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Do confidence indicators lead Greek economic activity?

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Abstract

In this paper, we evaluate the role of several confidence indicators (i.e., Economic Sentiment Indicator, Consumer Confidence Indicator, Construction Confidence Indicator and Industrial Confidence Indicator) as leading indicators to GDP and its components such as Investments and Private Consumption. Our econometric evaluation performed by popular techniques such as: i) rolling correlation methodology ii) Granger causality iii) ARIMA benchmark model and iv) Kalman filter technique. The results suggest that the inclusion of confidence indicators does not improve substantially the forecasting ability of our econometric models as far as macroeconomic variables are concerned. Thus, we conclude that there is space for improvement of the predictive power of confidence indicators in Greece.

JEL classification numbers: E21, E23, E37.
Keywords: confidence indicators; GDP; Granger causality; ARIMA; forecasting

1 Introduction

Economic confidence indicators are widely used by a significant number of international institutions in order to forecast economic activity (real GDP, consumption, investment rates and the unemployment rate among others). A confidence indicator is a statistical indicator based on the results of business surveys interrogating households and enterprises on their current economic situation and their expectations about future developments. The usage of confidence indicators to forecast economic activity is tempting because they are readily available on a monthly basis. Thus, the monthly frequency with which these data are made available is a strong advantage, taking into consideration that most data for economic variables are often released on a quarterly basis. However, the usefulness of confidence indicators to predict economic activity is a controversial issue that many authors tried to counter, with mixed results.

Seminal studies focused on what extent confidence indicators provide information that could be helpful to forecast future economic growth such as Pigou (1927) and Clark (1917). According to Pigou (1927) the psychological factors, such as waves of optimism and pessimism, lead entrepreneurs to false expectations about future profits. Similarly, Clark (1917) supports that a sudden wave of optimism can create an "impulse" that propagates economic growth. Recent studies also find that sentiment indicators have predictive power for future economic developments are, among others, Klein and Ozmucur (2010), Brinca and Dees (2011), Christiansen et al (2014). More specifically, Klein and Ozmucur (2010) found

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that the inclusion of economic sentiment indicator (ESI) improves forecasting performance of manufacturing growth by adding explanatory power, compared to a model, which is based only on past values of manufacturing growth. Brinca and Dees (2011) drawing data from both the United States and the Euro Area showed that confidence indicators can be a good predictor of consumption, since the contribution of confidence in explaining consumption expenditures increases when household survey indicators feature large changes. Finally, yet importantly, Christiansen et al (2014) found that sentiment variables are strong predictors of US recessions.

On the other hand there are studies concluding that sentiment indicators provide only limited information for predicting real economic activity (Croushore, 2005; Cotsomitis and Kwan, 2006). Croushore (2005) had shown that the levels of sentiment indicators are not able to add any additional information to the nowcast of US private consumption thus the consumer confidence indicator (CCI) may have only incremental power in conditional regression models. Cotsomitis and Kwan (2006) found that both consumer confidence indicator and economic sentiment indicator provide limited information about the future path of household spending in selected European economies. Other studies conclude with mixed results (Santero and Westerlund, 1994, Lozza et. al 2016, Croux et al, 2016). Santero and Westerlund (1994) find that the relationship between sentiment indicators and output varies considerably across countries and sentiment measures. They also found that consumer confidence indicators are much less useful than business confidence indicators for economic analysis due to their much looser relationship with output movements. Lozza et. al (2016) showed that the predictive power of consumer sentiment is stronger for the following trimester, while less predictive synchronously; and that its predictive power was stronger between 2009 and 2013 (i.e., crisis years) compared to previous years. Croux et al (2016) used both business and bank sentiment surveys answered by firms across Germany. They concluded that not all industry-specific sentiment indicators are equally predictive for all macroeconomic indicators.

Motivated by the work of Mourougane and Roma (2002), who investigated the usefulness of the European Commission confidence indicators for forecasting real GDP growth rates in selected euro area countries (Belgium, Germany, France, Spain, Italy and Netherlands). They conclude that indeed confidence indicators can be useful to predict GDP growth in the short-run.

In the European Union the business and consumers surveys are conducted by all member states, on the basis of the harmonized questionnaires from the European Commission. For Greece, particularly, the institution responsible for conducting the surveys, analyzing the data and publishing the results is the Foundation for Economic and Industrial Research (IOBE). The surveys of IOBE are conducted continuously since 1981 and they are part of the Harmonized Business Surveys Program of the European Union. Since January 2008 IOBE is the only conductor in Greece of the Consumer Survey (consumer confidence) for the Directorate General for Economic and Financial Affairs of the European Commission. The surveys are conducted on a monthly basis and concern surveys for consumers and businesses in the industry, construction, retail trade and services.

Our contribution to the current literature is twofold. Firstly, to the best of our knowledge, this will be the first study that will present evidence for the link of confidence/sentiment indicators to real macroeconomic variables for the Greek economy. Secondly, we explore the predicting value of the confidence indices not only to GDP but also to GDP components such as Investments (measured by Gross Fixed Capital Formation) and Private Consumption (Final consumption expenditure of households and non-profit institutions serving households, abbreviated as NPISH). Since the GDP components have different impact to the GDP, it is more appropriate to control for the predictability of the indices not only to the GDP, but also to its components, such as private consumption and investment. For instance, the construction confidence index is more likely to track closely the gross fixed capital formation since constructions correspond during the last decades to approximately 30% of total investments in Greece; while construction value corresponds only to, roughly, 4% of Greek GDP. Following the same line of

consideration, the "consumer sentiment index" is more likely to predict closer the Private Consumption than the GDP or other GDP components. Therefore, we include in our analysis the most popular confidence indicators, such as Economic Sentiment Indicator, Consumer Confidence Indicator, Construction Confidence Indicator and Industrial Confidence Indicator investigating their relation not only to GDP but also to its basic components such as consumption and investment.

