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Dynamic Asymmetries in the Electric Consumption of the GCC Countries

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ABSTRACT

This paper aims to achieve two fundamental objectives. First, we examine whether the electric consumption of the GCC countries exhibit any form of non-linearity that is of economic interest. In this context, we use the BDS test in order to determine the absence or presence of linear or non-linear dependence. The test results indicate that there is a substantial non-linear dependence in all the series of the countries in the region. In the second objective, we investigate the asymmetric properties of the electric consumption of these countries. In particular, we explore two types of asymmetry: deepness and steepness. The test results indicate that there is a strong corroborative evidence of asymmetric deepness and steepness relative to trend in these countries' electric consumption variable.

Keywords: Electric Consumption, Business Cycle Asymmetry, GCC Countries
JEL Classifications: E21, E32

1. INTRODUCTION

Since the pioneering work of Mitchell (1927) in which he wrote that "Business contractions appear to be a briefer and more violent process than business expansions," and the subsequent works by Keynes (1936), Burns and Mitchell (1946), Friedman (1969), DeLong and Summers (1988), Hamilton (1989) and Sichel (1993) among others, it has become exceedingly platitude that many macroeconomic variables exhibit asymmetric behavior around the business cycle. Hence, it has only been the last two decades that economists have instigated in examining empirically the business cycle hypothesis and became categorically eager in detecting non-linear structures in both macroeconomic and finance time series data. As such, one can easily glean from the empirical literature that many macroeconomic variables display idiosyncratic characteristics within each phase of the business cycle and have consistently shown more pronounced periods of expansions which are longer and slower than their corresponding periods of contractions[1]. However, if these variables exhibit business cycle asymmetries then this has noteworthy implications both theoretically and empirically in contemporary macroeconomics and more extensively for forecasting and policy analysis.

Theoretically, the presence of asymmetries has fundamental consequences in the formulations and assessments of business cycle models. For instance, once the existence of asymmetry is determined then this insinuates that linear models with symmetric shocks will no longer be germane for analyzing business cycle models. This is due to the fact that many of the standard statistical tests used in the empirical literature depend unwaveringly on the assumption of normality in their statistical analysis which in turn relies on symmetry. Subsequently by relying on linear models with Gaussian innovations (either implicitly or explicitly) at the outset in our statistical analysis will indubitably remiss the non-linear aspects of the data and will appropriately fail to illuminate indispensable characteristics of the underlying data[2]. So

1 Most of the empirical studies on this issue are confined on the time series data of the developed countries and little attention has been given to that of the less developed countries as well as the emerging markets. For the developed countries, see Kiani (2009), Narayan and Popp (2009), Carruth and Dickerson (2003), Bodman (2001), and Holly and Stannett (1995) among others. For emerging markets, see Narayan and Narayan (2007) and Narayan and Narayan (2008). On the other hand, most studies on electric consumption focusses on its relationship with economic growth, for instance see Pempetzoglou (2014).

2 For detailed discussions of the theoretical and empirical importance of asymmetries in business cycles, see for instance Sichel (1993), Bodman (2001) and McQueen and Thorley (1993).

knowledge of the presence of asymmetries in these variables will incontrovertibly enhance our understanding of the true dynamics of these macroeconomics time series, ability to model it more accurately and finally improve our forecasting exactitude.

Empirically, uncovering the existence of asymmetries in these variables is also important to the macroeconometric model builders since it can coxswain to the proper specification and estimations of the true model. Furthermore, it could also assist in comparing and contrasting the performances of the alternative theories. For instance, Filardo and Gordon (1998) have shown that non-linear models outperform linear models in predicting turning points in the business cycles. Also, empirically it is well established that asymmetries are not only variable specific but also country specific and subsequently if the variable in question is phase dependent then the underlying data generating process is non-linear. In this regard, asymmetry is indeed defined as non-linear phenomenon and archetypical non-linear relationships in macroeconomics are the standard Phillips curve, Okun's law, labor hoarding models and overlapping generations model among others.

For policy analysis, Boldin (1999) put it persuasively by suggesting that "policymakers should worry about asymmetries in business cycles because most econometrics models cannot capture empirically important asymmetries … most econometric model builders do not seem concerned with them …. I conclude that the symmetry/asymmetry question has as much, and maybe even more, practical significance than debates over identification assumptions that have influenced much of the empirical macroeconomic literature over the past 20 years."

