricted specification, (4), accommodating asymmetries in both the short- and long-run and three restricted specifications obtained by imposing the short- and the long-run symmetry restrictions in (4), separately and jointly. All the symmetry tests are based on the standard Wald tests (W_{LR} for long run and W_{SR} for short run). The long run symmetries can be examined by testing H_0: $\theta^{+} = \theta^{-}$, while the short run symmetries can be examined by testing individual H_0: $\theta_i^{+} = \theta_i^{-}$ (for all i = 0, ..., m-1), or the summative version**;** $H_0: \sum_{i=0}^{m-1}\theta_i^{+} = \sum_{i=0}^{m-1}\theta_i^{-}$.

3. Dynamic multipliers for shock transmissions

A useful tool for analysing both the asymmetric short run adjustment and the asymmetric long run reaction is the dynamic multipliers. These multipliers represent the transition between the initial equilibrium, short run disequilibrium after a shock, and the new long run equilibrium. Indeed, the asymmetric dynamic multiplier measure the effects of one unit change in LY_t^{+} and LY_t^{-} individually on LC_t and can be derived from equation (5). They are defined as:

$$m_h^{+} = \sum_{j=0}^{h}\frac{\partial LC_{t+j}}{\partial LY_t^{+}} \quad and\ m_h^{-} = \sum_{j=0}^{h}\frac{\partial LC_{t+j}}{\partial LY_t^{-}} \quad for\ h = 0, 1, 2 \ldots$$

where $m_h^+ \rightarrow \beta^+$ and $m_h^- \rightarrow \beta^-$ if $h \rightarrow \infty$. We calculate then the dynamic multipliers to obtain a measure of the cumulative effects of asymmetric output shocks on aggregate consumption and thus, to depict the adjustments of GDP in the disequilibrium consumption-output relationship towards new long run equilibrium.

C. Data investigation

Before going on the model specification, we have to analyse our data. Our study relates the Tunisian yearly consumption to GDP both in log over the period from 1970 to 2019 (T = 50) in current US $. Table 1 present descriptive statistics (average value, Median, Maximum, Minimum, standard deviation, Skewness, Kurtosis, Jarque & Bera (JB) statistic and its p-value) for consumption in log (LC) and GDP in log (LY) and the Average Propensity to Consume (APC = LC/LY). All skewness parameters are negative. Coefficient of kurtosis are almost equal to 3. JB test statistics do not reject the normality assumption. All considered series have Gaussian distribution (we do not reject null hypothesis that the sample is Normally distributed at 5% significance level).

Table 1: Descriptive statistics.

	LC	**LY**	**APC=LC/LY**
Mean	23.18510	23.20037	**0.999239**
Maximum	24.45676	24.39277	**1.005144**
Minimum	20.88409	20.96593	0.991253
Std. Dev.	0.992114	0.932614	0.003107
Skewness	-0.520956	-0.517782	-0.590738
Kurtosis	2.389713	2.436772	3.095091
Jarque-Bera	3.037566	2.895042	2.926929
Probability	**0.218978**	**0.235153**	**0.231433**

According to (Gujarati, 2004), before one pursues formal tests, it is always advisable to plot the time series under study. Such a plot (line graph of the level) gives an initial clue about the likely nature of the time series. From Figure 1 for each variable, consumption in log (LC) and GDP in log (LY) are likely to be not stationary. In addition, the graph shows that the two series do appear to move together as being cointegrated.

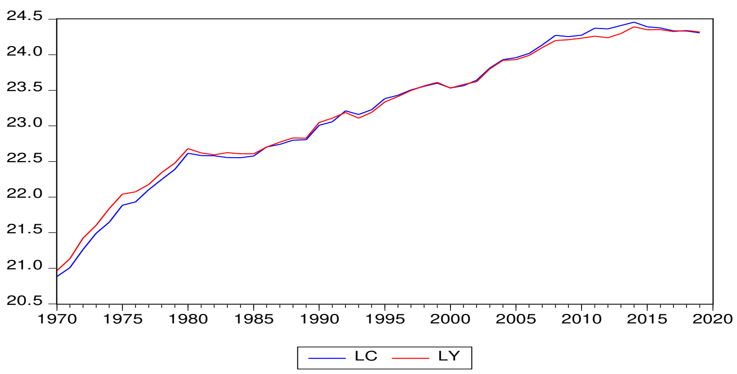

Figure 1: Dynamics of Tunisian consumption and Revenue in log between 1970-2019 period.