The relationship is controlled with various econometric techniques. Firstly, a simple and a rolling correlation between the aforementioned macroeconomic variables and confidence indicators is employed for a preliminary analysis of the relationship. Subsequently more formal econometric methodologies are employed. In order to investigate both short-run and long-run relationships, a linear relationship (Granger causality) is estimated and the forecasting performance of the estimated models is compared with a benchmark ARIMA model. Finally, we perform robustness test using a Kalman filter technique.

The remainder of the paper is structured as follows. Section 2 presents the data and a preliminary analysis through simple and rolling correlations. Section 3 introduces the testing framework including a description of Granger causality and ARIMA processes. Section 4 provides the empirical results and robustness tests using a Kalman filter technique. Finally, Section 5 reports the concluding remarks.

2 Data and preliminary analysis

The following data expanding from 1995 Q1 until 2016 Q4 for Greek economy are used in the analysis: The ESA 2010 seasonally and calendar adjusted for quarterly real GDP, the quarterly real household and NPISH final consumption expenditure (private consumption, hereafter) as well as the quarterly real gross fixed capital formation (investments, hereafter).

Regarding the monthly European Commission confidence indicators, we use the Economic Sentiment Indicator (ESI, hereafter), Consumer Confidence Indicator (CCI, hereafter), Construction Confidence Indicator (Con. CI, hereafter) and Industrial Confidence Indicator (ICI, hereafter) for the period 1995 Q1 until 2016 Q4.4 Data are seasonally and calendar adjusted. Monthly data were converted into quarterly series using a simple average. All data are sourced from Eurostat.

Following the approach of Mourougane and Roma (2002) we obtain the real GDP growth as the quarter over quarter percentage change. The same approach is followed for the other two macroeconomic variables (private consumption and investments). Furthermore, in order to describe the indicators, we use their first difference. The reasons for choosing the quarter over quarter growth rate, is that for short-term forecasts this analysis is tracking closer the cyclical changes than the year over year analysis which depends on what happened one year before.

Figure 1 illustrates the evolution of GDP growth and confidence indicators (first differences) during the period from 1995Q1 to 2016Q4. The figure does not show a clear relation of GDP growth to the four confidence indices, since the Global Financial Crisis and European Sovereign Debt Crisis hit Greece severely. Additionally, confidence indicators seem more volatile than the GDP. Figure 2 shows that private consumption growth has not tended to co-move with confidence indicators, since there are many spikes to confidence indicators that are not present in private consumption growth and vice versa. Figure 3 shows also that the grossed fixed capital formation follows a diverse path from confidence indicators. These preliminary results give some indications for the relation between GDP/components and indices but the results are not crystal clear, evoking the need for more advanced econometric techniques.

[4] The economic sentiment indicator, abbreviated as ESI, is a composite indicator made up of five sectoral confidence indicators with different weights: industrial confidence indicator (40%); construction confidence indicator (5%); services confidence indicator (30%); consumer confidence indicator (20%); retail trade confidence indicator (5%).