Against this background, we will examine and investigate empirically the following objectives. In the first objective, we will explore whether the GCC countries' electric consumption exhibits any form of non-linearity that is of economic interest. In this context, we use the powerful BDS test in order to determine the absence or the presence of linear or non-linear dependence.[3] The second objective is to examine whether the electric consumption of these countries reveals two particular forms of asymmetry introduced by Sichel (1993).[4] He has introduced two different types of business cycle asymmetries that could exist either separately or in combination which he termed them as "steepness" and "deepness." Steepness asymmetry is defined as that when the business cycle contractions are steeper than the corresponding periods of expansions while deepness asymmetry is defined as when the amplitude of troughs differ from that of peaks. Although there are other forms of asymmetries, these two types of asymmetries are the most extensively researched asymmetries in the empirical macroeconomics and finance time series literature. Fourthly, as mentioned at the outset, most of the studies that examine on the issue of non-linear dynamics are from the industrialized countries and have consistently shown that macroeconomic variables such as GDP, industrial production index, investment, unemployment, money supply, CPI, exports, imports, exchange rates, and consumption behave asymmetrically around the business cycle while little attention has been paid to the less developed countries in general and emerging markets in particular. As such, to the best of our knowledge there is no study that examines the non-linearity dynamics of the macroeconomic variables of the GCC countries. One of our main objectives in this paper to investigate the presence or absence of non-linear dependence in the data series of the electric consumption of the GCC countries and more importantly to obtain information on the structure of the time series of this variable. Finally, our empirical exercise is focused on the univariate analysis of the electric consumption of these countries in order to observe if the times series dynamic can be approximated to a non-linear stochastic process.

In view of this, we have reasons to believe that the GCC countries' electric consumption exhibits asymmetric behavior around the business cycle. First, it is important to note that the economies of these countries are intrinsically dependent on oil revenues whose trends and prospects vary with the world market price which has been fluctuating erratically over the years. Hence it is conceivable that the oil price shocks might affect differently the different stages of the cycle or simply the propagation mechanism might be different over the different phases of the cycle. Per se, this could increase the cyclical sensitivity of the electric consumption of these countries. Secondly, in the literature it is well established that consumers behave differently in the different phases of the business cycle. For instance, Zandi (1999) contends that consumers may respond more rapidly to wealth contractions than expansions during the business cycle. Kuo and Chung (2002) strengthened this point further by arguing that the consumption behavior of the liquidity constrained consumers is unequivocally correlated to the business cycle. Thirdly, although there are no studies focusing on the asymmetry of the GCC countries, there is strong evidence of the existence of asymmetry in the Asian economies studied by Kiani (2009) and Narayan and Narayan (2008). Similarly, we expect that asymmetric business cycle fluctuations are also present in these countries. Fourthly, as alluded hitherto the studies focusing on the possible existence of business cycle asymmetries were predominantly done for the developed countries but such research is non-existent for the GCC countries. Hence, it is our objective to fill this research gap. If the electric consumption of these countries is found to be asymmetric, then this will assist the policy makers by implementing appropriate macroeconomic policy measures in order to avoid any anticipated recessions in these economies. Finally, whether the electric consumption of these countries exhibits asymmetric behavior as the business cycle unfolds is hereafter an empirical interest whether this variable provides a richer source of such non-linearity and asymmetry.

The rest of the paper is organized as follows: section II discusses the data and methodology while section III presents the empirical results. Section IV concludes the paper.

3 Although the BDS is a powerful test in detecting nonlinearity structure in the data, it does not give any guidance as to the form of the underlying nonlinear generating mechanism, but it is important to note that it has a high power against a vast class of linear, non-linear and non-stationary models.

4 In our context asymmetry in the GCC electric consumption is simply defined that it responds differently to economic expansions and contractions. But the actual sources of asymmetry will not be addressed or investigated in this paper.

2. METHODOLOGY

2.1. The Hodrick–Prescott (HP) Filter

As a first step, before testing whether these macroeconomic variables exhibit cyclical asymmetry, it is indispensable that we derive the cyclical components of these variables. In the literature there are many statistical filters that are extensively used to extract the cyclical components of any macroeconomic time series. But in this paper we adopt the Hodrick and Prescott (1997) filter to extract the cyclical components of this variable since it is the most pervasive one among economists. As is standard in the literature, before applying the HP filter to these variables and deriving their cyclical components, we transform the data in to its natural logarithm. Similar to other statistical filters, this filter is not based on economic theory or on a structural relationship, but it instead gives a useful approximation of the growth rate of potential output. A desirable feature of the HP filter is that it makes output gap stationary over a wide range of smoothing values and allows the trend to change overtime. In addition, it is flexible and very simple to implement, which has contributed significantly to its wide application in the literature.