(Hall, 1978) argued that consumption is a random walk (and Income changes cannot determine consumption evolution). Prior to our empirical analysis, we carried out augmented Dickey–Fuller (ADF), Phillips–Perron (PP) unit root tests to examine whether considered variables follow stochastic trend. The tests unambiguously suggest the existence of one unit root for the variables in level (stationary at first difference), indicating that the time-series are integrated of order 1, I(1) (see Table 2). However, we are not discourages to go further in the investigation of Keynesian thought.

Besides, the look at static specifications**,** linear regression (2) or (1)' [and nonlinear regression (3)], yields a significant positive relationship between LC_t and LY_t or LYP_t [and LY_t^+ and LY_t^-] with negative [positive] significant constant. From Table 3, MPC (β) is positive but more than 1 (It can be seen that MPC is computed to be 1.063013 or 1.018365). However, this situation with high coefficients of determination (R^2) coupled by lower DW statistics and high Student t statistics indicates a case of spurious regressions! (see Table 3 Panel A1 and Panel A2 [Panel A3] given below).

From Freidman linear dynamic specification (1), the following regression results were obtained (given in Table 3 Panel A 4)

$$LC_t = -1.015126 + 0.836654\ LY_t + 0.207163\ LC_{t-1}$$

se	0.199532	0.063251	0.056550
t	-5.087531	13.22758	3.663392

R^2= 0.998828, DW= 1.105697 and F= 19598.30. The results show that the short-run marginal propensity to consume (MPC) is 0.836654, suggesting that a 1 TD increase in the current or observed real income (as measured by real GDP) would increase mean consumption by about 0.84 TD. But if the increase in income is sustained, then eventually the MPC out of the permanent income will be $\beta_2 = \gamma\beta_2/\gamma = \frac{\alpha_2}{1-\alpha_3}$ = 0.836654/ (1-0.207163) = 1.055266 or about 1.1 DT. In other words, when consumers have had time to adjust to the 1 TD change in income, they will increase their consumption ultimately by about 1.1 DT.

To test for no cointegration, we specify how many lags to include in the VAR models. Therefore, in order to find out the lag length, we followed a lag length selection criterion, the AIC: Akaike information criterion, SC: Schwarz information criterion, and HQ: Hannan-Quinn information criterion which suggests 1 lags for the time series data as the least value of AIC, SC, and HQ corresponds to 1 lags in the selected sample period. Hence, we connot use Johansen test for no cointegration hypothesis. We can use Rather Engel-Granger (EG) no cointegration test. Results of EG test are given at Table A1 in Annex. Results from Table A 1 show that no cointegration hypothesis is rejected in both eventual relationship at 5% level. Hence, stable long run relationship exist between consumption and output or permanent income.

Yet, the low Durbin-Watson statistic indicates positive serial correlation in the residuals, suggesting that the t-value is upward biased (≈ 180 for LY and ≈ 58 for LY_t^+). Hence, we should not make too much on *static* model results. To eliminate the bias, we'll then consider rather the autoregressive *dynamic linear and nonlinear ARDL* models (NARDL developed by (Pesaran et al., 1999)).

Table 2: Unit root test results.

