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Jordan Jordanov[1]
Marco Valentini[2]

STOCK MARKET INDICES AND SENTIMENT INDICATORS: CORRELATIONS AND CAUSALITY

This paper focuses on the possible causal relationships between the stock market indices and a set of sentiment indicators in seven European Union countries. The results are not univocal. In some countries, the local stock index seems to behave as a leading indicator with reference to most sentiment indicators, while in others the causal nexus seems to be reversed.
JEL: E44; G12; G14

1. Introduction

The pivotal idea of this paper is to test the lead-lag relationship between stock market indices and sentiment indicators for several European Union (EU) countries, in order to unveil whether or not stock market indices in the EU countries are affected by or affect the relevant sentiment indicators. Possible differences in how the different EU countries stock market indices react to their counterpart sentiment indicators could give us some hints in order to gauge the maturity and effectiveness of the local financial markets as well as to better understand how the mood of the European economic operators is taken into account by the stock indices.

Since the introduction of the USA consumer sentiment surveys in the 1940s, the debate over their possible use in forecasting economic activity has started (Souleles, 2001). Many studies have investigated the relationship between economic sentiment indicators and the economic variables, such as the expenditure (e.g. Souleles, 2001) or the GDP (e.g. Kappler and van Aarle, 2012). The conjecture is that a decline in the economic agents' confidence, for instance in a recession period, may lead to a further deterioration in the economic situation, while a confidence increase may contribute to the economic growth.

If the relationship between economic sentiment indicators and the "real economy" variables is plausible, it seems to be even more immediate a possible connection between the sentiment indicators and the financial markets, given the fact that stock markets tend to discount immediately all the available information, at least public

[1] *Jordan Jordanov – Ph.D., Associate Professor, Finance & Credit Dept., Varna University of Economics, Bulgaria.*
[2] *Marco Valentini – Ph.D., Senior Economist, Unicredit, Italy*

information. Actually, if the financial markets are very efficient we could even expect that the equity prices' movements anticipate the public release of the surveys exploiting unofficial or alternative sources[3].

As Stambaugh, Yu and Yuan (2011) point out, at least as early as Keynes (1936) numerous authors have investigate the possibility that investors' sentiment could cause prices to depart from fundamental values. Further studies investigate the relationship between returns and volume of trade.

There are some early studies as well as several contemporary empirical researches on how sentiment affect stock prices. During the 1970s and the 1980s, the emphasis is basically on the divergence between stock market indices and fundamentals, making use of the present value of dividends or earnings as well as of the price volatility.

Other recent studies have used ready-made investment sentiment indicators as well as home-made sentiment indicators such as in Malcolm Baker and Jeffrey Wurgler (2007, p. 129-151). In a previous paper on the relationship between EU sentiment indicators and the stock market, Kremer and Westermann (2004) use aggregate eurozone-wide data on consumer confidence, household spending and stock market movements to look into the possible presence and typology of a confidence channel. They do not make a direct use of stock indices and indicators as published but make use of proxy variables corrected with the earnings per share (EPS). Though, our conjecture is that using directly the available public indices, rather than some transformed variables, would lead to more robust results in accepting or rejecting the hypothesis related to the possible causal links between the equity price changes and the sentiment indicators[4].

The history shows us many examples in which an "extraordinary investor sentiment" pushed the prices of shares to unconceivable levels before the unavoidable crash (e.g. the Internet bubble). Baker and Wurgler (2007) stated that "Now, the question is no longer, as it was a few decades ago, whether investor sentiment affects stock prices, but rather how to measure investor sentiment and quantify its effects".

2. Data

The data refer to the following countries: Spain, France, Germany, Romania, Bulgaria, Italy and the UK For all countries, the raw data used in this study consist of time series of daily stock market indices (SMSI, CAC, GDAXHI, BETC, SOFIX, FTITLMS and FTSE) and monthly sentiment indicators (Industry, Services, Consumer, Retail and Building confidence indicators as well as a general Economic

[3] It is the case of the strong form of the Fama's Efficient Market Hypothesis.

[4] It is interesting to note that Kremer and Westermann (2004) applied normalized consumer confidence index by adding 100 to the original confidence index. They state in the data description: "Consumer Confidence for the euro area as published monthly by the European Commission. The original series of percentage balances is normalised by adding 100. This ensures that the transformed index remains bounded between zero and 200 and thus allows taking the natural logarithm of this series".

Sentiment Indicator) from January 2003 to November 2011. The source for the stock indices is Reuters, that for the sentiment indicators is the EU Commission.

For every stock index, starting from the daily data, we calculated the 20 days moving average (MA) at the last working day of the month. The intuition behind using a moving average is that taking only a single end-of-month day could be misleading in some cases, because of the volatility of financial markets. We think that smoothing the volatility on 20 working days should be more representative of the stock index monthly value.

Then, the stock monthly return is calculated as follows:

$R_t = Ln(Index_t / Index_{t-1})$

This applies for each single country stock index. The stock index series are denominated as follows: S_R_SMSI_MA (Spain), F_R_CAC_MA (France), G_R_GDAXHI_MA (Germany), R_R_BETC_MA (Romania), B_R_SOFIX_MA (Bulgaria), I_R_FTITLMS_MA (Italy) and UK_R_FTSE_MA (The UK).

After performing the Kremer and Westermann procedure[5], i.e. adding 100 to the consumer confidence index and then taking the natural logarithm of the series, we still find some non-stationarity in some confidence indicators. This non-stationarity is mostly due to the severe drop in these indicators in 2009 and later gradual recovery. That is why we have further processed all the normalized confidence indicator series in the following manner:

$Processed\ Confidence\ Index_t = Ln(Confidence\ Index_t / Confidence\ Index_{t-1})$.

In this way, we set up six processed confidence indices, denominated in brief: S_ESI_PRO (Economic Sentiment Indicator), S_INDU_COF_PRO (Industrial Consumer Confidence), S_SERV_COF_PRO (Services Confidence Indicator), S_CONS_COF_PRO (Consumer Confidence Indicator), S_RETA_COF_PRO (Retail Confidence Indicator), S_BUIL_COF_PRO (Building Confidence Indicator), where the first letter denotes the country, which in this example is "S" for Spain.

As mentioned before, the raw sentiment indicator series used in the present study are taken from the five monthly surveys developed within the Harmonised European Union Programme of Business and Consumer Surveys in the following five sectors: manufacturing industry, construction, consumers, retail trade and services. An overall Economic Sentiment Indicator (ESI), weighted average of the aforesaid indicators, is also provided by the EU surveys Programme. All the monthly surveys have a similar answer scheme. For qualitative questions, answers are usually given according to a three-option ordinal scale: "increase" (+), "remain unchanged" (=), "decrease" (-); or "more than sufficient" (+), "sufficient" (=), "not sufficient" (-); or "too large" (+), "adequate" (=), "too small" (-). In some cases, respondents have the choice between four, five or six options. In the consumer survey, a five-option ordinal scale is the rule. The monthly questions for the five surveys are shown in Table 1).