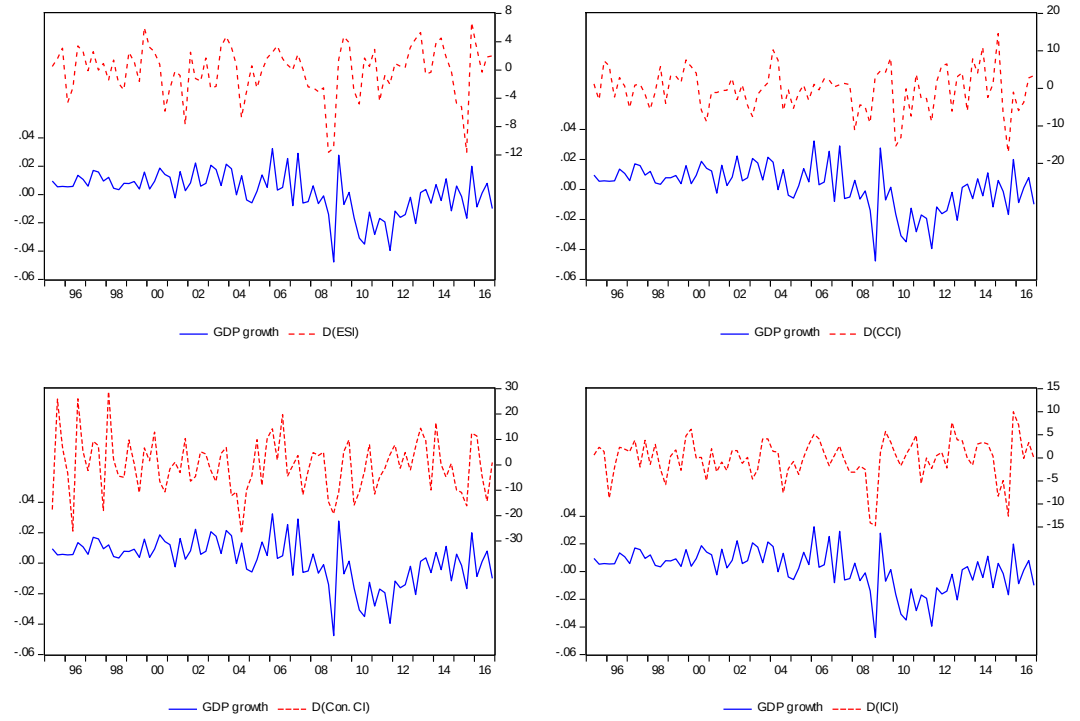

Figure 1: GDP growth and confidence indices behavior over time

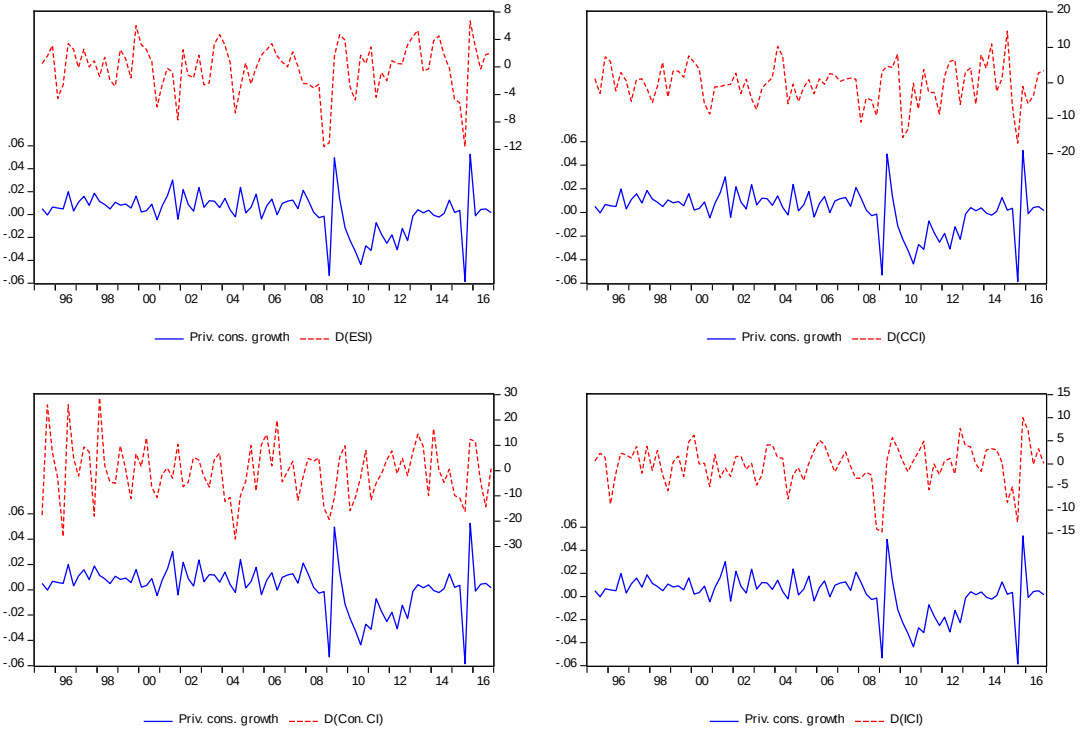

Figure 2: Private consumption growth and confidence indices behavior over time

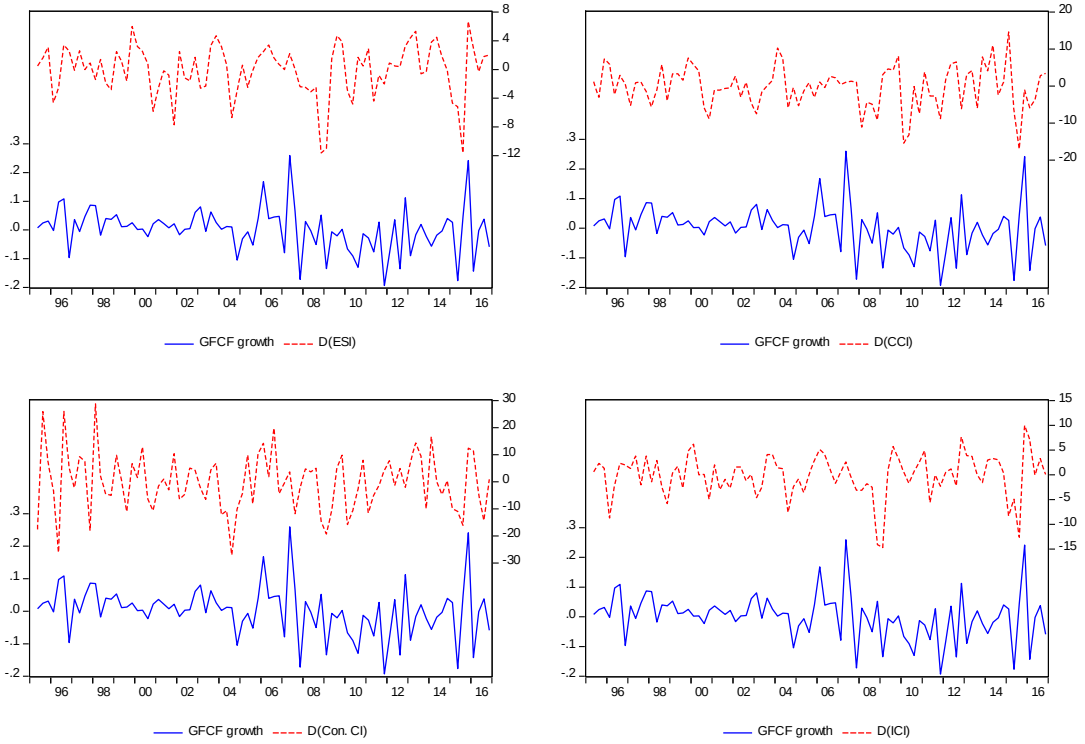

Figure 3: GFCF growth and confidence indices behavior over time

2.1 Simple and rolling correlation analysis

In more deep analysis, we check the correlation statistics among the three macroeconomic variables (GDP, Private Consumption and Investments measured by Gross Fixed Capital Formation) and four confidence indicators indices in first differences (Economic Sentiment Indicator, Consumer Confidence Indicator, Construction Confidence Indicator and Industrial Confidence Indicator). Drawing from Santero and Westerlund (1996) we consider, as a rule of thumb, a correlation coefficient exceeding 0.75 as large. Table 1 below shows the correlation values and the statistical significance between the macroeconomic variables and the confidence indicators. Statistical significant correlation values are observed mainly between the macroeconomic variables and D(ESI) or D(ICI). However, the correlation values are rather low (far below the threshold of 0.75). Furthermore the remaining correlations are also low and not statistically significant - except for the correlation of private consumption growth to D(CCI).