		Phillips–Perron (PP) URT				Dickey–Fuller (ADF) URT			
		At Level		At 1st Diff		At Level		At 1st Diff	
		LC	**LY**	**ΔLC**	**ΔLY**	**LC**	**LY**	**ΔLC**	**ΔLY**
With Constant & Trend	t-Statistic	-2.3109	-3.257	-5.942	-5.3820	-2.3002	-3.3130	-5.8917	-5.3933
	Prob.	**0.4203**	**0.0856**	0.0001	0.0003	**0.4259**	**0.0761**	0.0001	0.0003
Without Constant & Trend	t-Statistic	3.7151	3.7734	-3.264	-3.2880	5.4762	5.3993	-3.4795	-3.4947
	Prob.	**0.9999**	**0.9999**	0.0016	0.0015	**1.0000**	**1.0000**	0.0008	0.0008

Table 3: OLS results for linear and nonlinear static models. Dep var LC.

Panel A1: Keynes's *Linear static* specification (model (2))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LY	1.063013	0.005901	**180.1430**	0.0000
Constant	-1.477191	0.137012	-10.78145	0.0000
F-stat	32451.49			0.0000
DW	**0.751571**			
R^2	**0.99852 > DW**			

Panel A2: **Freidman's** *Linear static* specification (model (1)')

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LYP	1.018365	0.010423	97.70534	0.0000
C	-0.370361	0.242211	-1.529082	0.1331
F-stat	9546.333			0.0000
DW	0.865550			
R^2	0.995205> **DW**			

Panel A3: Keynesian *Nonlinear static* specification (model (3)).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LY_t^-	1.171386	0.156048	7.506559	0.0000
LY_t^+	1.079249	0.018631	**57.92655**	0.0000
C	20.78698	0.022339	930.5381	0.0000
F-stat	15313.10			0.0000
DW	**0.830634**			
R^2	**0.998500 > DW**			

Panel A4: **Freidman's** *Linear dynamic* specification (model (1))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LC(-1)	0.207163	0.056550	3.663392	0.0006
LY	0.836654	0.063251	13.22758	0.0000
C	0.836654	0.199532	-5.087531	0.0000
F-stat	19598.30			
DW	1.105697			
R^2	0.998828			

Note: LYP is the Permanent Income measured by taking 3 year moving average of aggregate income. For Model (1)' definition see note 3. For Panel A4, since permanent income is not directly observable, we use the adjustment made in (Gujarati, 2004) that is based on adaptive expectations hypothesis as explaned in sub-section A (section II).

D. NARDL model Results

As discussed above, we found that consumption-output relationship may be spurious for Tunisian economy. Could this be due to assuming static symmetric effects? Do the results change if we shift to nonlinear dynamic model and separate expansion from depression effects? This is what we seek to discover hereafter. This study tend to give support to the non-linear hypothesis. A well-specified Keynesian model indicating the asymmetric nature and handling the long-run stable relationship and the short run dynamic may be proved by the NARDL specification. To observe the impacts of positive and negative output shocks separately, we'll analyze the asymmetries of the consumption-output relationship. Here optimal lags are selected by AIC creteria whish give rise to an ARDL(1, 2, 0) model. Long-run results are summed up in Table 4 while short-run results are collected at Table 5.

Nonlinear cointegration is validated by F_{PSS} bound test in 5% level (see Table A 2 in Annex) for NARDL (Panel B) specifications [6]. *Long-run* symmetric hypothesis is rejected by Wald test (see Table 4). It means that the responsiveness of consumption to output shocks in Tunisia is asymmetric in the long-run. The asymmetric *long-run* relation between consumption and output in both recession period and expansion period is highly significant. The estimated long-run coefficients on LY_t^- (depression) and on LY_t^+ (expansion) are respectively equal to 1.71728 and 1.128975. This suggests that a 1% increase (decrease) in partial sum of GDP positive (negative) changes leads to about 1.13 % (1.72%) *increase* in consumption given the augmented nonlinear Keynesian model (NARDL).

Table 4: Long run relationship from NARDL model results.