The HP filter identifies a long-term trend component of output by minimizing a loss function of the form:

$$L = \Sigma_s^{\,t} (y_t - y_t^T)^2 + \lambda\, \Sigma\, (\Delta y_{t+1}^{\,T} - \Delta\, y_t^T)^2 \qquad (1)$$

That is a weighted average of the gap between actual and potential output and the rate of change of trend output. According to this method, the weighting factor, λ, is an exogenous detrending parameter and is set arbitrarily. Hodrick and Prescott suggest to set λ at 1600 for quarterly data and 100 for annual data. But the size of the weighting factor has been very contentious in the literature with some authors using different values for λ (Billmeier, 2004). The central argument is that the magnitude of the weighting factor determines how potential output responds to movements in actual output since it controls the smoothness of the series, by setting the ratio of the variance of the cyclical component and the variance of the actual series[5]. Needless to say that the magnitude of the output gap varies with the size of the smoothing factor, but most importantly, it also affects the relative scale and timing of the peaks and troughs in output.

Even with the two-sided filters, the HP filter has been criticized due to its end-of-sample problems[6]. Other statistical methods seem to suffer from the same weakness. A number of authors have noted that the end-of-sample estimates of output gap at the end of the sample is likely subjected to substantial revision as new data become available, a period that is of most relevance to policymakers. A number of corrective measures have been proposed - at least partially - to resolve this issue. The most preferred solution, as suggested in the literature, is that of extending the dataset with forecast variables. However, these corrective measures are in turn dependent on the accuracy of these forecasts. Nonetheless, if these remedial procedures are not undertaken, such as using output projections to augment the observations, this could lead to policy failures for users who are by and large interested in the most recent observations in order to make projections for the immediate future.

2.2. Testing for Cyclical Asymmetry

2.2.1. The BDS test

In order to test the presence of cyclical asymmetry or non-linearity in the electric consumption of the GCC countries, we use the BDS test[7]. This test was developed by Brock et al., (1987 and revised in 1996) and since has become one of the most commonly utilized tests in the literature for detecting linear and non-linear dependence or chaos. Not only it is useful in detecting serial dependence and non-linear structure in many macroeconomic and financial time series variables but it also serves as a general diagnostic tool in determining the adequacy of estimated models. The basic idea of the test is fairly simple and can be easily applied to any time series data whether it is macroeconomics or finance. First it is worth recognizing that unlike the other tests which are parametric the BDS test is a non-parametric test and is very similar to that of the Portmanteau test[8]. The test is essentially applied to the estimated residuals of a series in order to determine whether these residuals are independent and identically distributed (IID). Under this test the null hypothesis is that the time series sample in question comes from a data generating process that is IID against an unspecified alternative. To perform this test one needs to compute the correlation integrals of the time series ((X_t), t = 1 …, T) by first defining its m dimensional vectors such that the series becomes as $(X_t^m) = (X_t,\ X_{t+1}, \ldots\ X_{t+m-1})$ and then decide the distance ε of each pair of the vectors. Hence, the BDS statistic is defined as

$$C_{m,T}(\varepsilon) = T^{1/2}\,\frac{C_T(\varepsilon) - C_1(\varepsilon^m)}{\sigma_{m,t}(\varepsilon)} \qquad (2)$$

Where:

$$\sigma_m(\varepsilon) = 4\left[K^m + 2\left(\sum_{j=1}^{m-1} K^{m-j} C(\varepsilon)^{2j}\right) + (m-1)^2 \times C(\varepsilon)^{2m} - m^2 K C(\varepsilon)^{2m-2}\right] \qquad (3)$$

Similar to other serial dependence tests it has some weaknesses that are documented in the literature. One of its major weaknesses is that since it uses the concept of correlation integrals which measures the spatial correlation among the points to calculate the BDS statistic it is sensitive to the values of the embedding dimensions "m" and the distance parameter "ε." The choice of the values of these parameters is arbitrary and generally there is no well-defined criterion that determines their values. Virtually, the values of these two parameters are commonly left to the

5 Higher values of λ leads to higher weight attached to the smoothness of the trend and vice versa. More precisely, as λ approaches infinity this resembles the linear trend method and as λ approaches zero the potential output will be equal to actual output.