[5] Note that ESI does not need to be "normalized" as it is already provided as "normalized".

Table 1

Variables Covered in the Monthly Business and Consumer Surveys

Type of survey	Monthly questions
Industry	Production, past 3 months Production, next 3 months Total order books Export order books Stocks of finished products Selling prices, next 3 months Firm's employment, next 3 months
Construction	Business activity, past 3 months Factors limiting production Domestic order books Firm's employment, next 3 months Selling prices, next 3 months
Retail trade	Business activity, past 3 months Business activity, next 3 months Stocks of goods Orders placed with suppliers, next 3 months Firm's employment, next 3 months
Services	Business situation, past 3 months Turnover, past 3 months Turnover, next 3 months Firm's employment, past 3 months Firm's employment, next 3 months
Consumers	Financial situation, past 12 months Financial situation, next 12 months General economic situation, past 12 months General economic situation, next 12 months Consumer prices, past 12 months Consumer prices, next 12 months Unemployment, next 12 months Major purchases of durable consumer goods, current environment Major purchases intentions, next 12 months Savings, current environment Savings intentions, next 12 months Capacity to save

Source: EU Commission.

For each survey, answers are aggregated in the form of "balances", constructed as a difference between the percentage of positive responses and the negative ones. Thus, balances are the difference between positive and negative answering options, measured as percentage points of total answers. In particular, if a question has three alternative options, "positive" ("up", "more", "more than sufficient", "good", "too large", "increase", "improve", etc.), "neutral" ("unchanged", "as much", "sufficient", "satisfactory", "adequate", etc.) and "negative" ("down", "less", "not sufficient", "too small", "decline", etc.) - calling P, E and M (with P+E+M=100) the percentages of respondents having chosen respectively the option positive, neutral, and negative - the balance is calculated as

$$B = P - M.$$

Therefore the extreme values are achieved either if all respondent answers are positive (P=100%), then B=+100%, or if all respondent answers are negative (M=100%), then B=-100%.

In the case of questions with six options, i.e. the three options above plus "very positive" ("got/get a lot better", "very much higher", "increase sharply", etc.), "very negative" ("got/get a lot worse", "very unfavourable", "fall sharply", etc.) and "don't know", the balances are calculated on the basis of weighted averages. If P, E and M have the same meaning as in the previous paragraph, while PP denotes the percentage of respondents having chosen the option "very positive", MM the percentage of respondents having chosen the option "very negative" and N is the percentage of respondents without any opinion (so that PP+P+E+M+MM+N=100), balances are calculated as

$$B = (PP + \tfrac{1}{2}P) - (\tfrac{1}{2}M + MM)$$

It is clear from the expressions above that balance values range from -100, when all respondents choose the negative option (or the most negative one in the case of five-option questions) to +100, when all respondents choose the positive (or the most positive) option.

The balance series are then used to build composite indicators. Each confidence indicator is calculated as the simple arithmetic average of the (seasonally adjusted) balances of answers to specific questions chosen from the full set of questions in each individual survey[6].

These indicators provide information on the economic developments in the aforesaid different economic sectors. As mentioned before, the results for the five surveyed sectors are aggregated into the Economic Sentiment Indicator, whose purpose is tracking the movements of the EU economy as a whole. The Economic Sentiment Indicator is made up of the 15 individual components of the previously described confidence indicators. Different weights are given to the different sectors for the computation of the composite indicator:

- Industry: 40%
- Services: 30%
- Consumers: 20%
- Construction: 5%
- Retail trade: 5%

ESI is standardized so that values greater than 100 indicate an above-average economic sentiment, whereas values below 100 indicate a below-average position. Assuming approximate normality, the imposed standard deviation of 10 implies that in about 68% of the cases the ESI will be within the range 90-110.

[6] The Joint Harmonised EU Programme of Business and Consumer Surveys, User Guide (updated 4 July 2007), p.16.

3. Correlation Analysis

In this paragraph we discuss the results of the correlation analysis between the local stock exchange index and the local confidence indicators for each single country of the sample.

As a first step we analysed the contemporaneous correlation (i.e. both the indicators' series taken at current values, t_0).

As a second step, we carried out the cross-lagged correlation between the aforesaid indices. We chose to take a maximum lag of 12 months (i.e. 1 year) because financial markets tend to incorporate all available information quickly. That is why, to the scope of the present research, we had considered useless the application of larger lags.

In general, we found out significant positive contemporaneous correlations between the local stock indices and several confidence indicators in many countries of our sample. In particular, the contemporaneous correlations between the local stock exchange index and the Economic Sentiment Indicator in France, Italy, Germany and UK take, respectively, values equal to 0.55, 0.46, 0.44, and 0.31. The correlation of the stock index with the Industrial Confidence Indicator, in the same countries, shows the following figures: 0.46, 0.37, 0.33, 0.13. The Consumer Confidence Indicator's correlation coefficients, in the same countries, take the values: 0.54, 0.26, 0.30, 0.20.

The cross correlation analysis shows, in general, a higher (positive) correlation between the contemporaneous series (i.e. both taken at t_0) then between the lagged series. This result is consistent with the hypothesis that the financial markets are usually quite efficient in taking immediately into account the available information. We carried out the cross-lagged correlation analysis for all indicators and for all the countries of the sample. However, in order to avoid encumbering the present working paper, we reported in the *Appendix.A)* only the UK lagged correlation test between the stock index and the lagged Retail sentiment indicator as an example of the few cases where the cross-lagged correlations showed significantly different results with respect to the contemporaneous correlations. Actually, only in five cases out of the forty-two tests overall carried out, the lagged sentiment indicators showed a correlation higher than that of the contemporaneous ones. In particular, three of these cases were related to the building confidence indicators.

United Kingdom

The following correlation matrix[7] for the UK shows, in particular, significant positive correlations between the stock exchange index (FTSE) and the Economic

[7] In the correlation matrix for UK as well as for the other countries of our sample, the first indicator is the financial market indicator (FTSE for UK), *_esi* is the Economic Sentiment Indicator, *_indu* is the Industrial Confidence Indicator, *_serv* is the Service Confidence Indicator, *_cons* is the Consumer Confidence Indicator, *_reta* is the Retail Confidence Indicator and *_buil* is the Building (Construction) Confidence Indicator. We used Stata as statistical software.