Variables	**Coeff**	**t-statistic**
LY_t^+	1.128975	27.67354
LY_t^-	1.717287	4.994671
Symmetric hypothesis (W_{LR})	**χ^2-stat**	**p-value**
H_0: $\theta^+ = \theta^-$	24.24377	(0.0000)
Diagnostic		
R^2		0.890929
JB		(0.806)
Breusch-Godfrey Serial Correlation LM Test:		0.568253 (0.7527)
Heteroskedasticity Test: Breusch-Pagan-Godfrey		7.107727 (0.2128)

Note: (.): p-value. This is done by Eviews 10.

Looking now to the analysis of *short-run* dynamic non-linearity, we find that the Wald test reject the null of strong (weak-form: summative) symmetric adjustment at the 1% level. In addition, our confidence in the power of these tests is not limited given the well apparent asymmetry in the patterns of the dynamic multipliers presented in Figure 3 hereafter. The results show that the ECM term has negative sign ($\hat{\rho}$ = – 0.470949) and is statistically significant at 5% level, ensuring that *long-run equilibrium* can be obtained in the case of the augmented Keynesian model. The magnitude of the estimated coefficient ρ suggest that adjustment process is quite important. About 50% of the disequilibrium of previous year output shock is adjusted back to equilibrium in the current year for Tunisian consumption.

Results from Table 5 provide evidence of the existence of *short-run* asymmetry. It is observed that only the *positive* change in the output is significant while the *negative* change in output have no effect. The positive coefficient of short-run association between consumption and output growth imply that an immediate positive change in partial sum of GDP (output) *increases* the consumption by 1.018803% in the short-run. However, previous output positive changes have negative but *insignificant* effect on consumption at 5% level.

Table 5: Short run dynamic adjustment from NARDL model results.

	Coefficient	t-stat
Variable		
ECM*$_{t-1}$	**-0.470949**	-5.506176
ΔLY_t^+	**1.018803**	17.06804
ΔLY_{t-1}^+	-0.095402	-1.727103
ΔLY_t^-	–	–
Symmetric hypothesis (W$_{SR}$)	**χ^2-stat**	**p-value**
$H_0: \theta_0^+ + \theta_1^+ = \theta_0^- + \theta_1^-$	20.66329	(0.0000)
$H_0: \theta_0^+ = \theta_0^-$	24.77050	(0.0000)
$H_0: \theta_1^+ = \theta_1^-$	191.0386	(0.0000)

Note: (.) denote p-value. * p-value incompatible with t-Bounds distribution. From (Pesaran, Shin, & Smith, 2001, pp. 303, Table CII, Case III), the appropriate critical value for significance of ECM$_{t-1}$ is -3.21 (-3.53) at the 10% (5%) level when k = 2.

To analyze whether or not the link between consumption and output has been stable over time, Cumulative Sum (CUSUM) and CUSUM of Squares (CUSUMSQ) tests are used. Results for checking the structure stability are illustrated in Figure 2. Results presented at Figure 2 give a clear conclusion about stability of proposed model (both graphs are inside limits). NARDL Model is stable since QUSUM and QUSUM of square of recursive stability tests give the same conclusion (see Figure 2).

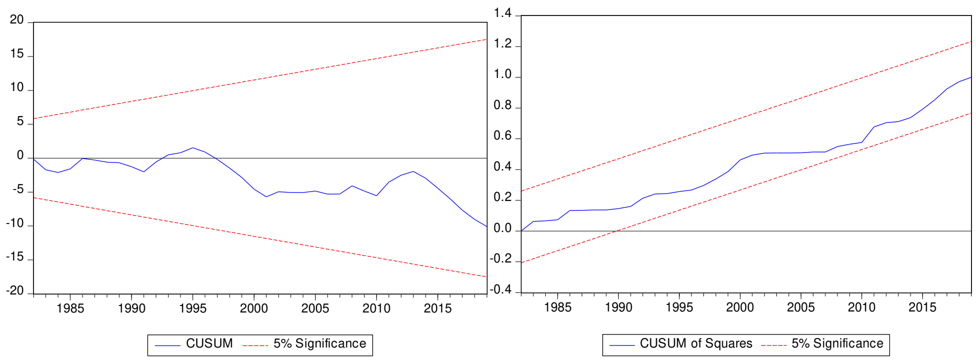

Figure 2: Stability Diagnostic Test: CUSUM and CUSUM of Squares.