6 The difference between the two-sided filters and the one-sided filter is that the two sided-filters use both past and future information while the one-sided filters use only past information.

7 For a comprehensive analysis of the test, see the original paper by Brock et al. (1996) and Gao et al., (1993).

8 Other tests that are similar to the BDS test include Tsay test,.

discretion of the author although Brock et al. (1996) have made some specific recommendations. They have suggested that the values that "m" takes essentially depends upon the number of observations in the data set or simply the sample size in question. Accordingly, "m" follows the following rule: $2 \leq m \leq 5$ if $T \leq 500$ where T = number of observations. They also recommended that the distance parameter "ε" be set as a proportion to the sample standard deviations. Conventionally, "ε" takes these values of 0.5; 0.75; 1.00; 1.25 and 1.50 times the series' standard errors. In the present study, we set the "m" values in the range of 2-5 inclusive.

2.2.2. The Sichel's test

It is truism that macroeconomic time series display some form of asymmetry over the different phases of business cycle. Particularly, as Sichel (1993) indicated, time series variables contain two types of asymmetry either separately or simultaneously. These two types of asymmetries are termed as: (i) Steepness, and (ii) deepness. In the business cycle context, deepness asymmetry is characterized as one which is negatively skewed relative to its mean or trend. More precisely, it occurs when it has more observations above trend than below it and that the cyclical troughs are normally further below trend than the cyclical peaks are above trend. On the other hand, a series which displays a steepness asymmetry is one in which contractions in the cycle are steeper and short lived than their corresponding expansions in the cycle. This means that steepness asymmetry occurs when changes in the cyclical component of the series is negatively skewed. In order to complete our exercise of the cyclical behavior of the time series, one needs to construct a formal test of these two concepts of asymmetry. Following Sichel (1993) one needs to construct a coefficient of skewness in order to test these two concepts.

For deepness test, the following coefficient of skewness is used.

$$D(c) = \left[\left[\left(\frac{1}{T}\right)\sum(c_t - \bar{c})^3\right]\right] / \sigma^{(c)^3} \tag{4}$$

Where $\bar{c}$ the mean of the cyclical component of the series,c_t T is the sample size and σ (c) is the standard deviation of c_t. Since the c_t are likely to be serially correlated and heteroscedastic then an asymptotically consistent standard error of D(c) is needed. To this end, Sichel proposed that the following variable be constructed.

$$Z = \frac{(c_t - \bar{c})^3}{\sigma^{(c)^3}} \tag{5}$$

Then, this variable is regressed on a constant and compute the Newey–West standard error for the regression coefficient. The resulting estimated coefficient of this regression is identical as the deepness static, D(c) in equation (1) and the Newey–West (1987) standard errors are asymptotically normal.

Similarly, for steepness asymmetry test, this coefficient of skewness is used.

$$S(\Delta c) = \left[\left[\left(\frac{1}{T}\right)\sum(\Delta c_t - \Delta\bar{c})^3\right]\right] / \sigma\,(\Delta c)^3 \tag{6}$$

Where $\Delta\bar{c}$ is the sample mean of the Δc and σ(Δc) is the standard deviation of Δc. In order to test the significance of the point estimate of equation (3), we construct the following variable.

$$Z = \frac{(\Delta c_t - \Delta\bar{c})^3}{\sigma^{(\Delta c)^3}} \tag{7}$$

Again the test proceeds as before by regressing this variable on a constant and the resulting estimated coefficient is similar to the steepness asymmetry statistic of equation (3).

3. DATA AND EMPIRICAL ANALYSIS

As was mentioned at the outset, in this paper we culminate our efforts on analyzing the dynamics of the electric consumption of the GCC countries namely Bahrain, Kuwait, Qatar, Oman, Saudi Arabia and the United Arab Emirates. We use annual data and the choice of the frequency of the data as well as the starting period is unreservedly determined by the availability of the data. Electric consumption is measured in KWH and the data were obtained from the World Bank Indicators 2014. Before proceeding with the empirical analysis, it will be instructive to examine the underlying statistical features of the data. Table 1 provides descriptive statistics that can be used as a preliminary evidence of asymmetric behavior of the electric consumption of the GCC countries. The Table 1 shows that there is greater homogeneity in the behavior of the electric consumption across the countries in the region. In particular, it is noteworthy to observe that the values of the mean and the median are very comparable across the countries in the region with Oman posting the lowest values in both variables.