Sentiment Indicator as well as between the FTSE and both the Service Confidence Indicator (corr=0.28)[8] and the Consumer Confidence Index (0.20). In general, the correlation coefficients between the UK stock index and the confidence indicators are in the range 0.13-0.31, which overall suggests a certain degree of correlation between the changes in the equity prices and the variation of the economic operators' sentiment.

The analysis of the cross-lagged correlations between the financial market index and the confidence indicators (we considered maximum 12 lags) shows that the highest correlation values are related when both series are taken at t_0 (contemporaneous values). For the UK, the only exception is the Retail Confidence Indicator, where the highest correlation is that between the current value of the stock market index and the t_{-9} lagged retail confidence indicator (correlation coefficient equal to 0.32; see Appendix A).

```
correlate uk_r_ftse_ma u_esi_pro u_indu_cof_pro u_serv_cof_pro u_cons_cof_pro
u_reta_cof_pro u_buil_cof_pro

(obs=107)

             | uk_ftse    u_esi  u_indu   u_serv  u_cons  u_reta  u_buil

-------------------------------------------------------------------------------

uk_r_ftse_ma |   1.0000

u_esi_pro    |   0.3144   1.0000

u_indu       |   0.1278   0.7497   1.0000

u_serv       |   0.2786   0.5754   0.1861   1.0000

u_cons       |   0.1987   0.2568   0.1277   0.1885   1.0000

u_reta       |   0.1342   0.2293   0.1709   0.1194   0.3852   1.0000

u_buil_      |   0.1753   0.2121   0.0289   0.0975   0.1659   0.0349   1.0000
```

Spain

The highest contemporaneous correlation values for Spain, are between the stock exchange index and the Economic Sentiment Indicator (*s_esi*, corr=0.22) and the Consumer Confidence Indicator (*s_cons*, corr=0.27). The third highest correlation is with the Industrial Confidence Index equal to 0.17. The other correlations are negligible, assuming values close to zero.

The cross-lagged correlation analysis does not show higher correlation coefficients, with the exception of the lagged building confidence indicator which shows a light correlations for some lags (the lags t_{-1}, t_{-2} , t_{-3}, t_{-5} and t_{-9} show coefficients between 0.13 and 0.15).

[8] Note that the first column shows the correlations between the stock market index and the different confidence indicators.

```
correlate s_r_smsi_ma s_esi_pro s_indu_cof_pro s_serv_cof_pro s_cons_cof_pro
s_reta_cof_pro s_buil_cof_pro

(obs=107)

               s_r_smsi s_esi_~o s_indu~o s_serv~o s_cons~o s_reta~o s_buil~o

-------------+------------------------------------------------------------

 s_r_smsi_ma |   1.0000

   s_esi_pro |   0.2181   1.0000

s_indu_cof~o |   0.1748   0.6467   1.0000

s_serv_cof~o |   0.0894   0.5503   0.1534   1.0000

s_cons_cof~o |   0.2683   0.4590   0.2502   0.1819   1.0000

s_reta_cof~o |   0.0024   0.3558   0.1549   0.5050   0.2666   1.0000

s_buil_cof~o |   0.0864   0.0440   0.0212  -0.0571   0.1395   0.0207   1.0000
```

Romania

As far as the Romanian case is concerning, the below correlation matrix shows significant positive correlation coefficients between the stock market index and the Economic Sentiment Indicator (correlation coeff. 0.29) as well as with the Consumer Confidence Indicator (coeff. 0.32). The other correlation coefficients between the stock index and the sentiment indicators take values in the range 0.11-0.16. Also in this case, the cross-lagged correlations do not show different results, with the exception of the Building Confidence Indicator (BCI), where the lag t_{-8} shows a higher correlation coefficient (corr.coeff. t_{-8} =0.28).

```
correlate r_r_betc_ma r_esi_pro r_indu_cof_pro r_serv_cof_pro r_cons_cof_pro
r_reta_cof_pro r_buil_cof_pro

(obs=107)

             | r_r_betc r_esi_~o r_indu~o r_serv~o r_cons~o r_reta~o r_buil~o

-------------+------------------------------------------------------------

 r_r_betc_ma |   1.0000

   r_esi_pro |   0.2920   1.0000

r_indu_cof~o |   0.1133   0.5494   1.0000

r_serv_cof~o |   0.1587   0.6902   0.2799   1.0000

r_cons_cof~o |   0.3251   0.3782   0.0434   0.1226   1.0000

r_reta_cof~o |   0.1492   0.3995   0.2146   0.4511   0.1729   1.0000

r_buil_cof~o |   0.1196   0.1043   0.4809   0.0626   0.0062   0.1297   1.0000
```

Italy

The Italian case highlights significant positive correlations between the Italian financial market index (FTSEMIB) and the confidence indices, as it can be seen in the below correlation matrix. With the exception of the Building Confidence Index, where the correlation is close to zero, the correlation coefficients are in the range 0.26-0.46. The highest correlation coefficient (0.46) is that one related to the Economic Sentiment Indicator.

The cross-lagged correlation analysis confirms that, in general, the highest correlation is that recorded by taking both time series at t_0.

```
correlate i_r_ftitlms_ma i_esi_pro i_indu_cof_pro i_serv_cof_pro i_cons_cof_pro
i_reta_cof_pro i_buil_cof_pro

(obs=107)

             | i_r_ft~a i_esi_~o i_indu~o i_serv~o i_cons~o i_reta~o i_buil~o

-------------+---------------------------------------------------------------

i_r_ftitlm~a |   1.0000

   i_esi_pro |   0.4597   1.0000

i_indu_cof~o |   0.3696   0.5568   1.0000

i_serv_cof~o |   0.3122   0.5819   0.4287   1.0000

i_cons_cof~o |   0.2585   0.5328   0.2729   0.3247   1.0000

i_reta_cof~o |   0.2722   0.3239   0.3826   0.1234   0.2344   1.0000

i_buil_cof~o |   0.0397   0.1076  -0.0122   0.1322   0.1380   0.2152   1.0000
```

Germany

In Germany we also register significant positive correlations between the stock market index (DAX) and several confidence indicators. These are in particular the cases of the Economic Sentiment Indicator (corr.coeff. 0.44), the Industrial Confidence Index (corr.coeff. 0.33), the Consumer Confidence Index (0.38) and the Services Confidence Index (0.28). The correlation analysis referred to the lagged indicators, in general, do not exhibit higher coefficients. Only the Industrial Confidence Indicator shows a slightly larger coefficient for the t_{-9} lag (t_{-9} corr.coeff. 0.38).

```
correlate g_r_gdaxhi_ma g_esi_pro g_indu_cof_pro g_serv_cof_pro g_cons_cof_pro
g_reta_cof_pro g_buil_cof_pro

(obs=107)

             | g_r_gdax  g_esi_~o g_indu~o g_serv~o g_cons~o g_reta~o g_buil

-------------+------------------------------------------------------------------

g_r_gdaxhi~a |   1.0000

   g_esi_pro |   0.4415   1.0000

g_indu_cof~o |   0.3354   0.7095   1.0000

g_serv_cof~o |   0.2809   0.6768   0.4297   1.0000

g_cons_cof~o |   0.3028   0.6958   0.4141   0.4535   1.0000

g_reta_cof~o |   0.0407   0.2901   0.3311   0.1769   0.1867   1.0000

g_buil_cof~o |  -0.0557   0.1191   0.4325   0.2126   0.1978   0.2587   1.0000
```