We checked the adequacy of our dynamic model based on various diagnostic statistic tests. Lagrange multiplier (LM) for autocorrelation up to lag (2) and the Breusch-Pagan-Godfrey statistic for heteroscedasticity. All these results are shown in the lower panel of the Table 4. In terms of normality in error term Jarque-Bera statistic was used. The model is well specified since errors behave as WN (Table 4). Neither serial correlation (p-value = 0.7527) nor heteroscedasticity (p-value = 0.2128) was detected from LM tests in the residuals. The error term has normal distribution since p-value for Jarque–Bera test is equal to 0.806.

The dynamic multipliers provide interesting insights into the nature of both the long- and short-run asymmetries characterising the consumption output relationship. The dynamic multiplier represents also the patterns of dynamic asymmetric adjustments of consumption from its initial equilibrium to the new steady state in the long-run. It is associated with unit changes in LY_t^+ and Y_t^- (positive or negative shock) on LC_t respectively. The predicted dynamic multipliers for the nonlinear adjustment of Tunisian consumption for the period 1970–2019 to the shock in the output are displayed in Figure 3. The black continue curves is for positive changes while discontinue black curves is for negative changes. Red curve is for the difference with its confidence intervals. The results indicate that consumption respond rapidly and strongly in the decrease (increase) of output in the very short-run. The full adjustment to the new equilibrium is relatively long process. Consumption exhibit relatively rapid adjustment in the first year with the absolute of an economic expansion being significantly larger that that of a contraction. Following this initial period, the speed of adjustment slows. It takes about 5 years to converge to the new long-run stable equilibrium. Figure 3 demonstrates also the existence of asymmetric effects in the consumption-output relation dominated by the negative output shock in the long-run.

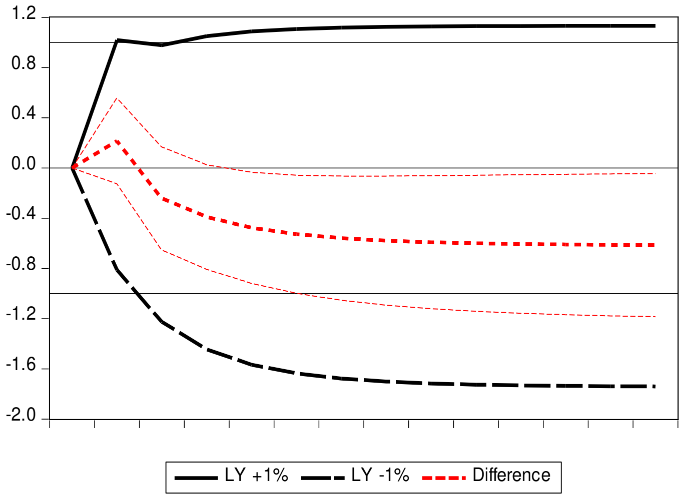

Figure 3: Cumulative asymmetric adjustments of consumption to output (dynamic multipliers and SR & LR asymmetry).

III. Conclusion

In this paper, we investigate possible nonlinearity in the consumption-output relationship in Tunisia. We evaluated the impact of the output shock on Tunisian consumption over the period from 1970 to 2019. We used an advanced NARDL model to analyze the co-integration of positive (expansion) and negative (recession) output changes on the Tunisian yearly consumption.

In the short-run, it is found that only the *positive* change in the output is significant while the *negative* change in output have no effect. An immediate *positive* change in partial sum of GDP (output) *increases* the consumption.

In the long-run consumption-output relationship in both recession and expansion period is highly significant suggesting that each of the partial sum of GDP changes leads to an *increase* in Tunisian consumption.

However, based on the dynamic multiplier analysis, the results indicate that consumption *respond rapidly* and strongly in the cumulative of partial sum output decrease (increase) in the very *short-run*. The full adjustment to the new equilibrium is relatively long process.