In line with the conventional practice of modern time series econometrics, we begin our empirical analysis by first testing the order of integration of the variables used in our estimation process. In order to ascertain the stationarity of the variables (i.e. the electric consumption variable of the GCC countries), we used the standard Augmented Dickey-Fuller (1979) test. Test statistics for each series in both levels and first differences for all the countries are presented in Table 2. As can be gleaned from Table 2, the null hypothesis of non-stationarity cannot be rejected at the conventional level of significance for all the levels and this implies that all the series are integrated of order (I[1]) except Qatar and Saudi Arabia which are integrated of order (I[2]). Hence, this undoubtedly demonstrates that the presence of a unit root is straightforwardly rejected for all the countries.

Table 1: Summary statistics

Countries	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Kurtosis	JP-P value
Bahrain	21.898	21.970	23.349	19.879	0.9814	−0.5027	2.36936	0.30025
Kuwait	23.477	23.622	24.642	21.604	0.8523	−0.5491	2.31203	0.23819
Qatar	22.144	22.242	24.127	19.568	1.2046	−0.5278	2.57370	0.33047
Oman	21.646	22.254	23.808	16.380	1.8894	−1.2068	3.63859	0.00486
Saudi Arabia	24.525	24.959	26.146	21.403	1.3880	−0.9337	2.68406	0.04667
UAE	23.353	23.576	25.319	19.128	1.5345	−0.954	3.3234	0.0405

On the other hand, the Kingdom of Saudi Arabia posted the highest values in these variables among the countries in the region. The minimum and the maximum statistics indicate that the series did not fluctuate significantly for most of the countries in the region except Oman and the United Arab Emirates. More precisely, Oman shows the greatest variation over the sample period and exhibits the highest standard deviation while Kuwait reports the lowest standard deviation. A significant finding is that the coefficient of skewness is low and negatively skewed implying that the distribution of the data series has a long left tail. For most of the countries the value of the kurtosis is less than three whereas for Oman and UAE, the value of the kurtosis exceeds the benchmark for normal distribution of three indicating the lack of symmetry in the distribution. Correspondingly, the results reported in the Table 2 indicate that for all the countries the electric consumption variable did not follow normal distribution during the period of study.

As indicated at the outset, in order to determine the possibility of existing non-linear dependency, we have used the BDS test. Tables 3-5 provide the BDS test results of the electric consumption series of the GCC countries for all the embedding dimensions from 2 to 8. This test which is a form of portmanteau test is essentially used to detect whether the series of the estimated residuals are IID. Hence, according to the BDS test results obtained, the null hypothesis of IID is strongly rejected since the *P* values are below 0.05. In that sense, the results reveal that there is a substantial non-linear dependence in all the series of the countries in the region. To this end, the BDS test results imply that there may be non-linear structure in the data set and this allows one to apply further the techniques of non-linear data analysis.

Table 6 provides the test results of deepness and steepness asymmetries of the GCC countries. These results have been derived using annual data covering the period from 1971 to 2011 on the electric consumption of the GCC countries. As can be garnered from Table 6, the results indicate that not only the electric consumption series of the GCC countries are characterized by deepness and steepness asymmetry but are also highly significant except Bahrain whose steepness statistic is not significant at any conventional level. More specifically, all the countries in the region show that they are characterized by positive deepness and negative steepness asymmetry during the sample period under consideration. These results imply that positive deepness indicates that peaks' heights are greater or deeper than troughs in this series while negative steepness indicates that contractions are steeper than expansions. Consequently, these results could be considered as evidence of asymmetric behavior of the electric consumption series of the GCC countries.

4. CONCLUSION

It is truism that macroeconomic variables behave differently in the different phases of the business cycle. This hypothesis of business cycle asymmetries is mostly tested on the developed economies and little attention has been given to the less developed countries. Particularly, no study on this issue has been done on the GCC countries and this paper is intended to fill this gap in the literature. Therefore, we have culminated our efforts in investigating two main objectives in this paper. In the first objective, we focused on examining whether the electric consumption of the GCC countries exhibit any form of non-linearity that is of economic interest. To this end, we have used the BDS test in order to determine the presence or lack thereof linear or non-linear dependence. The test results indicated that there is a substantial non-linear dependence in all the series of the countries in the region and this implies that

Table 2: Unit root test results

Country	Level	1st difference	2nd difference
Bahrain	−2.14	−5.91	
Kuwait	−2.69	−6.72	
Qatar	−2.33	−3.67	−9.32
Oman	−2.06	−8.81	
Saudi Arabia	−2.53	−1.62	−11.60
UAE	−3.68	−6.57	

Table 3: BDS test results

Country	Bahrain				Kuwait			
Dimension	BDS statistic	Standard error	*z*-statistic	*P*	BDS statistic	Standard error	*z*-statistic	*P*
2	0.2012	0.009	21.60	0.000	0.1922	0.009	20.94	0.000
3	0.3418	0.015	22.70	0.000	03271	0.014	21.97	0.000
4	0.4428	0.018	24.28	0.000	0.4207	0.018	23.26	0.000
5	0.5153	0.019	26.65	0.000	0.4861	0.019	25.27	0.000
6	0.5689	0.018	29.99	0.000	0.5325	0.018	28.12	0.000
7	0.6093	0.017	34.44	0.000	0.5668	0.017	31.99	0.000
8	0.6427	0.015	40.38	0.000	0.5930	0.015	37.08	0.000

Table 4: BDS test results for Qatar and Oman

Country	Qatar				Oman			
Dimension	BDS statistic	Standard error	*z*-Statistic	*P*	BDS statistic	Standard error	*z*-statistic	*P*
2	0.1953	0.011	17.67	0.000	0.2084	0.013	14.89	0.000
3	0.3333	0.017	18.57	0.000	0.3548	0.022	15.62	0.000
4	0.4347	0.021	19.91	0.000	0.4583	0.027	16.57	0.000
5	0.5088	0.023	21.88	0.000	0.5310	0.029	18.01	0.000
6	0.5637	0.022	24.59	0.000	0.5822	0.029	20.02	0.000
7	0.6048	0.021	28.16	0.000	0.6180	0.027	22.67	0.000
8	0.6394	0.019	32.93	0.000	0.6431	0.024	26.07	0.000

Table 5: BDS test results for Saudi Arabia and UAE

Country	Saudi Arabia				UAE			
Dimension	BDS statistic	Standard error	*z*-statistic	*P*	BDS statistic	Standard error	*z*-statistic	*P*
2	0.2082	0.012	16.20	0.000	0.2073	0.012	16.02	0.000
3	0.3554	0.020	17.08	0.000	0.3521	0.021	16.76	0.000
4	0.4583	0.025	18.14	0.000	0.4547	0.025	17.79	0.000
5	0.5307	0.026	19.75	0.000	0.5282	0.027	19.41	0.000
6	0.5807	0.026	21.97	0.000	0.5812	0.026	21.67	0.000
7	0.6151	0.024	24.88	0.000	0.6196	0.025	24.65	0.000
8	0.6388	0.022	28.63	0.000	0.6474	0.022	28.50	0.000

Table 6: Test results for deepness and steepness asymmetry

Country	Deepness			Steepness		
	Coefficient	*t* value	*P* value	Coefficient	*t* value	*P* value
Bahrain	0.235	2.77	0.008	−0.092	−1.56	0.128
Kuwait	1.217	2.96	0.005	−0.117	−2.38	0.022
Qatar	0.274	2.45	0.019	−0.114	−2.35	0.024
Oman	0.154	3.35	0.001	−0.116	−2.41	0.020
Saudi Arabia	0.157	3.53	0.001	−0.075	−1.69	0.098
UAE	0.203	2.74	0.009	−0.117	−2.04	0.048

linear models will no longer be germane for their analysis. This will irrefutably remiss the non-linear aspects of the data. In the second objective, the asymmetric properties of the electric consumption of the GCC countries were tested using Sichel's methodology. Particularly, two types of asymmetry that is deepness and steepness tests were performed and the results revealed that the electric consumption of the countries in the region are characterized by positive deepness and negative steepness asymmetry during the sample period under investigation.

This finding has important macroeconomic implications in terms of designing and formulating economic models that are designed to capture the dynamics of these variables. For instance, the finding of asymmetric behavior in these variables suggest that linear models are not capable of generating asymmetric fluctuations as expressed by Sichel (1993). To this end, an important caveat is in order. Policy makers should be cautious and pay attention to the asymmetric properties of these variables since this could lead to very different model simulations being derived with significantly different policy implications.

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