France

Amazing results come out from the correlation analysis in the French case. With the exception of the Retail Confidence Indicator, all the other confidence indicators show important correlations with the French stock market index (CAC). In particular, we emphasise the correlations with the Economic Sentiment Indicator (correlation coefficient 0.55), the Consumer Confidence Indicator (corr.coeff. 0.54) and the Industrial Indicator (corr.coeff. 0.46). Also in this case, the lagged correlations do not show significant higher coefficients.

```
correlate  f_r_cac_ma  f_esi_pro f_indu_cof_pro f_serv_cof_pro f_cons_cof_pro
f_reta_cof_pro f_buil_cof_pro

(obs=107)

             | f_r_ca~a f_esi_~o f_indu~o f_serv~o f_cons~o f_reta~o f_buil~o

-------------+------------------------------------------------------------

  f_r_cac_ma |   1.0000

   f_esi_pro |   0.5509   1.0000

f_indu_cof~o |   0.4604   0.6108   1.0000

f_serv_cof~o |   0.3349   0.5759   0.2806   1.0000

f_cons_cof~o |   0.5365   0.6238   0.3425   0.4627   1.0000

f_reta_cof~o |   0.0833   0.3766   0.1629   0.1480   0.1874   1.0000

f_buil_cof~o |   0.3344   0.3163   0.2637   0.4135   0.2789  -0.0113   1.0000
```

Bulgaria

In the Bulgarian case we found out less stronger correlations, but not negligible. The highest contemporaneous correlations are those between the stock index and the Consumer Confidence Indicator as well as with the Industrial Confidence Indicator (both correlations are around 0.23). The correlation with the Economic Sentiment Indicator is lower (coeff.corr. 0.18) even if not so close to zero.

The leaded and lagged correlations, in general, do not bring to different conclusions, with the only exception of the Building Confidence Indicator where the t_{+9} lead shows a correlation coefficient equal to 0.31 (while the t_0 correlation was negligible).

```
correlate  b_r_sofix_ma b_esi_pro b_indu_cof_pro b_serv_cof_pro b_cons_cof_pro
b_reta_cof_pro b_buil_cof_pro

(obs=107)


             | b_r_sofix  b_esi_p  b_indu~  b_serv~ b_cons~  b_reta  b_buil~

-------------+------------------------------------------------------------

b_r_sofix_ma |   1.0000

   b_esi_pro |   0.1775   1.0000

b_indu_cof~o |   0.2297   0.4849   1.0000

b_serv_cof~o |   0.0319   0.6680   0.2372   1.0000

b_cons_cof~o |   0.2314   0.5867   0.2670   0.2829   1.0000

b_reta_cof~o |   0.0470   0.1483   0.1599   0.0954  -0.0258   1.0000

b_buil_cof~o |   0.0360   0.1466   0.0455   0.0902  -0.0767  -0.1605   1.0000
```

4. Unit Root Test

Since we are using first-differenced data, it is likely that the variables are "stationary". Nevertheless, we used the Dickey-Fuller in order to test for a unit root in the time series patterns. The test was applied including an intercept but without trend variable (since we are using first differences). We implemented the DF and ADF test with 12-months lagged dependent variables. For each country we tested the stock market index, the Consumer Confidence Indicator, the Economic Sentiment Indicator and the Indicator which had the highest correlation coefficient, besides the aforesaid indicators. In general, we found out that the null hypothesis of a unit root can be rejected at five percent significance level for current and lagged indicators.

For illustrative purposes, we reported in the Appendix B) the DF/ADF test for UK related to the Stock market index (UKRFTSEMA), the Economic Sentiment Indicator (UESIPRO).

5. Granger Causality Test

In the application of Granger test we ask the question: Is it the stock market that "causes" the sentiment indicators or is it the sentiment indicators that "cause" the stock market. The test involves estimating the following pair of regression:

$$R_t = \sum_{i=1}^{n} \alpha_i PCI_{t-i} + \sum_{j=1}^{n} \beta_j R_{t-j} + u_{1t} \tag{1}$$

$$PCI_t = \sum_{i=1}^{n} \lambda_i PCI_{t-i} + \sum_{j=1}^{n} \delta_j R_{t-j} + u_{2t} \tag{2}$$

where it is assumed that the disturbances u_{1t} and u_{2t} are uncorrelated.

Equation 1 postulates that the current R_i (return on relevant Stock Market Index) is related to it's past values as well as that of PCI (Processed Confidence Index) and equation 2 presumes a similar behaviour for PCI. If, the estimated coefficients on the lagged PCI in eq. 1 are statistically different from zero as a group (i.e., $\sum \alpha_i \neq 0$) and the set of estimated coefficients on the lagged R in eq. 2 is not statistically different from zero (i.e., $\sum \delta_j = 0$), then an unidirectional causality from PCI to R is suggested. On the other hand, if the set of lagged PCI coefficients in eq. 1 is not statistically different from zero (i.e., $\sum \alpha_i = 0$) and the set of the lagged R coefficients in eq.2 is statistically different from zero (i.e., $\sum \delta_j \neq 0$), then the unidirectional causality from R to PCI is in place. If the sets of R and PCI coefficients are statistically different from zero in both regressions, then a feedback or bilateral causality exists. At the end, independence is implied

when the set of R and PCI coefficients are not statistically significant in both regressions.

The practical steps (Gujarati, 2003, p. 698) in implementing the Granger causality test consist of:

1. Regress current R on all lagged R terms, but do not include the lagged PCI variable in this regression. From this restricted regression obtain the restricted residual sum of squires, RSS_R.
2. Run the regression including the lagged PCI terms. From this regression is obtained the unrestricted residual sum of squires, RSS_{UR}.
3. The null hypothesis is $H_0 = \sum \alpha_i = 0$, that is, lagged PCI terms do not belong to the regression.
4. To test this hypothesis is applied F test:

$$F = \frac{(RSS_R - RSS_{UR})/m}{RSS_{UR}/(n-k)}$$

which follows the F distribution with m and $(n-k)$ degrees of freedom. In the above test m is equal to the lagged PCI terms and k is the number of parameters estimated in the unrestricted regression. Steps 1 to 4 can be repeated to test the eq. 2 that is whether R causes PCI.