Table 1: Correlations among confidence indicators and macroeconomic variables (GDP, Private Consumption and Investments)

	GDP growth	**Private Cons. growth**	**GFCF growth**
D(ESI)	0.3050***	0.3741***	0.1890*
t-stat.	(2.953)	(3.719)	(1.774)
D(CCI)	0.1688	0.2581**	0.0370
t-stat.	(1.579)	(2.463)	(0.341)

D(Con. CI)	0.1759	0.1667	0.1466
t-stat.	(1.648)	(1.559)	(1.366)
D(ICI)	0.2705**	0.3038***	0.2190**
t-stat.	(2.590)	(2.940)	(2.069)

Notes: *** and ** represent statistical significance at the 1% and 5% levels, respectively.

At a next level analysis, in order to capture the correlation behavior of the series over time, we estimate the rolling correlation coefficients among confidence indicators and macroeconomic variables. This technique allows the evaluation of their co-movement relationship, as well as its stability over time. Figures 4-6 show rolling correlations for a 12-quarter window (ECB 2006) for the period 1995Q1-2016Q4. The paths of correlations are in all case high volatile and with diverse intensities over time. However most of the time the rolling correlation of the variables examined does not go beyond the bound of 0.75 but in the most cases, the rolling correlations stay between the band of -0.4 to 0.4. Since the simple correlation analysis does not show a significant relationship between macroeconomic variables and confidence indicators more formal econometric evidence is needed in order to clarify whether or not a strong link between macroeconomic variables and confidence indicators existed in Greece during the last two decades.

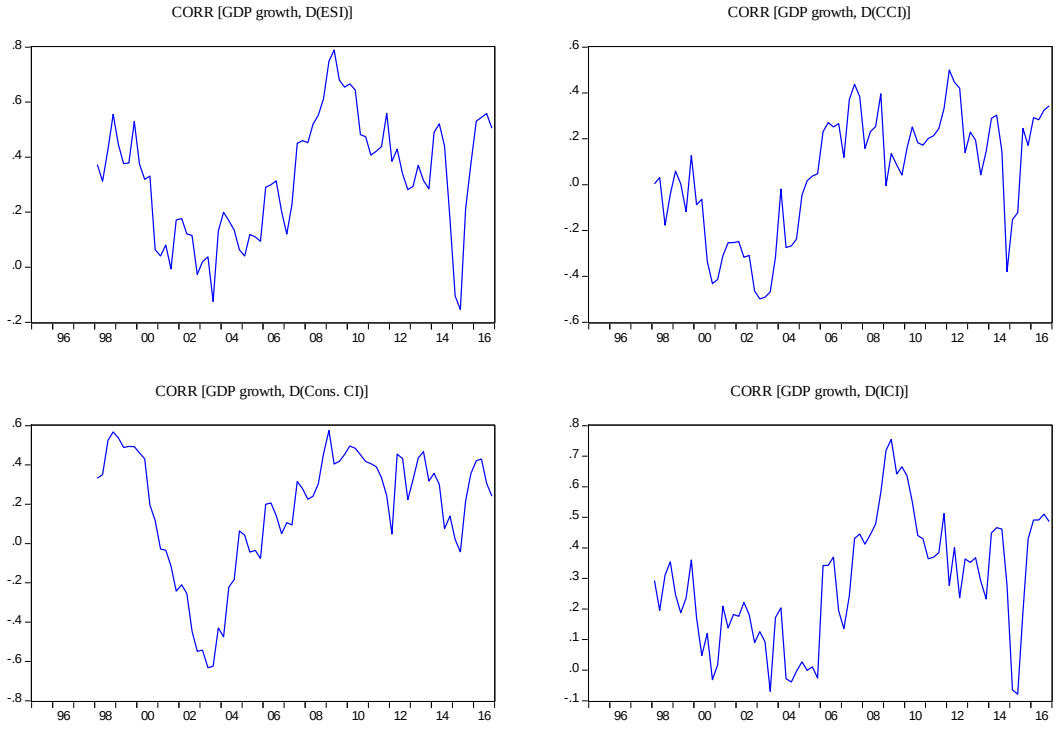

Figure 4: Rolling correlations among confidence indicators and GDP growth

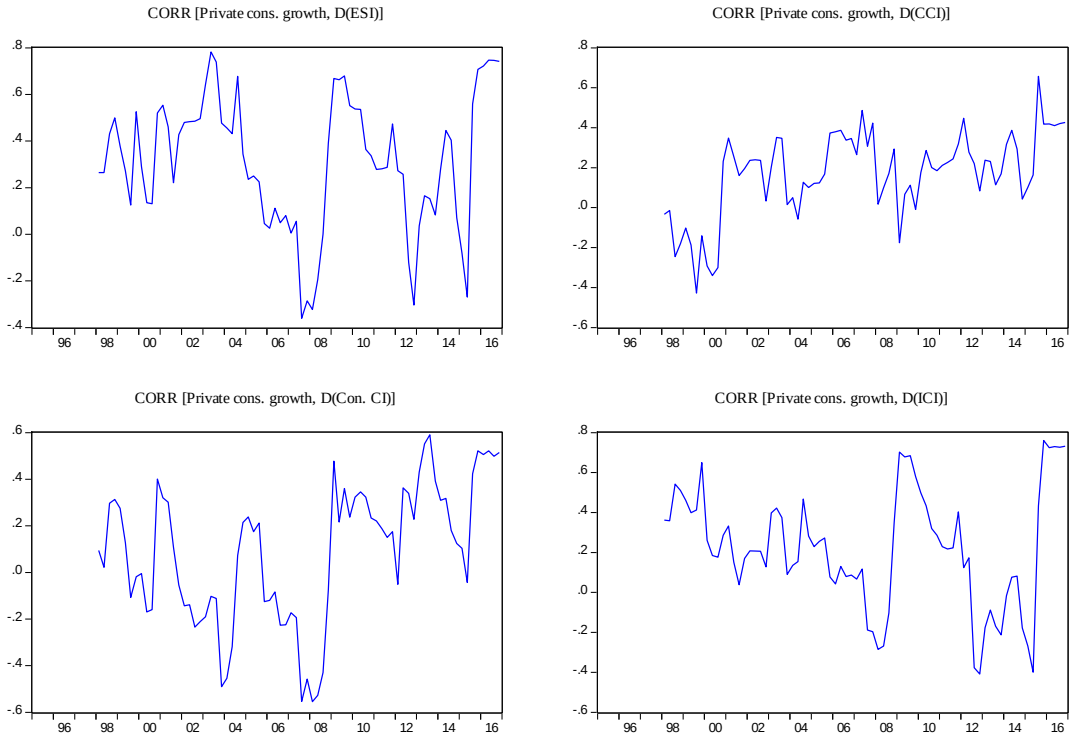

Figure 5: Rolling correlations among confidence indicators and Private cons. growth