Consumption exhibit relatively rapid adjustment in the first year with the absolute of an economic *expansion* being significantly larger than that of a contraction. Following this initial period, the speed of adjustment slows. It takes about 5 years to converge to the new long-run stable equilibrium.

The positive coefficients of GDP growth (decline) implies that in the good (or bad) economic conditions (over 1970-2019 period) individuals make optimistic expectations and do not reduce their consumption spending in the long-run. Whereas, the Tunisian government is going towards the alleviation of the compensation fund. Under the impetus of the IMF, the authorities hope to reduce chronic budget deficits and a large public sector debt.

Before going to the harmful effect of the compensation subsidies reduction on the society, we propose then that the State has interest to (i) put in place some tools like rationalization of the consumption of fuel, (ii) achieve stability in the exchange rate target, and (iii) create a stable political and economic climate to encourage new investments, increase exports, and reduce imports. Otherwise, Tunisian risk to go further towards another revolution.

More investigations are needed then to see rigorously if the high rate of inflation and depreciation of the domestic currency (DT) against the current US $ contribute for consumption-output relationship.

Notes

1. (Bunting, 1989) concluded that Keynes's fundamental law is valid during 1929-1982 on US data. (Abeysinghe & Choy, 2004) suggested a long run stable equilibrium relationship between consumption, disposable income, and wealth in Singapore under the considered period of study. (Akekere & Yousuo, 2012) found a significant positive relationship between private consumption expenditure and the GDP in Nigeria during 1981-2010. (Ofwona, 2013) revealed that the (Keynes, 1936)'s Absolute Income Hypotheses was found to be significant over the period 1992-2011 in Kenya; that consumption is determined by income. (Khan et al., 2014) explored the Keynesian relationship between income and consumption using annual time series data for the period 1975 to 2012 in Pakistan. Results support the existence of a significant positive relationship between income and consumption.
2. According to the INS (Institut Nationale de Statistique), the trade deficit continued to widen to beat the record of 15.6 billion dinars in 2017, a deepening of 23.7% compared to a year earlier. As for the budget deficit, the increase reached more than 25% over the same period. The accumulation of a budget deficit with the trade deficit has resulted in an inevitable decline in the national currency value (TD) and then an increase in domestic inflation.
3. In view of Freidman's Permanent Income Hypothesis (PIH), equation (1) can be written as $LC_t = \alpha + \beta\ LYP_t + u_t$ (1)', where the Permanent Income YP_t can be measured by taking a 3 year moving average (MA) of aggregate income. The constant parameter α is expected to be positive (i.e. $\alpha > 0$). For the marginal propensity to consume (MPC), it is expected that the increase in consumption will be less than the increase in income (i.e., $0 < \beta < 1$).
4. ECM model can be formulated as the follow $\Delta LC_t = \lambda u_{t-1} + \sum_{i=1}^{n} \beta_i \Delta LY_{t-i} + \sum_{i=1}^{n} \pi_i \Delta LC_{t-i} + \varepsilon_t$, where coefficient of adjusment is $\lambda < 0$, and β_i and π_i coefficients

measure the short-run dynamics. The speed of adjustment λ is a percentage of the equilibrium error that is corrected in each period.

5. Or $\lambda = 0$ in the ECM representation.
6. For ARDL (Panel A) model, there is no clear cut results since based on bound critical values provided by (Pesaran et al., 2001) there is no cointegration at 5% level, while cointegration is present if conclusion is based on critical values provided by Eviews output.

Annex: Some Tables

Table A 1: Engel Granger non cointegration test results.

Dependent	τ-stat	Prob.*	Z-statistic	Prob.*	Conclusion
LC	-3.553237	**0.0409**	-20.02641	**0.0316**	Co-integration
LY	-3.589087	**0.0377**	-20.23874	**0.0299**	Co-integration

Dependent	τ-stat	Prob.*	Z-statistic	Prob.*	Conclusion
LC	-3.552533	0.0415	-20.84013	0.0246	Co-integration
LYP	-3.571775	0.0398	-20.95784	0.0238	Co-integration

Note: Null hypothesis: Series are not cointegrated.