When reviewing the overall Granger causality test results, for illustrative purposes, we may form two groups of countries. A first group, in which the direction of causality goes, in general, from the stock market to the sentiment indicators and a second one, in which the direction of causality runs from the sentiment indicators to stock market.

In some countries the test results are not completely unequivocal, so that the criteria for an inclusion of a country in one of the two groups is based on the principle of dominance.

In the first group of countries, we may include Spain, Germany and UK, where the stock index, appears, in general, to be a leading indicator with respect to the sentiment indicators.

In the table below, we report the results for Spain, which seems to be a very interesting case. Here the null hypothesis that the stock market does not cause the sentiment indicators is rejected for all the six sentiment indicators and for all lags at a 5% p-value. Though, at the same time, the alternative null hypothesis that the sentiment indicators do not cause the Spanish stock market index is rejected in four cases out of six, with the exception of Economic Sentiment Indicator (ESI) and of the Consumer Confidence Indicator. For these two indicators, it can not be ruled out the hypothesis that they do not cause the equity index.

Table 1

Null Hypothesis that the Spanish Stock Market Index (SMSI) Does Not Cause Sentiment Indicators and Vice-Versa

Spain	Lags: 1		Lags: 2		Lags: 4		Lags: 6		
	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	
SMSI_MA not cause	3.05127	0.08366	2.01432	0.13879	1.16252	0.33241	1.44688	0.206	**R**
ESI not cause	1.79918	0.18276	3.45361	0.03545	1.16252	0.33241	1.41735	0.21696	**A**
SMSI_MA not cause	2.24003	0.13754	1.27	0.28532	1.64989	0.16827	1.01049	0.42378	**R**
INDU_COF not cause	1.77204	0.18607	1.70479	0.18705	0.9588	0.43394	1.55505	0.16988	**R**
SMSI_MA not cause	0.17908	0.67305	2.23439	0.11238	1.1829	0.32343	1.66308	0.13956	**R**
CONS_COF not cause	5.19559	0.02471	3.13615	0.04775	2.27071	0.06735	2.24952	0.0457	**A**
SMSI_MA not cause	0.68067	0.41126	0.35312	0.70337	0.72674	0.57586	0.60341	0.7269	**R**
RETA_COF not cause	0.00264	0.9591	0.25369	0.77643	0.15392	0.9608	0.28504	0.94263	**R**
SMSI_MA not cause	0.89938	0.34517	1.65865	0.19559	1.99521	0.10156	1.55251	0.17066	**R**
SERV_COF not cause	0.02006	0.88764	0.76304	0.46894	0.63614	0.63798	0.43473	0.85384	**R**
SMSI_MA not cause	0.59097	0.4438	0.53023	0.59011	1.08856	0.36677	0.74486	0.61504	**R**
BUIL_COF not cause	2.02108	0.15815	1.34372	0.26554	1.05786	0.38186	1.26497	0.28179	**R**

Table 2

Null Hypothesis that the German Stock Market Index (GDAXHI) Does Not Cause Sentiment Indicators and Vice-Versa

Germany	Lags: 1		Lags: 2		Lags: 4		Lags: 6		
	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	
GDAXHI not cause	3.68168	0.05778	2.09876	0.12798	1.50494	0.20703	1.60582	0.15496	**R**
ESI not cause	4.22246	0.04242	4.97733	0.0087	2.25217	0.06925	1.87746	0.09356	**A**
GDAXHI not cause	7.08232	0.00903	5.67926	0.00461	3.98174	0.00499	4.04703	0.00125	**A**
INDU_CO not cause	0.21525	0.64366	0.92981	0.39801	0.81095	0.52126	0.90596	0.4945	**R**
GDAXHI not cause	3.59092	0.0609	6.71258	0.00184	2.86648	0.02734	1.8029	0.10766	**A**
CONS_CO not cause	0.24421	0.62223	1.20266	0.3047	1.2556	0.29305	1.4314	0.21169	**R**
GDAXHI not cause	0.33998	0.56111	0.04404	0.95694	1.20797	0.31266	2.80464	0.01522	**R**
SERV_CO not cause	5.82014	0.01761	4.43838	0.01423	3.31059	0.01388	2.35182	0.0374	**A**
GDAXHI not cause	3.60253	0.06049	1.97777	0.14375	1.12344	0.35021	0.98695	0.43911	**R**
RETA_CO not cause	0.01127	0.91566	1.52972	0.22162	3.23436	0.0156	2.36007	0.03679	**A**
GDAXHI not cause	1.75506	0.18817	1.08559	0.34165	1.46395	0.21939	0.87505	0.51666	**R**
BUIL_CO not cause	0.3524	0.55406	0.23554	0.79058	0.56649	0.68756	0.44634	0.84574	**R**

In the German case, the null hypothesis that the German stock market does not cause the sentiment indicators is rejected for four indicators out of six, with the exception of the Industry and the Consumer confidence indicators. On the other hand, three sentiment indicators (Industry, Consumer and Building confidence indicators) appear to Granger-cause the financial index, DAX, for some of the lags here selected.

The UK is somehow a border line case (see Tab.3 below), having in three cases the sentiment indicators caused by the stock index and in other three cases the opposite. In fact, the stock market does not cause the ESI, the Industry Confidence Indicator and the Retail Confidence Indicator. At the same time, it can not be rejected the hypothesis that the Industry, Consumer and Services confidence indicators cause the equity market changes.

Table 3

Null Hypothesis that the UK Stock Market Index (FTSE) Does Not Cause Sentiment Indicators and Vice-Versa

UK	Lags: 1		Lags: 2		Lags: 4		Lags: 6		
	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	
FTSE not cause	5.96694	0.01628	1.58612	0.20983	2.68341	0.03611	2.61687	0.02213	**A**
ESI not cause	5.61147	0.01971	7.57028	0.00087	2.88062	0.02676	2.48532	0.02873	**A**
FTSE not cause	7.77657	0.00631	4.51777	0.01323	5.39198	0.00059	3.49304	0.00381	**A**
INDU_CO not cause	5.09368	0.02612	4.40292	0.0147	1.83208	0.12913	1.68654	0.13366	**R**
FTSE not cause	2.89656	0.09179	1.44237	0.24124	1.16702	0.33041	1.58658	0.16047	**R**
CONS_CO not cause	0.42787	0.51449	3.05518	0.05154	1.94537	0.10932	1.61705	0.15182	**R**
FTSE not cause	0.80341	0.37217	0.6249	0.53739	2.59933	0.04102	5.39062	8.80E-05	**R**
SERV_CO not cause	0.00088	0.97636	1.29384	0.27877	1.00065	0.4113	1.41545	0.21769	**R**
FTSE not cause	6.90769	0.00989	4.56537	0.01267	2.41734	0.05402	2.1391	0.05666	**A**
RETA_CO not cause	2.35934	0.1276	2.8894	0.06027	4.29066	0.00312	3.65096	0.00278	**A**
FTSE not cause	0.57929	0.44833	0.94094	0.39369	1.84621	0.12649	1.50845	0.18469	**R**
BUIL_CO not cause	0.04773	0.8275	6.1645	0.00299	2.97061	0.02333	3.7761	0.00216	**A**

In the second group (i.e. the countries where the sentiment indicators' variations precede, in general, the stock index's changes) we include Italy, France, Romania and Bulgaria.