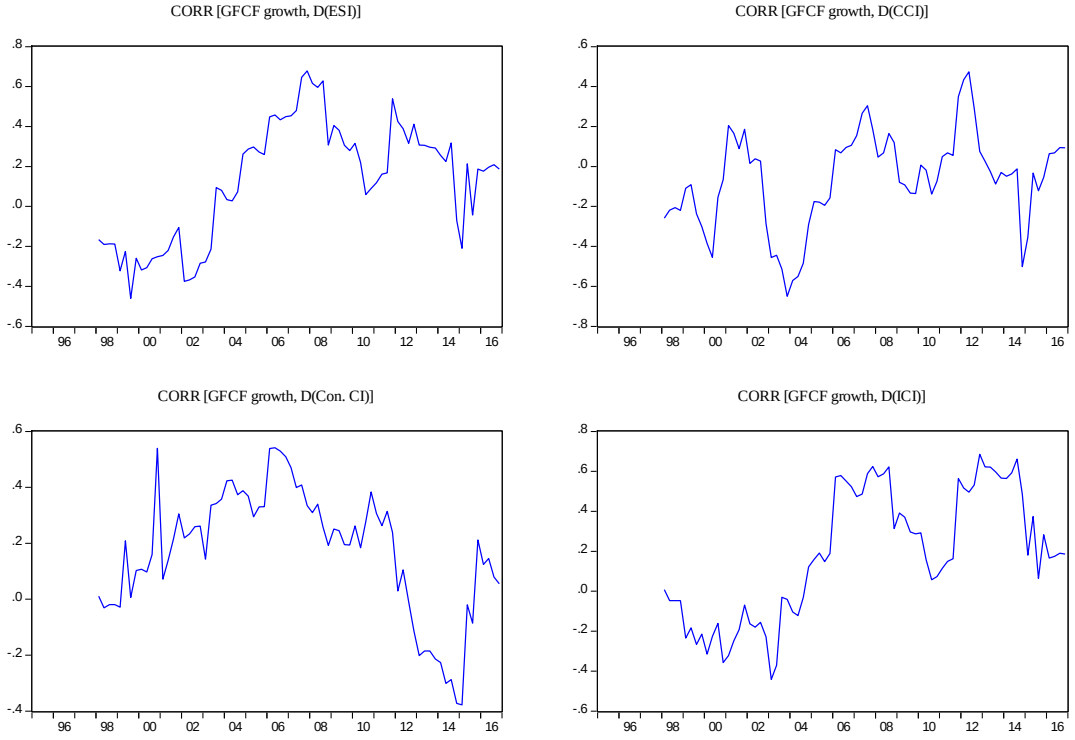

Figure 6: Rolling correlations among confidence indicators and GFCF growth

3 Testing framework

In order to assess the predicting power of confidence indicators, we follow various econometric techniques. Firstly, we implement the Granger causality test to examine the existence of short-term causal relationships between confidence indicators and macroeconomic variables. Let y_t and x_t be stationary time series, then the general form of Granger causality test is:

$$y_t = a_0 + \Sigma a_i y_{t-i} + \Sigma \beta_j x_{t-j} + \epsilon_t \quad (1)$$

$$x_t = a_0 + \Sigma a_i x_{t-i} + \Sigma \beta_j y_{t-j} + \epsilon_t \quad (2)$$

The methodology of Granger determines whether a present variable y_t can be explained by past values of y_t and whether adding lags of another variable x_t improves the explanation. This technique provides useful information about the lead effect of confidence indicators on the macroeconomic variables.

Furthermore, we employ a benchmark ARIMA (Autoregressive Integrated Moving Average) model to produce rolling forecasts for y_t. The ARIMA method can be used to identify complex patterns in data and to generate forecasts (Box and Jenkins, 1976). ARIMA models involve a combination of three types of processes: i) an autoregressive (AR) process, ii) differencing to strip the integration (I), and iii) a moving average (MA) process. The general form of the ARIMA (p,d,q) model is

$$\emptyset_p(L)(1-L)^d y_t = \theta_0 + \theta_q(L) U_t \quad (3)$$

where θ_0 represents the intercept term, $\emptyset_p(L)$ represents the AR part ($1-\emptyset_1 L-\ldots-\emptyset_p L_p$), $\theta_q(L)$ represents the MA part ($1-\theta_1 L-\ldots-\theta_p L_p$), and U_t represents a zero mean white process with constant variance. Using various information criteria (MAE, MAPE and RMSE among others), we evaluate the forecasting performance of the above model with an ARIMA model that includes the y_t variable along with each confidence indicator as an exogenous variable. If the performance is better when a confidence indicator is included, then the specific confidence indicator is useful in forecasting real macroeconomic variables. In other words, there are serious signs that confidence indices lead economic activity.