Table A 2: Bound test results.

Panel A: for ARDL specification

Test Statistic	Value	Signif.	I(0)	I(1)	Conclusion
F_{PSS}	**4.752200**	10%	3.02	3.51	
k	1	5%	3.62	**4.16**	Co-integration !
		2.5%	4.18	4.79	
		1%	4.94	5.58	

Panel B: for NARDL model

Test Statistic	Value	Signif.	I(0)	I(1)	Conclusion
F_{PSS}	**7.062710**	10%	2.63	3.35	
k	2	5%	3.1	**3.87**	Co-integration
		2.5%	3.55	4.38	
		1%	4.13	5	

Note: The bound critical values reported in this Table are given by Eviews 10. From (Pesaran et al., 2001, p. 300) Table CI, Case III, the upper bound critical value of the F-test for cointegration when there are [1] 2 exogenous variables is [4.78 (5.73)] 4.14 (4.85) at the 10% (5%) level of significance.

References

Abeysinghe, T., & Choy, K. M. (2004). The Aggregate Consumption Puzzle in Singapore. *Journal of Asian Economics, 15*(3), 563-578.

Akekere, J., & Yousuo, P. J. (2012). Empirical Analysis of Change in Income on Private Consumption Expenditure in Nigeria from 1981 to 2010. *International Journal of Academic Research in Business and Social Sciences, 2*(12), 188-197.

Banerjee, A., Dolado, J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in single-equation framework. *Journal of Time Series Analysis, 19*, 267-283.

Brown, T. M. (1952). Habit Persistence and Lags in Consumer Behaviour. *Econometrica, 20*(3).

Bunting, D. (1989). The Consumption Function 'Paradox'. *Journal of Post Keynesian Economics, 11*(3), 347-359.

Engle, R. F., & Granger, C. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251–276.

Friedman, M. (1957). The Permanent Income Hypothesis: Comment. *American Economic Review, 48*, 990-91.

Gujarati, D. (2004). *Basic Econometrics,.* 4th Edition, McGraw-Hill.

Hall, R. (1978). Stochastic Implications of the Life-Cycle Permanent Income Hypothesis. *Journal of Political Economy, 86*(6), 971-987.

Hamilton, J. D. (1994). *Time Series Analysis.* Princeton, New Jersy: Princeton university press.

Hendry, D., Pagan, A., & Sargan, J. (1984). *Dynamic specification. In Handbook of Econometrics (Vol. II).* Amsterdam: Griliches Z, Intriligator MD (des). Elsevier.

Keynes, J. M. (1936). *The General Theory of Employment, Interest, and Money.* New York: Harcourt Brace & World.

Khan, A. Q., Azam, M., & Qureshi, M. E. (2014). Analysis of consumption behaviour concerning current income and lags consumption: Empirical evidence from Pakistan. *EKONOMSKI VJESNIK/ ECONVIEWS, Review of contemporary business, entrepreneurship and economic issues*, 59-70.

Modigliani, F. (1986). Life Cycle, Individual Thrift, and the Wealth of Nations. Nobel Lecture delivered in Stockholm, Sweden, December 9, 1985. *The American Economic Review, 76*(3), 297-313.

Ofwona, C. A. (2013). An Estimation of the Consumption Function for Kenya Using Keynes' Absolute Income Hypothesis for the Period 1992-2011. *Journal of Emerging Trends in Economics and Management Sciences, 4*(1), 103-105.

Pesaran, M. H., Shin, Y., & Smith, R. J. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association, 94*, 621–634. Retrieved from http://www.jstor.org/stable/2670182

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*, 289-326.

Pesaran, M., Shin, Y., & Smith, R. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*, 289-326.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. *In Festschrift in Honor of Peter Schmidt, Springer*, 281–314.