In Italy, the null hypothesis that the stock market does not cause sentiment indicators is accepted for all sentiment indicators with the exception of the Building Confidence Indicator. The reverse hypothesis, that is that the sentiment indicators do

not cause the stock market, is rejected for all six sentiment indicators, including the building confidence indicator (see Table 4).

Table 4

Null Hypothesis that the Italian Stock Market Index (FTILMS) Does Not Cause Sentiment Indicators and Vice-Versa

Italy	Lags: 1		Lags: 2		Lags: 4		Lags: 6		
	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	
FTITLMS not cause	8.78782	0.00377	4.48125	0.01368	2.89435	0.0262	2.6562	0.02046	**A**
ESI not cause	0.00529	0.94218	0.09216	0.91203	1.86783	0.12254	2.33473	0.03867	**R**
FTITLMS not cause	5.4665	0.02132	2.97668	0.0555	3.39215	0.01226	2.62292	0.02187	**A**
INDU_CO not cause	0.16198	0.68818	0.70297	0.49754	0.76484	0.55075	1.11498	0.3602	**R**
FTITLMS not cause	5.53029	0.02059	3.8421	0.02468	2.76867	0.03172	5.15599	0.00014	**A**
CONS_CO not cause	0.96792	0.3275	0.75951	0.47058	1.77056	0.14127	1.99731	0.07447	**R**
FTITLMS not cause	18.4372	4.00E-05	9.10496	0.00023	6.33173	0.00015	5.45678	7.70E-05	**A**
SERV_CO not cause	0.3755	0.54137	0.08489	0.91868	0.18265	0.94688	0.12018	0.99372	**R**
FTITLMS not cause	5.30219	0.02331	5.75198	0.00432	3.53902	0.0098	4.85344	0.00025	**A**
RETA_CO not cause	0.70388	0.40343	2.02363	0.13755	3.86023	0.006	2.25077	0.04559	**R**
FTITLMS not cause	0.95689	0.33026	1.55281	0.21671	1.94885	0.10876	1.87898	0.09329	**R**
BUIL_CO not cause	1.5026	0.22307	0.94365	0.39264	1.11614	0.35362	0.37747	0.89156	**R**

France does not differ significantly from Italy (see Table 5). For all the six sentiment indicators is rejected the null hypothesis that they do not cause the first differences (returns) of the French stock index, CAC. On the other hand, the table below shows that is rejected the possibility that the index CAC do not cause the Consumer confidence indicator.

Both in Bulgaria and Romania there is a strong evidence that the causal nexus runs from the sentiment indicators to the stock market indices.

The following Table 6 shows that most Romanian sentiment indicators cause the Romanian stock market index. However, there are two cases in which stock index Granger-causes the sentiment indicators (the Consumer confidence and Building confidence indicators).

Table 5

Null Hypothesis that the French Stock Market Index (CAC) Does Not Cause Sentiment Indicators and Vice-Versa

France	Lags: 1		Lags: 2		Lags: 4		Lags: 6		
	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	
CAC not cause	6.92748	0.00979	3.89108	0.02359	2.50615	0.04724	1.86468	0.09585	**A**
ESI not cause	1.65126	0.20167	0.98384	0.37746	1.61607	0.17666	1.19458	0.31671	**R**
CAC not cause	9.62122	0.00248	5.48434	0.0055	3.85894	0.00601	3.06124	0.00909	**A**
INDU_CO not cause	0.09931	0.7533	0.03976	0.96103	0.61868	0.65029	0.30897	0.93075	**R**
CAC not cause	1.0489	0.30816	0.94307	0.39287	1.55168	0.19371	2.82382	0.01464	**R**
CONS_CO not cause	0.1198	0.72995	0.48646	0.61625	0.43491	0.78308	0.43965	0.85042	**R**
CAC not cause	6.98815	0.00949	3.58631	0.03132	3.66736	0.00805	3.5573	0.00335	**A**
SERV_CO not cause	1.85611	0.17605	0.55053	0.57838	0.72453	0.57734	1.45209	0.20412	**R**
CAC not cause	4.04911	0.04681	3.26729	0.04222	2.38077	0.05708	1.89839	0.08992	**A**
RETA_CO not cause	0.12231	0.72726	0.15417	0.85733	0.34338	0.84801	0.91415	0.48872	**R**
CAC not cause	4.71723	0.03216	3.56681	0.03189	2.14737	0.081	2.12345	0.05841	**A**
BUIL_CO not cause	0.77905	0.37949	0.76419	0.46841	0.63606	0.63803	0.78356	0.58507	**R**

Table 6

Null Hypothesis that Romanian Stock Market Index (BETC) Does Not Cause Sentiment Indicators and Vice-Versa

Romania	Lags: 1		Lags: 2		Lags: 4		Lags: 6		
	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	
BETC not cause	10.0113	0.00205	4.02585	0.02082	3.22001	0.01594	2.19125	0.05120	**A**
ESI not cause	1.14807	0.28646	0.57094	0.56683	0.62227	0.64775	1.58207	0.16178	**R**
BETC not cause	20.6545	1.50E-05	9.23528	0.00021	8.15719	1.1E-05	5.03906	0.00017	**A**
INDU_CO not cause	0.90437	0.34384	0.51675	0.59804	0.68494	0.60413	1.29350	0.26856	**R**
BETC not cause	1.1183	0.29276	1.64038	0.19908	1.07123	0.37522	0.70970	0.64264	**R**
CONS_CO not cause	1.82604	0.17956	1.01445	0.36630	0.52042	0.72092	1.17554	0.32672	**R**
BETC not cause	5.73468	0.01844	2.94014	0.05744	4.08374	0.00427	3.98970	0.00141	**A**
SERV_CO not cause	0.62967	0.4293	1.10779	0.33431	1.20522	0.31383	1.87370	0.09423	**R**
BETC not cause	9.768	0.00231	5.48193	0.00551	4.44627	0.00246	3.56270	0.00332	**A**
RETA_CO not cause	1.10134	0.29643	1.72870	0.18278	1.13334	0.34563	1.38767	0.22849	**R**
BETC not cause	0.59209	0.44337	0.48404	0.61773	0.52783	0.71553	0.29201	0.93927	**R**
BUIL_CO not cause	0.00069	0.9791	0.00638	0.99364	1.08208	0.36991	0.82848	0.55100	**R**

We find a similar pattern in Bulgaria, which it can be not unexpected, considering the similar recent economic history of these two countries. The only difference is

that the null hypothesis that the SOFIX, the stock index, does not cause the building confidence is somehow weaker than for the Romanian stock index, BETC.