4 Empirical results

In order to perform the econometric analysis, it is necessary to investigate the integration order of all variables involved. Table 1 reveals the results of two mainstream unit root tests, the ADF and PP unit root test. As expected growth rates and first differences of the series are stationary, I(0), indicating their suitability for methodologies such as Granger causality tests and ARIMA forecasting.[5]

Table 1: Unit root tests for Greek macro and confidence data

Levels of the series		**GDP**	**Private Consumption**	**GFCF**	**ESI**	**CCI**	**Con. CI**	**ICI**
ADF	*test stat.*	-1.546	0.976	-1.195	-3.054	-3.022	-2.834	-3.209*
PP	*test stat.*	-0.786	0.957	-1.187	-2.512	-2.779	-2.797	-2.610

[5] The results of ADF and PP tests for GDP growth series conclude to contradictory outcomes. One possible reason is the existence of breaks in the series. Following Perron (1989), Perron and Vogelsang (1992a, 1992b), and Vogelsang and Perron (1998), we consider four distinct specifications for the Dickey-Fuller regression which correspond to different assumptions for constant and/or trend and break behavior. The Perron test selects the breakpoint by minimizing the Dickey-Fuller t-statistic, while the lag lenth is selected via SIC. In all cases, the GDP growth is stationary. Due to space limitations these results are not presented, but are available upon request.

Growth rates & 1st Differences	**GDP growth**	**Private Consump. growth**	**GFCF growth**	**D(ESI)**	**D(CCI)**	**D(Con. CI)**	**D(ICI)**
ADF *test stat.*	-2.544	-8.573***	-10.490***	-6.718***	-7.771***	-9.644***	-6.991***
PP *test stat.*	-8.655***	-8.902***	-10.496***	-6.493***	-7.771***	-9.674***	-6.710***

Notes: The critical values for both tests, at 1%, 5%, and 10% significant levels are −4.06, −3.46 and −3.15, respectively. The models include trend and intercept, while for ADF model the selection of lag length performed via SIC (maximum lags 11). Regarding the PP test the Bartlett kernel-based estimator of spectral density adopted, while the bandwidth parameter selected via Newey-West procedure. ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively.

4.1. Granger causality analysis

Since the issue of stationarity is solved, we proceed to Granger causality estimations. **Table 2** presents the results of Granger causality among confidence indicators and macroeconomic variables. We used up to 4 lag for all tests in order to investigate the leading effect of confidence indicators to Greek economy in a short-term basis.

Table 2: Granger causality test among confidence indicators and GDP/components

Granger causality with 1 lags	**GDP growth**	**Private Cons. growth**	**GFCF growth**
D(ESI) does not Granger cause			
D(CCI) does not Granger cause			
D(Con. CI) does not Granger cause			
D(ICI) does not Granger cause			
Granger causality with 2 lags	**GDP growth**	**Private Cons. growth**	**GFCF growth**
D(ESI) does not Granger cause			
D(CCI) does not Granger cause			
D(Con. CI) does not Granger cause			
D(ICI) does not Granger cause			
Granger causality with 3 lags	**GDP growth**	**Private Cons. growth**	**GFCF growth**
D(ESI) does not Granger cause			
D(CCI) does not Granger cause			
D(Con. CI) does not Granger cause			
D(ICI) does not Granger			

cause			
Granger causality with 4 lags	**GDP growth**	**Private Cons. growth**	**GFCF growth**
D(ESI) does not Granger cause			
D(CCI) does not Granger cause			
D(Con. CI) does not Granger cause			
D(ICI) does not Granger cause			

Notes: The white color accepts the null hypothesis (i.e., H_0: *X* variable does not Granger cause *Y* variable), while the grey color rejects the null for at least 10% confidence level. We used 4 lag for all tests in order to investigate the leading effect of confidence indicators to Greek economy in a short-term basis. Robustness test applied with more lags (up to 6 lags) and the results showed that the confidence indicators does not Granger cause the GDP and its components for at least 10% confidence level.

We check forty-eight different cases of Granger causality and only two show that confidence indicators granger cause macroeconomic variables; the "economic sentiment indicator" (ESI) and the "consumer confidence indicator" (CCI) Granger cause GDP growth, but only for 3 and 2 lags, respectively. Thus, overall, the results provide little evidence of a significant relationship between confidence indicators indices and macroeconomics variables showing that in the case of Greece confidence indicators do not lead the economic activity at least in the framework of Granger cause analysis.

4.2. ARIMA forecasting evaluation

In this subsection, we evaluate the forecasting performance of a benchmark ARIMA model that contains the macroeconomic variables' growth rates with an alternative ARIMA model that use as exogenous variable each confidence indicator. **Tables 3 – 5** present the results of the forecast evaluation. The evaluation is conducted through one-step ahead rolling in sample forecasts. Then we calculate the average performance criteria over the real observations.

Table 3: GDP growth ARIMA forecasting evaluation (h=1, rolling sample)

Variable/exogenous	GDP gr./none	GDP gr./d(ESI)	GDP gr./d(CCI)	GDP gr./d(Con. CI)	GDP gr./d(ICI)
Best ARIMA	(2,1)(0,1)	(2,4)(0,1)	(3,3)(0,0)	(2,4)(0,1)	(3,0)(0,0)
Forecast evolution					
Bias	0.001	0.000	**0.000**	0.002	0.001
MSE	**0.000**	0.000	0.000	0.000	0.000
RMSE	**0.010**	0.011	0.010	0.010	0.010
SE	0.010	0.011	**0.009**	0.010	0.010
MAE	0.008	0.009	**0.007**	0.009	0.008
MAPE	1.420	1.497	**1.330**	1.422	1.358

Notes: The ARIMA lags are selected via AKAIKE information criterion. The rolling one-step ahead forecasting estimations are started from 2010 Q4 until the end of our sample.

Regarding GDP (**Table 3**) growth forecasting information criteria converge that when the CCI variable is added the forecasting performance is slightly improved. This result is in line with Granger causality outputs, since the CCI seems to Granger cause GDP growth but only after two quarters. However, the best second alternative is the GDP growth with a constant term, which is an evidence of weak forecasting performance of the rest confidence indicators.