Table 7

Null Hypothesis that Bulgarian Stock Market Index (SOFIX) Does Not Cause Sentiment Indicators and Vice-Versa

Bulgaria	Lags: 1		Lags: 2		Lags: 4		Lags: 6		
	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	F-Statistic	Probability	
SOFIX not cause	5.60282	0.0198	5.85356	0.00394	4.17394	0.00372	2.73407	0.01752	**A**
ESI not cause	0.00078	0.97776	0.08146	0.92183	0.36693	0.83163	0.32345	0.92309	**R**
SOFIX not cause	10.5483	0.00157	5.35812	0.00616	3.26530	0.01488	2.90512	0.01244	**A**
INDU_CO not cause	0.07671	0.78237	0.09808	0.90666	0.30994	0.87069	0.50836	0.80053	**R**
SOFIX not cause	1.8945	0.17168	1.35501	0.26264	1.85428	0.12500	1.31592	0.25852	**R**
CONS_CO not cause	1.99641	0.16069	1.16230	0.31696	0.99617	0.41368	0.78890	0.58098	**R**
SOFIX not cause	2.96725	0.08797	3.48111	0.03455	2.64132	0.03849	1.77956	0.11247	**A**
SERV_CO not cause	0.53652	0.46554	0.4304	0.65145	0.12748	0.97213	0.14478	0.98963	**R**
SOFIX not cause	15.0143	0.00019	7.57971	0.00086	4.98103	0.0011	4.30079	0.00075	**A**
RETA_CO not cause	1.73894	0.1902	0.67602	0.51094	0.94167	0.44347	0.57523	0.74908	**R**
SOFIX not cause	0.25475	0.61483	2.09982	0.12785	2.40658	0.0549	2.18161	0.05217	**R**
BUIL_CO not cause	1.24438	0.26722	0.75442	0.47294	0.40822	0.80232	0.24145	0.96151	**R**

6. Conclusions

In this paper we analyzed the possible correlations between the six sentiment indicators elaborated by the European Commission and the stock market indices in seven EU countries (UK, France, Italy, Spain, Germany, Bulgaria and Romania). The sentiment indicators are built by carrying on surveys in the following sectors: consumers, industry, manufacturing, construction, retail trade and services, plus an Economic Sentiment Indicator (ESI) that is composite indicator of the overall sentiment of the economy, calculated as a weighted average of the aforesaid indicators.

We found out a significant positive correlation between the stock market index and several sentiment indicators. In particular, in the seven countries of our sample the ESI and the Consumer Confidence Indicator (CCI) were always present among the first two or three relevant indicators, ranked in term of highest correlation coefficients. Also the Industrial Confidence Indicator (ICI) resulted in having a significant positive correlation in most of the sample's countries.

With reference to the Granger causality analysis, in these conclusive remark, we want to highlight, as a first step, the results about the aforesaid sentiment indicators (ESI, CCI and ICI), which the correlation analysis highlighted as particularly significant in most of the countries.

First, we focus on the Consumer Confidence Indicator, given also the fact that most of the economic literature in this field deals with this sentiment indicator. The null hypothesis that "the stock market index does not cause the CCI" (i.e. the stock index Granger-causes the CCI) is accepted only in the cases of Germany and Italy. The alternative null hypothesis that "the CCI does not cause the stock market" is accepted only in the case of Spain. In all the other five countries the hypothesis is rejected. Therefore, for Germany and Italy it can be stated that there is unambiguous statistical evidence that the Granger causality runs, in the short term[9], from the Consumer Confidence Indicator to the stock market index. The opposite case is that of Spain where there is empirical support that the stock market index Granger-causes the CCI. In all the other four countries (UK, France, Bulgaria and Romania) there is not a univocal evidence of the causal nexus.

As far as the Industrial Confidence Indicator is concerned, in all countries except Spain the hypothesis that "the stock market index does not Granger cause the ICI" is accepted and, at the same time, is rejected the alternative hypothesis that the ICI does not cause the stock market index. This means that in six out of the seven countries of our sample the changes in the sentiment of the industrial operators anticipate the variations of the equity market index. This result is interesting, because the equity markets, to some extent, seem to follow the fundamentals of the economy which are reflected in the industry surveys.

With reference to the Economic Sentiment Indicator (ESI), which we recall is a weighted composite indicator reflecting the sentiment of all the economic sectors (consumers, entrepreneurs, builders etc.) covered by the EU surveys, in general, the causality direction seems to be from the ESI to the stock index[10].

As a second step, still dealing with the Granger test results, we have divided our sample in two groups of countries on the grounds of the overall behaviour of the six sentiment indicators with respect to the relative national stock index.

In the first group, we have included the countries where there is a statistical evidence of the stock index Granger-causing the majority of the sentiment indicators (that is three or more indicators). In the second group, we have put the countries where the causality link from the market to the sentiment indicators appear to be weaker and, vice-versa, is higher the probability of a reverse causal relationship, i.e. from the sentiment indicators toward the stock indices.

In particular, in the first group we have included: i) Spain, where the stock market index causes all the six confidence indicators; ii) Germany, where the stock market

[9] One month to six months are the lags considered in the analysis.

[10] In the cases of Spain and Germany the results are not univocal: the hypothesis that the stock index does not cause the ESI is accepted only at a 10% p-value for 1 month lag (while in the other countries is accepted at a 5% level) and the alternative null hypothesis the ESI does not cause the stock index is accepted too.

causes four confidence indicators, and iii) UK, border line case, with three confidence indicators out of six caused by the stock market index[11]. In the second group, instead, we have put those countries where the stock market causes only a few sentiment indicators, two confidence indicators in Bulgaria and Romania and only one in Italy and France.

The alternative null hypothesis tested, that is if the sentiment indicators cause the stock market index, brings to interesting results as well.

The null hypothesis that the sentiment indicators do not cause the stock market indices is rejected for four sentiment indicators in Spain and for three sentiment indicators both in Germany and UK, countries included in the first group (i.e. where most of the sentiment indicators cause the stock index). Spain appears to be a particular case, given the fact that four out of six sentiment indicators seem at the same time to cause and to be caused by the stock market, which suggests a sort of a mutual dependence.