Table 4: Priv. Cons (PC) growth ARIMA forecasting evaluation (h=1, rolling sample)

Variable/exogenous	PC gr./none	PC gr./d(ESI)	PC gr./d(CCI)	PC gr./d(Con. CI)	PC gr./d(ICI)
Best ARIMA	(2,2)(1,0)	(2,4)(0,0)	(2,3)(0,0)	(2,2)(0,1)	(0,3)(2,0)
Forecast evolution					
Bias	0.004	**-0.004**	-0.002	0.001	**-0.004**
MSE	**0.000**	0.000	0.000	0.000	0.000
RMSE	**0.012**	0.016	0.016	**0.012**	0.015
SE	**0.011**	0.015	0.016	0.012	0.014
MAE	**0.009**	0.012	0.012	**0.009**	0.011
MAPE	2.022	1.689	1.833	1.209	**1.156**

Notes: Same as Table 3.

Weak evidence is provided for private consumption (**Table 4**), since the results are mixed; most criteria (RMSE, SE and MAE) supports that the confidence indicators are not improving the forecasting procedure of the depended variable. These results are in line with Granger causality estimations.

Table 5: Gross FCF (FCF) growth ARIMA forecasting evaluation (h=1, rolling sample)

Variable/exogenous	FCF gr./none	FCF gr./d(ESI)	FCF gr./d(CCI)	FCF gr./d(Con. CI)	FCF gr./d(ICI)
Best ARIMA	(2,2)(0,0)	(2,4)(2,0)	(0,4)(1,0)	(1,4)(1,0)	(2,4)(0,1)
Forecast evolution					
Bias	0.003	-0.001	**-0.005**	0.001	0.001
MSE	**0.001**	0.002	0.002	**0.001**	0.002
RMSE	**0.034**	0.046	0.046	0.038	0.043
SE	**0.034**	0.046	0.046	0.038	0.043
MAE	**0.027**	0.038	0.036	0.031	0.033
MAPE	**4.779**	10.031	8.177	8.586	7.656

Notes: Same as Table 3.

Regarding the GFCF growth (**Table 5**), most criteria support that the best performance occurred when none indicator is taken into account. This result is in line with Granger causality outputs, since none of the confidence indicators seems to be a leading indicator for GFCF growth.

4.3. Robustness tests using Kalman filter forecasting methodology

Finally, as robustness test for our core results, we evaluate the forecasting performance, using a Kalman filter algorithm. In its simplest form Kalman filter is consisting of a single observable variable ($y_{i,t}$) and a single latent factor ($s_{i,t}$).

$$\begin{aligned} y_{i,t} &= \beta_i s_{i,t} + u_{i,t} \\ s_{i,t} &= \phi_i s_{i,t-1} + v_{i,t} \end{aligned} \quad (4)$$

Where $y_{i,t}$ is the GDP growth rate, $u_{i,t} \sim N(0,\sigma^2)$ and $v_{i,t} \sim N(0,1)$ are independent disturbances, and $\{\beta,\phi,\sigma^2\}$ are unknown parameters. In order to assess the forecast outputs, we include a confidence indicator to the first equation and then compare the RMSEs (between forecasts and real values), before and after the inclusion of the indicator. The results for GDP growth are presented in **Table 6**. Most state space equations have statistical significant parameters, supporting the correct choice of initial values. The RMSE criterion has its minimum value when Eq. (4) is estimated without any confidence indicator, supporting the best forecasting ability for this model. Although, the ARIMA forecasting evaluation concluded that adding CCI leads to improved forecasts in a considerable number of cases, the Kalman filter supports that this is the third best choice. Thus, within the Kalman filter framework the CCI gives poorer results concerning the forecasting performance of GDP growth.

Table 6: Forecast evaluation of Kalman filter algorithm (constant, GDP growth and confidence indicators)

Parameters / model	**GDP gr./ none**	**GDP gr./ d(ESI)**	**GDP gr./ d(CCI)**	**GDP gr./ d(Con. CI)**	**GDP gr./ d(ICI)**
Constant	0.0017	0.0018	0.0021	0.0017	0.0014
z-stat.	0.228	0.0024	0.316	0.234	0.190
β	-0.0027**	-0.0024***	-0.0025**	-0.0025**	-0.0025***
z-stat.	-2.438	-2.628	-2.377	-2.496	-2.695
Conf. ind.	n.a.	0.0013***	0.0002	0.0001	0.0011***
z-stat.	n.a.	3.326	0.962	1.435	3.148
σ^2	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
z-stat.	4.974	5.033	5.003	5.029	5.002
ϕ	0.9609***	0.9647***	0.9594***	0.9633***	0.9663***
z-stat.	19.825	22.587	19.208	21.476	23.419
Final state (s)	5.1578***	5.4319***	4.986**	5.2539***	5.6396***
z-stat.	2.577	2.660	2.449	2.562	2.804
Log.lik.	185.358	190.470	185.822	186.378	189.950
RMSE	**0.0207**	**0.0224**	**0.0223**	**0.0209**	**0.0445**

Notes: The likelihood optimized by the BFGS algorithm, using Marquardt steps. The covariance computed using Hessian information matrix.
*,**, *** denote significance at 1%, 5% and 10% level, respectively. Numbers in brackets are p-values.

The evidence on the Private Consumption growth validates the previous results, since none of the indicators improves the forecasting ability of the model (see Table 7).

Table 7: Forecast evaluation of Kalman filter algorithm
(constant, Private Consumption growth and confidence indicators)

Parameters / model	**PC gr./ none**	**PC gr./ d(ESI)**	**PC gr./ d(CCI)**	**PC gr./ d(Con. CI)**	**PC gr./ d(ICI)**
Constant	0.0018	0.0032	0.0029	0.0019	0.0026
z-stat.	0.248	0.520	0.479	0.262	0.383
β	-0.0034**	-0.0050***	-0.0031*	-0.0034*	-0.0049**
z-stat.	-2.020	-2.389	-1.881	-1.997	-2.239
Conf. ind.	n.a.	0.0017***	0.0005	0.0001	0.0013***
z-stat.	n.a.	3.580	0.163	0.527	2.910
σ^2	0.0001***	0.0001***	0.0001***	0.0001***	0.0001***
z-stat.	4.654	3.951	4.697	4.654	3.950
ϕ	0.9414***	0.88541***	0.9325***	0.9412***	0.9011***
z-stat.	12.181	6.691	10.452	12.146	7.253
Final state (s)	4.9141***	4.2323***	4.4902**	4.9053***	4.5341***
z-stat.	2.634	2.871	2.384	2.618	2.985
Log.lik.	176.342	182	177.669	186.378	180.791
RMSE	**0.0241**	**0.0294**	**0.0277**	**0.0243**	**0.0274**

Notes: The likelihood optimized by the BFGS algorithm, using Marquardt steps. The covariance computed using Hessian information matrix.
*,**, *** denote significance at 1%, 5% and 10% level, respectively. Numbers in brackets are p-values.

Lastly, the results of **Table 8** follow the same pattern as the ARIMA model, since the minimum value of RMSE is present when none of the indicators are taken into account.

Table 8: Forecast evaluation of Kalman filter algorithm
(constant, Gross Fixed Capital Formation growth and confidence indicators)

Parameters / model	**GFCF gr./ none**	**GFCF gr./ d(ESI)**	**GFCF gr./ d(CCI)**	**GFCF gr./ d(Con. CI)**	**GFCF gr./ d(ICI)**
Constant	0.0102	0.0126	0.0129	0.0128	0.0125
z-stat.	0.913	1.340	1.353	1.350	1.393
β	-0.0111	-0.0671	-0.0672	-0.0654	-0.0651
z-stat.	-0.760	-0.0003	-0.053	-0.004	-0.0040
Conf. ind.	n.a.	0.0057**	0.0010	0.0018**	0.0035*
z-stat.	n.a.	2.471	0.433	2.353	1.813
σ^2	0.0040***	3.78E-07	2.48E-10	2.48E-10	2.48E-10
z-stat.	4.594	1.54E-07	1.48E-09	1.16E-10	1.20E-10
ϕ	0.8190**	-0.0044	0.0505	-0.0138	0.0137
z-stat.	2.385	-0.0001	0.027	-0.0019	0.002
Final state (s)	1.3914	-0.0018	0.0135	-0.0084	0.0071
z-stat.	0.857	-0.0018	0.0137	-0.008	0.000
Log.lik.	81.485	82.563	81.255	83.135	82.700
RMSE	**0.0389**	**0.0415**	**0.0437**	**0.0486**	**0.0459**

Notes: The likelihood optimized by the BFGS algorithm, using Marquardt steps. The covariance computed using Hessian information matrix.
*,**, *** denote significance at 1%, 5% and 10% level, respectively. Numbers in brackets are p-values.

5 Conclusions

Consumer sentiment surveys are regularly conducted in a substantial number of countries. The surveys are based on the premise that confidence indicator data represent a leading indicator of future changes in the macroeconomy. A considerable amount of research empirically evaluates the forecasting ability of confidence indicators with controversial results. By conducting different estimation techniques (simple and rolling correlation, Granger causality, ARIMA rolling and Kalman filter forecasts), we conclude that in the case of Greece the last two decades there are poor indications that confidence indicators lead economic activity. The only indicator that show a link but only to GDP growth is the consumer confidence index; though the evidence is arising from only one estimation technique (ARIMA rolling). The other three confidence indicators (economic sentiment index, construction confidence indicator and industrial confidence indicator) were not able to add any additional information to the forecast of Greek GDP growth, private consumption and gross fixed capital formation.

Overall, the results suggest that there is space for improvement of the predictive performance of confidence indicators in Greece. Further research could focus on improvements related to differences in sampling, choice of questions, index construction and changes in the survey administration. In addition, even if European Commission's harmonized questionnaires may have contributed considerably in the comparability of the surveys' results for the member states of the European Union, it cannot be taken for granted that the harmonized indicators are the most appropriate ones for forecasting macroeconomic variables in each country.

The main caveat of our analysis depends on the quality of our forecasting models. We employed popular models, which are commonly used in the forecasting literature. However, we cannot rule out the possibility that other forecasting methods could show that economic confidence indexes do indeed have improved explanatory power, if any such methods can be found.

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References

Box, G.E.P, and G.M. Jenkins (1976) Time series analysis: Forecasting and control. Rev. ed. San Francisco. Holden-Day.

Brinca Pedro and Stephane Dees (2013) Consumer confidence as a predictor of consumption spending: Evidence for the United States and the Euro area. International Economics, issue 134, pages 1-14.

Christiansen, C. , Eriksen, J. , and Moller, S. (2014) Forecasting US recessions: The role of sentiment. Journal of Banking & Finance, 49 , 459–468.

Clark, M.J. (1917) Business acceleration and the law of demand: A technical factor in economic cycles. Journal of Political Economy, No 25, pp. 217-235.

Cotsomitis, J. and Kwan, A. (2006) Can consumer confidence forecast household spending? Evidence from the European commission business and consumer surveys. Southern Economic Journal, 72(3), pp. 597–610.

Croushore D. (2005). Do consumer-confidence indexes help forecast consumer spending in real time? The North American Journal of Economics and Finance 16, pp.435–450.

Croux C., Gelper S. and Wilms I. (2016) The predictive power of the business and bank sentiment of firms: A high-dimensional Granger Causality approach. European Journal of Operational Research 254, pp.138–147.

ECB (2006) Monthly Bulletin, February.

Klein, L.R. and Özmucur, S. (2010) The use of consumer and business surveys in forecasting. Economic Modelling, vol. 27(6), pp. 1453-1462.

Lozza, E., Bonanomi, A., Castiglioni, C. and Bosio A. C. (2016) Consumer sentiment after the global financial crisis. International Journal of Market Research Vol. 58 Issue 5, pp. 671-691.

Mourougane, A. and Roma, M., (2003) Can confidence indicators be useful to predict short-term real GDP growth. Applied Economics Letters Vol. 10, Issue 8.

Pigou, A. (1927). Industrial Fluctuations. Macmillan, London.

Santero T. and Westerlund, N. (1996). Confidence indicators and their relationship to changes in economic activity. OECD, Working paper No. 170.