Though, more striking are the test results concerning the alternative hypothesis for the aforesaid second group of countries (Italy, France, Bulgaria and Romania). Here the null hypothesis that the sentiment indicators do not cause the stock market is rejected for all the six sentiment indicators. That is, the stock prices' changes are preceded by the changes in the sentiment indicators. Thus, for the countries of the second group, the sentiment indicators appear to be leading indicators with respect to the local stock indices.

We may only make some hypothesis about the possible explaining factors of such differences. One explanation could be the size of the stock market, which can be also seen as a proxy of a country's financial development level. The less developed financial markets, like those of Bulgaria and Romania - given their relatively low grade of technical development and small size (i.e. they are "thin" markets) - could be unable to process quickly, and therefore to discount, the relevant market information available, either public or unofficial. The relatively low informational efficiency of these stock markets could explain why, in general, in these countries the stock indices movements follow the changes in the sentiment indicators.

In fact, the market capitalization in Bulgaria and Romania as a percentage of the GDP, notwithstanding its growth in the last years (from 2000 to 2007 it grew, respectively, from 5 to 55% and from 3 to 27%)[12], is still lower then that of other more financially developed countries. Also the Italian stock market seems less developed then that of other western countries (Italy's market capitalization as a percentage of the GDP grew from 39 to 70% in the period 2000-2007, but it is still lower than that of other western countries). Conversely, the French case does not seem to support this hypothesis, as the French market capitalization to the GDP is quite high (75% in 2000 and 109% in 2007).

Under the aforesaid assumptions, in the first group (where the majority of sentiment indicators are caused by the financial market index) we would expect to find higher market capitalisation countries. In fact, we find in this group the UK and Spain

[11] 5% is the p-value here considered in order to accept or to reject the null hypotheses.
[12] Word Bank Statistics (http://web.worldbank.org/)

which have relatively large stock markets.[13] Actually, in this group we find also Germany, which is characterized by a lower market capitalization (34% of GDP in 2000 and 67% in 2007). In this case, however, the lower weight of the stock market reflects most likely the particular structure of the German financial system (where the bank lending plays a relevant role in the firms' funding) than a lower level of financial development.

Obviously, the financial market size cannot be the only explanation for the country differences in the interaction between the equity prices' variations and the sentiment changes of the economic operators. Many other factors may have an impact on these performances. This suggests the need for further research on the issues raised in this work.

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[13] For UK, 119 and 179% was the market capitalization on GDP ratio, respectively, in 2000 and 2007. In Spain, 77 and 126% was the ratio in the same years.

APPENDIX A: LEADS & LAGS CROSS-CORRELATION ANALYSIS

Note: we report here only the case of the "UK Retail trade confidence indicator" as an example of the few cases where the correlation between the leaded/lagged indices was significantly different from the correlation between the contemporaneous indices (i.e. at t_0).

UNITED KINGDOM

Cross-correlation between the UK stock index and the retail trade confidence indicator

```
xcorr uk_r_ftse_ma  u_reta_cof_pro,table lags(12)

                -1       0       1

 LAG      CORR   [Cross-correlation]

-----------------------------------

-12      0.1449           |-

-11     -0.0792           |

-10      0.0323           |

-9       0.3153           |--

-8      -0.0457           |

-7      -0.0839           |

-6       0.0466           |

-5       0.0004           |

-4      -0.0531           |

-3       0.0687           |

-2      -0.1063           |

-1      -0.0458           |

0        0.1342           |-

1        0.0521           |

2       -0.0749           |

3       -0.0398           |

4        0.0371           |

5        0.0349           |

6        0.0422           |

7        0.0411           |

8        0.0614           |

9        0.0407           |

10      -0.0165           |

11       0.0775           |

12       0.0882           |
```

APPENDIX B: ADF test applied to the series of the UK stock index and ESI

Note: we reported the following ADF test output as an example of all ADF tests ran in the analysis

Unit root tests for variable UKRFTSEMA

The Dickey-Fuller regressions include an intercept but not a trend

****

94 observations used in the estimation of all ADF regressions.

Sample period from 2004M2 to 2011M11

****

	Test Statistic	LL	AIC	SBC	HQC
DF	-8.7350	163.1246	161.1246	158.5813	160.0973
ADF(1)	-7.5328	164.3186	161.3186	157.5036	159.7776
ADF(2)	-4.8407	166.0982	162.0982	157.0117	160.0436
ADF(3)	-3.7372	166.8687	161.8687	155.5105	159.3004
ADF(4)	-2.9792	167.8453	161.8453	154.2155	158.7634
ADF(5)	-3.2808	168.8735	161.8735	152.9720	158.2780
ADF(6)	-3.0329	168.8780	160.8780	150.7048	156.7688
ADF(7)	-2.9978	168.9730	159.9730	148.5281	155.3501
ADF(8)	-2.9485	169.0473	159.0473	146.3308	153.9108
ADF(9)	-3.2431	170.1366	159.1366	145.1484	153.4864
ADF(10)	-2.9903	170.1537	158.1537	142.8940	151.9899
ADF(11)	-3.1877	170.8516	157.8516	141.3202	151.1742
ADF(12)	-2.9013	170.8886	156.8886	139.0856	149.6975

****

95% critical value for the augmented Dickey-Fuller statistic = -2.8922

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable UESIPRO

The Dickey-Fuller regressions include an intercept but not a trend

****

94 observations used in the estimation of all ADF regressions.

Sample period from 2004M2 to 2011M11

****

	Test Statistic	LL	AIC	SBC	HQC
DF	-9.7145	179.1781	177.1781	174.6348	176.1508
ADF(1)	-5.0743	183.4478	180.4478	176.6329	178.9068
ADF(2)	-3.5183	186.7268	182.7268	177.6403	180.6722
ADF(3)	-3.3557	186.7470	181.7470	175.3887	179.1787
ADF(4)	-3.0452	186.7861	180.7861	173.1562	177.7042
ADF(5)	-3.1577	187.1834	180.1834	171.2818	176.5878
ADF(6)	-2.8747	187.2726	179.2726	169.0994	175.1634
ADF(7)	-3.3517	189.3117	180.3117	168.8669	175.6888
ADF(8)	-2.9427	189.5323	179.5323	166.8158	174.3958
ADF(9)	-2.9409	189.6640	178.6640	164.6759	173.0138
ADF(10)	-3.0447	190.0450	178.0450	162.7853	171.8812
ADF(11)	-3.6456	192.7498	179.7498	163.2184	173.0723
ADF(12)	-3.2543	192.8068	178.8068	161.0038	171.6157

****

95% critical value for the augmented Dickey-Fuller statistic = -2.8922

LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion