Vasileiou Evangelos (Greece)

Long live day of the week patterns and the financial trends' role. Lessons from the Greek stock market during the Euro era

Abstract

The main objective of this study is to examine if the long term financial trends influence not only a stock market's returns, but also the day of the week pattern (DOW). In order to examine the specific issue the author tries to find a financial market which: (1) presents clear and long-term financial trends, and (2) during the examined period does not present significant regulatory, institutional and economic reforms (*ceteris paribus* principle), which influence the DOW. The Greek stock market during the period 2002-2012 satisfies the assumptions. The author divides the total period into growth (2002-2007) and recession (2008-2012) sub-period in order to examine the patterns behavior under changing financial trends. Several models that are usually used in the respective literature (OLS, GARCH family) are applied in order to conclude that the TGARCH asymmetry model is the most appropriate due to the leverage effect. The literature review and the empirical results show that for the Greek stock market there is a long-term tendency for the turn of the week effect, but the changing financial trend influences the strength of the specific calendar effect. Therefore, if the author examines the calendar anomalies without taking into account the financial trend the author may reach conclusions that are not completely correct. Moreover, the fact that scholars do not take into account the ceteris paribus and/or the financial trend's role may be a new-alternative explanation why the empirical literature provides conflicting findings for the calendar anomalies existence through time.

Keywords: calendar anomalies, day of the week effect, market efficiency, financial crisis, weekend effect.
JEL Classification: C58, G14, G20.

Introduction

Financial markets' time series returns often present seasonal abnormalities, which are widely known as "calendar effects (or anomalies)". These anomalies have confused economists for decades because their existence questions two of the most popular theories of contemporary finance: the asset pricing theory (Sharpe, 1964; Lintner, 1965), and the efficient market hypothesis (Fama, 1970). That may be the main reason for the significant number of calendar anomalies that have been documented in the vast literature which exists in this specific area of study.

The most "popular" calendar effects in the international literature are: (1) the turn of the year (TOY) or "January effect", according to which returns are higher in January than in the other months of the year, (2) the day of the week effect (DOW), which suggests that the stock returns are considerably differentiated depending on the weekday, (3) the trading month effect (TM), which suggests that returns are higher in the first fortnight of the month and lower in the second, and (4) the turn of the month (TOM) effect according to which the stock returns are significantly higher during the turn of the month than during other days[1].

Through the years, scholars document several other calendar anomalies such as the "October effect", which stresses that in October the returns are lower than in other months, the religious holiday effect', according to which returns are higher before holidays and lower the days after etc. In some cases there are some calendar anomalies which, even if they are documented in a study their existence is strongly questioned afterwards, e.g. Kohers and Patel (1999) document a new calendar anomaly: the time of the month effect (which assumes significantly different returns during the month's first-third, second-third and third-third). However, this was rejected some years later by Cadsby and Torbey (2003).

A major question arises: why are there so many anomalies? Neuroscientists, such as Zweig (2000), state that, in general, human beings have a tendency to look for patterns in a series of events, even when they are told that these events are random. This tendency, however, seems to be hardwired into the human brain[2].

Apart from the scientific explanation, behavorial and financial economists try to explain these specific abnormalities. Several explanations for each calendar anomaly have been suggested. On the other hand, several studies suggest the calendar anomalies fade after the scholars documented them (Agrawal and Tandon, 1994; Schwert, 2003), because the markets incorporate the knowledge of the observed patterns into the pricing of the securities and trade the anomalies out of existence. In contrast, there are other studies, which call them in question due to the violations of the OLS assumptions in the returns (Connolly, 1989; Alford and Guffey, 1996).

Vasileiou Evangelos, Ph.D. Student, University of the Aegean, Greece.
[1] As turn of the month days are usually defined the last trading day of the previous month and the first three trading days of the next month (Lakonishok and Smidt, 1988).

[2] Wolford et al. (2000) suggests that the left hemisphere of the human brain is responsible for the patterns search.

The evolution of the methodological approaches not only helps scientists to avoid the methodological counterarguments, but also enables them to examine calendar anomalies under different assumptions. In particular, the easy step in such a study is to apply all the methodologies (OLS estimators and GARCH family models) that are usually used in similar studies in order to find which is the most appropriate for our research. It is harder to find an explanation as to why CAs fade or under which circumstances the CAs exist.

Recent literature has presented some studies that examine the calendar anomalies under volatility regime shifts. The results suggest that high/low volatility periods influence not only the markets' returns, but also their anomalies (Floros and Salvador, 2014). However, the volatility periods change sooner than the long-term financial trends (Vasileiou and Samitas, 2013). In this study we examine whether the calendar anomalies are influenced by a long-term financial crisis and if there is a long-term tendency in favor of a specific pattern.

In order to examine the specific relationship we should find a stock market which presents long-term and clear financial trends. Moreover, the literature has documented studies which demonstrate that regulatory and economic reforms (e.g. the electronic settlement of the transactions, the upgrade/downgrade of markets, the Euro entrance etc.) influence the CAs. These reforms violate the *ceteris paribus* principle.

The Greek stock market during the "Euro era" (2002-2012) meets all the points mentioned above. The last part of our research is to find the CA anomaly which is the most examined in the specific case in order to draw conclusions for a possible long-term tendency and a comparison with previous results. Therefore, we choose to examine the DOW for the Greek stock market during the years 2002-2012[1].

This study contributes to the existing literature by: (1) examining if the long-term financial trends influence not only the stock markets' returns, but also their calendar anomalies, (2) approaching the "day of the week" effect under the *ceteris paribus* principle in order to "immunize" the results from structural changes' influence, (3) extending previous literature about the Greek stock market's "day of the week" pattern, (4) comparing the results of previous "day of the week" studies in order to suggest whether there is a long live "day of the week" pattern, (5) presenting a new explanation-alternative for the calendar anomalies fade/existence through time, and (6) a new approach on the calendar anomalies study, which takes into account the financial trends role.

[1] In the next sections we analytically present why the Greek case meets our assumptions (financial trends, long term economic cycles, regulatory and economic reforms etc.) and that the Greek CAs literature is mainly focused on the DOW effect.

The rest of this paper is as follows: Section 1 reviews the literature background; Section 2 briefly provides information about the Greek stock market; Section 3 presents the data, Section 4 analyzes the methodology and Section 5 displays the results. Section 6 discusses the empirical findings and, Final Section concludes the study.

1. Literature review

This study's main objective is the DOW effect, therefore we present below only specific literature in order to save text space. We ought to mention that the day of the week effect is often referred to as the "turn of the week" or "weekend" effect. This term dominates the DOW literature, since in most studies that primary examine – this pattern the empirical findings suggest significantly lower Monday returns (which is called "Monday effect") and significantly higher Friday returns (which is called "Friday effect") in comparison to the other weekdays.

French (1980) first notes the "weekend effect" examining Standard and Poor's (S&P) daily returns during the period 1953-77. Subsequent international studies confirm the DOW effect (Jaffe and Westerfield, 1985; Basher and Sadorsky, 2006; Cho et al., 2007; Lim et al., 2010), but others do not (Brusa et al., 2003; Apolinario et al., 2006). International literature provides several explanations for the DOW effect, such as: the companies' tendency to release bad news announcements after the market's Friday close, in order to give said market enough time to absorb the shock, for psychological reasons, such as a positive effect before the weekend. Other studies produce evidence that speculates short sellers behavior leading to the DOW effect, because the short sellers close their positions on Fridays and re-establish new short positions on Mondays, due to their inability to trade over the weekend. This strategy leads to increased stock prices on Fridays, which fall on Mondays (Chen and Singal, 2003).

Furthermore, according to some scholars the "Monday effect" is influenced by the institutional investors' holdings in the stock market. Particularly, Chan et al. (2004) suggest that the "Monday effect" is weak in stock markets with a high percentage of institutional holdings. In such stock markets, Monday returns are not significantly different than the mean Tuesday to Friday returns, so they conclude that the "weekend effect" may be related to the trading activities of less sophisticated individual investors.

However, there are some studies which prove that the negative (positive) returns are noted on weekdays other than Mondays (Fridays), therefore in these cases the "day of the week term" may fit better. Previous Athens Exchange (ATHEX's) calendar effect studies, which are presented below and cover the 1985-2005 period, seem to be consistent with this term, therefore we use the "day of the week" term in our study. This study examines the DOW for the Greek case and for thus we present below the respective literature in detail.

Alexakis and Xanthakis (1995) use data from January 1985 to February 1994 in order to study the DOW. They divide these years into two sub-periods. In the first period (1985-1988) ATHEX operates under backward statutory conditions, but during the second period (1988-1994) significant regulatory changes have been introduced (measures which increase transparency, increased stock market freedom by government intervention, the computerization of ATHEX, etc.) that influence all market players. They find positive returns on Mondays and negative on Tuesdays when the total period or the first sub-period is examined, but when they examine the second sub-period Mondays and Tuesdays present to have negative returns. Regarding the other week days positive returns are founded either during the total or the two sub-periods are examined. Therefore, as they empirically show the significant regulatory reforms influence the calendar anomalies.

Mills et al. (2000) discuss the day of the week effect using ATHEX General Index (AGI) data from October 1986 to April 1997. They find evidence for: (1) negative results on Tuesdays (Tuesday effect) and positive returns on Fridays. Their explanation is that in Greece bad news is announced at the weekend, but the information is not instantly reflected in the prices. A possible explanation may be that Greek investors are hesitant and act with a delay of one day (Jacobs and Levy, 1988). Therefore, their analysis does not take into account either the structural reforms or the financial trend.

Kenourgios and Samitas (2008) examine several indexes, included the ATHEX General Index, for the period 1995-2005. They find positive returns on Fridays and Mondays, but negative on Tuesdays for the emerging ATHEX over the period 1995-2000. These results change, though, during 2001-2005 when Mondays turn to be negative returns days. However, during the second sub-period several significant structural events take place in the Greek stock market and economy (in 2001 Greece enters the Euro-Zone, the Euro officially circulates in 2002 and the Greek stock market upgrades to mature), which violates the *ceteris paribus* principle and influence the calendar effects.

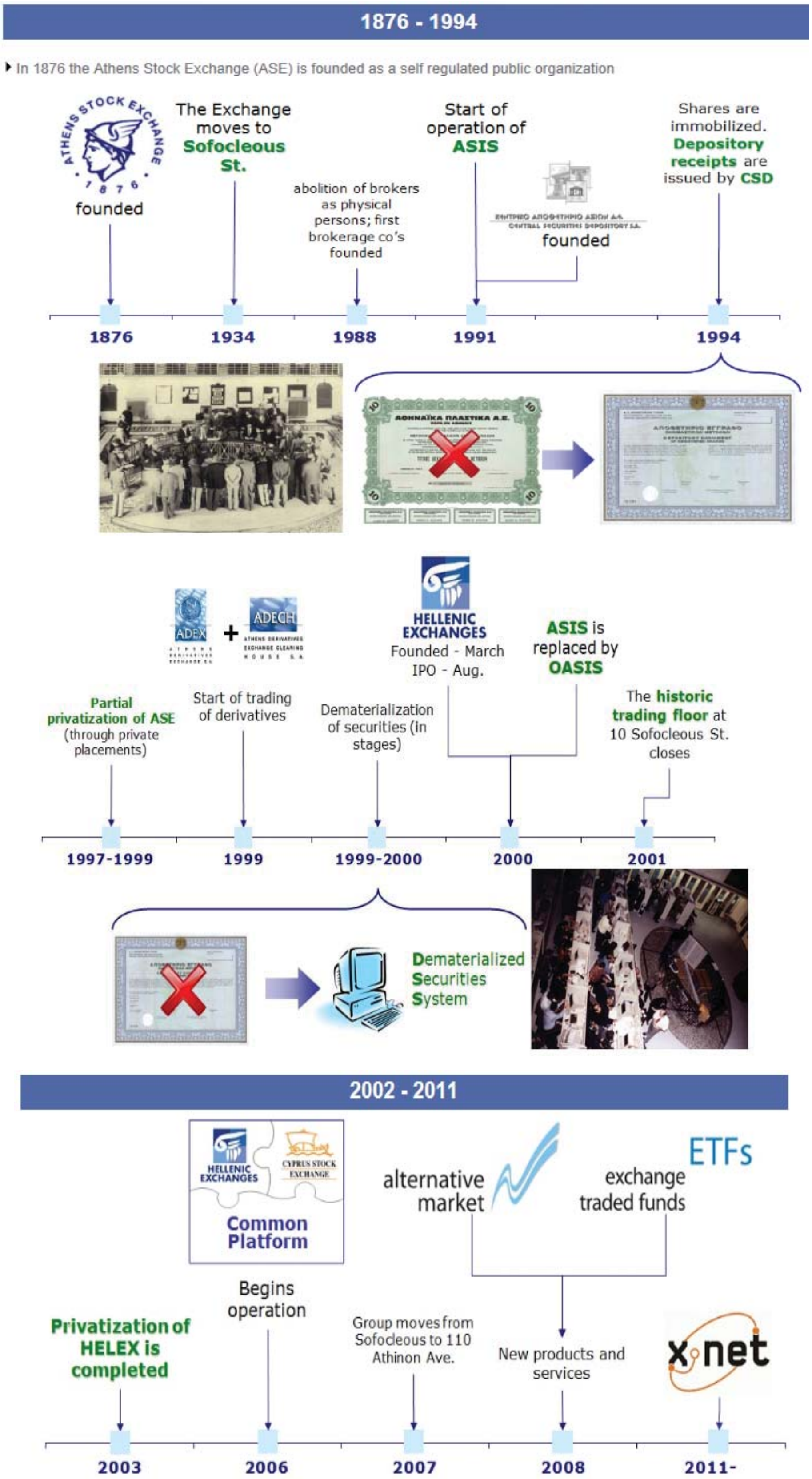
Concluding the aforementioned DOW empirical literature for Greece we should note the following: (1) the regulatory, economic and financial changes (the ATHEX reforms, the entrance to the Eurozone, the ATHEX upgrade etc.) violate the *ceteris paribus* principle and influence the DOW effect, (2) the aforementioned studies examine the day of the week effect applying either linear (Mills et al., 2000) or non-linear methodologies (Alexakis and Xanthakis, 1995; Kenourgios and Samitas 2005) which as we presented in the introduction may be a field of controversy (Connolly, 1989; Alford and Guffey, 1996).

However, none of these studies take into consideration the financial trend and if it influences the DOW patterns. For example, we assume that in the Greek stock market there is a predisposition for a weekend effect pattern. If we assume that the financial conditions are positive (negative) why Monday (Friday) returns should be negative (positive)? Could the positive (negative) environment statistically increase the positive (negative) predisposition for the Friday (Monday) effect?

This study tries to fill the aforementioned gap by examining the calendar effects – financial trend relationship, while we "immunize" our sample from the reforms' influences. In order to avoid methodological counterarguments we have applied several linear and non-linear models. Finally, we compare the so far known results for the Greek case during the period 1985-2005, to the new findings in order to draw conclusions if there is a predisposition for possible long-lived day of the week pattern and how it is influenced by the financial trend.

2. Market information

The ATHEX was founded in 1876 as an autonomous public regulatory body, but significant efforts for its modernization have been made since 1991 (Alexakis and Xanthakis, 1995). Figure 1 presents the most important regulatory changes in ATHEX history. However, in our opinion, there are two important reforms which may cause a violation of the *ceteris paribus* principle, but are not mentioned in the figure: (1) ATHEX upgrades to the mature markets in May 2001 and (2) the Greek entrance to the EMU in 2001 (official circulation starts in 2002). Therefore, during the period 2002-2012 the *ceteris paribus* principle is not violated.



Source: Hellenic Exchanges web site (http://www.helex.com/helex-history).

Fig. 1. Athens exchange brief history

The next step of our study is to find the index which best represents the ATHEX behavior. According to Tsangarakis (2007) the ATHEX General Index (AGI) is a very reliable indicator, adequately representing the stock market capitalization and the average daily trading value. Moreover, AGI has been used in previous studies (Mills et al., 2000; Kenourgios and Samitas, 2008 etc.), therefore their findings are directly comparable to ours. In order to quantitatively present the AGI's appropriateness to our study, Table 1 presents the participation ratios of the AGI stocks capitalization and the average trading value to the size of the total market. The increased ratios enable us to assume that the AGI adequately represents the Greek stock market[1].

Some useful AGI information for readers who are not familiar with the Greek stock market and the AGI are presented below. AGI consists of the 60 largest companies' (blue chips) stocks, which are listed in the main market and calculated daily. It is a market capitalization weighted-index, while there are specific criteria (e.g. increased liquidity) for a stock to be included in the ATHEX general index. The ATHEX general index (AGI) has a base value of 100 as of December 31, 1980 and its purpose is to be a reliable measure for the trend of the listed companies' stocks, which are traded in ATHEX's Large Capitalization Index. AGI is biannually reviewed in April and October[2].

Table 1. Athens stock exchange general index participation to the total market capitalization and the average daily trading value

Index \ year	2009	2010	2011	2012
% market capitalization	76.95%	78.60%	80.61%	85.80%
% average daily trading value	87.87%	92.02	91.09%	76.50%

Source: Athens stock exchange web site http://www.athex.gr/content/gr/Ann.asp?AnnID = 148310.

3. Data and descriptive statistics of the Greek market

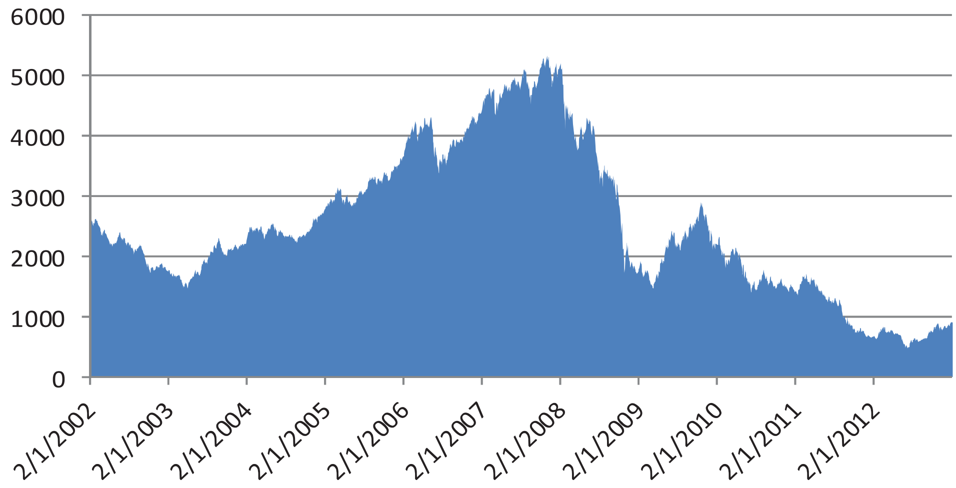
The US crisis in 2007-2008 could not but influence the EMU economies. Among them, the Greek economy faces the most long lasting recession (Table 2). Financial economists suggest that the stock market performance is a leading indicator for the economic growth/recession (Levine, 2005; Levine and Zervos, 1998, etc.). Theoretically: (1) the Greek stock market should present the long-lasting and clear financial trends, and (2) in the Greek stock market the growth period should appear during 2002-2007 and the recession period should appear during 2008-12. Figure 2 (a) presents the AGI index prices for the period 2002-2012 and confirms our assumptions. Furthermore, Figure 2 (b) presents the returns chart[3]. The sample consists of 2,744 returns' daily observations. The closing prices are obtained from the Bloomberg data base.

Table 2. Gross domestic product annual percentage growth in constant prices for the 2002-2012 period in the sample countries

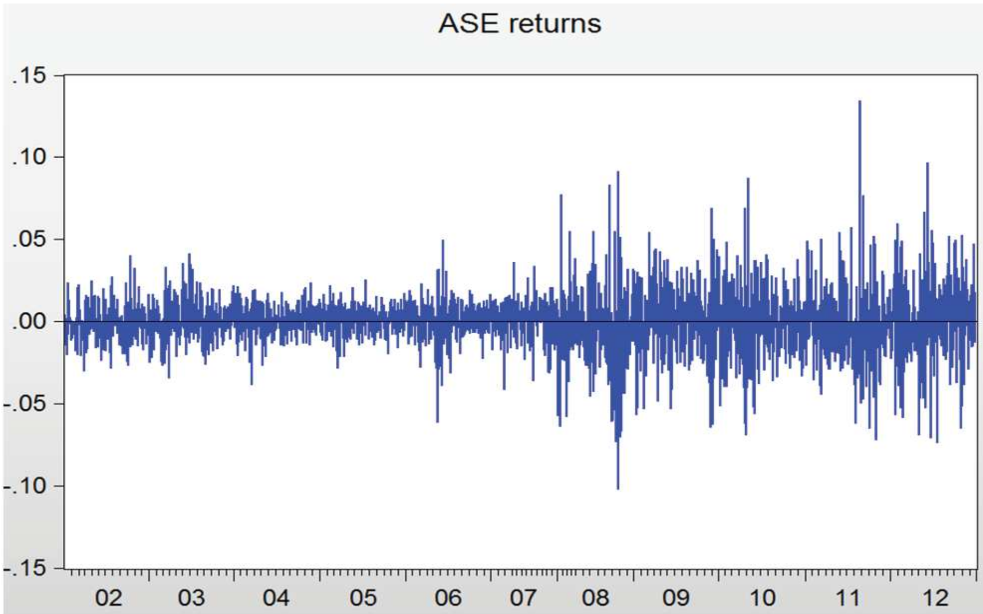
Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Austria	1.694	0.866	2.590	2.401	3.670	3.706	1.436	-3.822	1.769	2.834	0.871
Belgium	1.359	0.807	3.274	1.752	2.666	2.883	0.985	-2.787	2.416	1.840	-0.281
Finland	1.834	2.012	4.126	2.915	4.411	5.335	0.294	-8.539	3.363	2.726	-0.827
France	0.929	0.899	2.545	1.826	2.467	2.285	-0.081	-3.147	1.725	2.027	0.014
Germany	0.030	-0.387	0.694	0.846	3.886	3.389	0.807	-5.085	3.857	3.399	0.896
Greece	3.440	5.944	4.368	2.280	5.511	3.536	-0.214	-3.136	-4.943	-7.105	-6.389
Ireland	5.417	3.730	4.200	6.080	5.505	4.970	-2.160	-6.384	-1.063	2.169	0.157
Italy	0.451	-0.047	1.731	0.931	2.199	1.683	-1.156	-5.494	1.723	0.374	-2.369
Luxembourg	4.088	1.669	4.376	5.253	4.933	6.588	-0.735	-4.073	2.891	1.656	0.336
Malta	2.434	0.716	-0.289	3.585	2.580	4.073	3.881	-2.812	3.189	1.819	1.039
Netherlands	0.076	0.336	2.237	2.046	3.394	3.921	1.804	-3.668	1.528	0.945	-1.247
Portugal	0.764	-0.911	1.560	0.775	1.448	2.365	-0.009	-2.908	1.936	-1.288	-3.238
Slovak Republic	4.583	4.775	5.058	6.655	8.346	10.494	5.751	-4.936	4.382	3.226	2.027
Slovenia	3.827	2.930	4.402	4.007	5.850	6.960	3.383	-7.943	1.258	0.709	-2.543
Spain	2.707	3.088	3.257	3.588	4.075	3.479	0.893	-3.832	-0.203	0.052	-1.643
United States	1.776	2.791	3.798	3.351	2.667	1.790	-0.291	-2.802	2.507	1.847	2.779

Source: International Monetary Fund (IMF), World Economic Outlook Database, October 2013 Definition: Gross domestic product, constant prices.

[1] We do not have official data for the pre 2009 that is why we present the 2009-2012 period. The appropriateness of the AGI during the pre-2009 years is confirmed from previous studies which are mentioned above.
[2] More information from the section "Indicators" on ATHEX website: http://www. athex. gr.
[3] The daily returns are defined as $R_t = \text{Ln}\,(P_t/P_{t-1})$.



(a) The ATHEX Index from 3rd January 2002 to 31 December 2012



(b) Returns from 3rd January 2002 to 31 December 2012

Fig. 2. ATHEX index and ATHEX returns chart

Observing Figure 2, we may note the following: (1) the time series is approximately stationary, (2) the volatility varies over the period, (3) the high (low) volatility periods are followed by periods of high (low) volatility, and (4) the stock values fall and the volatility increases from the 2007's last months to the end of 2012.

Table 3 quantitatively confirms our previously mentioned notes. The AGI mean return during the growth period is positive, and negative during the recession period. Moreover, the volatility (standard deviation) increases during the second (recession) sub-period. Beside the descriptive statistics, we include the stationarity and correlation tests of the time series. We briefly mention three main results. Firstly, there is increased kurtosis and the Jarque-Bera test confirms that the time series does not follow the normal distribution. The leptokurtosis of these three distributions is a sign that linear models may not be adequate to explain the specific time series' behavior. Secondly, the correlation tests using the Ljung-Box (Q) statistics reject the hypothesis of first and second-order independencies, which means that the conditional mean is a function of past returns and/or past errors and the conditional variance of returns is time-dependent and heteroscedastic[1]. Thirdly, we use the augmented Dickey and Fuller statistics in order to test for a unit root in the ATHEX returns series. The hypothesis for a unit root is strongly rejected in favor of the stationary alternative.

[1] The results are similar to Alexakis and Xanthakis (1995).

Table 3. Summary statistics for the ATHEX General Index returns in period 2002-2012.

	Total period (3/1/2002-31/12/2012)	Growth sub-period (3/1/2002-27/12/2007)	Recession sub-period (2/1/2008-31/12/2012)
Mean	-0.000387	0.000453	-0.001396
Median	0.000110	0.000692	-0.001225
Max	0.134311	0.049736	0.134311
Min	-0.102140	-0.061067	-0.102140
St.dev.	0.017577	0.010548	0.023338
Skewness	0.039841	-0.208261	0.163840
Kurtosis	7.509174	4.891524	5.094249
Jarque-Bera	2325.426	233.9906	233.4619
Probability	0.000000	0.000000	0.000000
Q (1)	9.0279 (0.0003)*	6.7079 (0.010)*	3.3404 (0.068)***
Q (5)	15.508 (0.008)*	9.9190 (0.078)***	8.6161 (0.125)
Q (10)	24.685 (0.006)*	11.642 (0.310)	14.943 (0.134)
Unit root tests for (R_t) Augmented Dickey-Fuller (ADF)	-49.43299 (0.0001)*	-36.14652 (0.0000)*	-33.49104 (0.0000)*
Total observations	2.744	1.497	1.247
Days with positive returns	1.385	796	588
% of days with positive returns	50.47%	53.17%	47.15%
Days with negative returns	1.359	701	659
% of days with negative returns	49.53%	46.83%	52.85%

Finally, in Table 4 we present descriptive statistics for each day (in each period) and we may highlight the following: (1) almost all the distributions are leptokurtic, so we do not have normal distributions, (2) Mondays and Tuesdays are days with negative average returns, while Fridays are days with positive returns, (3) Mondays give negative returns in almost 55% of the observations for each period (Mondays are the weekdays with the most stable behavior), while Fridays' positive returns range from 52.05% to 58.39% during recession and growth periods respectively, and (4) Wednesdays and Thursdays seem to be influenced by financial trends.

Table 4. General index day of the week descriptive statistics

Total period (3/1/2002-31/12/2012)					
	Monday	Tuesday	Wednesday	Thursday	Friday
Mean	-0.002166	-0.001400	0.000293	7.38E-05	0.001192
Median	-0.001296	-8.74E-05	0.000110	0.000670	0.001707
Max	0.134311	0.069058	0.091144	0.096372	0.083283
Min	-0.073664	-0.071679	-0.072950	-0.070225	-0.102140
St.dev.	0.019781	0.018128	0.016606	0.016874	0.016234
Skewness	0.442681	-0.346864	0.216137	0.195921	-0.296874
Kurtosis	9.128695	5.353571	6.778243	7.074291	8.253130
Jarque-Bera	835.5963	139.9779	338.6514	390.2143	631.1569
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Total observations	523	558	562	559	542
Positive returns days	230	278	284	291	301
% of days with positive returns	43.98%	49.82%	50.53%	52.06%	55.54%
Negative returns days	293	280	278	268	241
% of days with negative returns	56.02%	50.18%	49.47%	47.94%	44.46%
Growth sub-period (3/1/2002-27/12/2007)					
	Monday	Tuesday	Wednesday	Thursday	Friday
Mean	-0.001381	-0.000417	0.000769	0.001373	0.001817
Median	-0.000857	7.18E-05	0.001025	0.001386	0.001881
Max	0.035276	0.032818	0.041005	0.049736	0.040209

Table 4 (cont.). General index day of the week descriptive statistics

Growth sub-period (3/1/2002-27/12/2007)					
	Monday	Tuesday	Wednesday	Thursday	Friday
Min	-0.061067	-0.041343	-0.032752	-0.036005	-0.026361
St.dev.	0.011660	0.010480	0.010108	0.010618	0.009580
Skewness	-0.402651	-0.359908	-0.053642	-0.103546	0.219484
Kurtosis	5.969638	4.455007	3.954282	4.429026	4.130348
Jarque-Bera	111.6348	33.37895	11.79603	26.49692	18.25720
Probability	0.000000	0.000000	0.002745	0.000002	0.000109
Total observations	283	304	307	305	298
Positive returns days	126	156	165	175	174
% of days with positive returns	44.52%	51.32%	53.75%	57.38%	58.39%
Negative returns days	157	148	142	130	124
% of days with negative returns	55.48%	48.68%	46.25%	42.62%	41.61%
Recession sub-period (2/1/2008-31/12/2012)					
	Monday	Tuesday	Wednesday	Thursday	Friday
Mean	-0.003092	-0.002578	-0.000281	-0.001486	0.000428
Median	-0.003030	-0.001845	-0.001014	-0.001752	0.001103
Max	0.134311	0.069058	0.091144	0.096372	0.083283
Min	-0.073664	-0.071679	-0.072950	-0.070225	-0.102140
St.dev.	0.026317	0.024277	0.022031	0.022092	0.021761
Skewness	0.537369	-0.164962	0.272649	0.369847	-0.212650
Kurtosis	6.178592	3.443652	4.655739	5.109971	5.474068
Jarque-Bera	112.5851	3.235079	32.28747	52.90737	64.06922
Probability	0.000000	0.198386	0.000000	0.000000	0.000000
Total observations	240	254	255	254	244
Positive returns days	104	122	119	116	127
% of days with positive returns	43.33%	48.03%	46.67%	45.67%	52.05%
Negative returns days	136	132	136	138	117
% of days with negative returns	56.67%	51.97%	53.33%	54.33%	47.95%

4. Methodological approach

In the introduction, we present that through the years scholars document fade of the CAs, but some other suggest that the violations of the OLS assumptions may be an explanation for the specific conflicting findings. In order to avoid similar counterarguments we apply OLS and GARCH family models in our sample. The econometric tests we run suggest that the GARCH family models are more appropriate than the OLS due to the ARCH effect. Moreover, the OLS models are inappropriate because our sample's time series present the following financial features: (1) leptokurtosis, that is the returns' tendency to peak at the mean, (2) leverage effect, which is the tendency of a negative return to increase subsequent volatility much more than a positive return of the same magnitude (Engle and Ng, 1993; Pagan and Schwert, 1990), and (3) the volatility clustering, which was first observed by Mandelbrot (1963) and has the tendency for volatility to appear in bunches[1]. Therefore, a GARCH family model theoretically and practically may be more appropriate than an OLS estimation (Brooks, 2008).

The next step in the methodological approach is to choose the most appropriate GARCH family model that may be applied. In the calendar anomalies literature the GARCH family models that are usually applied are: (1) GARCH, (2) T-ARCH, and (3) E-GARCH. In order to find which model best fits our case we use the Akaike and the Schwartz criteria[2]. Theoretically the asymmetric GARCH models may better fit the sample due to our suspicions for leverage effect. Using an asymmetric GARCH model we are able to take into account the leverage effect, which leads to volatility asymmetries. The two asymmetric models that are mainly used in the specific literature are: (1) the T-GARCH or GJR model, named from the authors' initials Glosten, Jagannathan and Runkle (1993), and (2) the exponential GARCH (EGARCH) model proposed by Nelson (1991). Both models of empirical results' are similar, but we

[1] During the recession period the volatility is higher than during the growth period (Table 3). Furthermore, periods of high (low) volatility are followed by periods of high (low) volatility (Figure 2 (*b*)). A possible explanation for the volatility clustering is the time arrival of the information to the investors. Gaunersdorfer and Hommes (2000) suggest that volatility clustering is an endogenous phenomenon caused by the interaction between different types of traders, fundamentalists and technical analysts.

[2] All the data, which are not presented, are available upon request.

present the T-GARCH model, because it performs better than the EGARCH for all the examined periods, according to the Akaike and the Schwartz criteria[1].

The mean equation of the T-GARCH model is the following:

$$R_t = \sum_{i=1}^{5} a_i \times D_{it} + xR_{t-1} + crisis + \varepsilon_t\,, \quad (1)$$

where D_{it} is a dummy variable that takes the value 1 for day i (i = 1,..., 5 for Monday through Friday), α_i is the mean value for day i, x is the coefficient for previous day's return[2], ε_t is an IID (0,σ^2) error term. We do not use a constant term in order to avoid the dummy variable trap. We should stress that only for the total period (2002-12) we include in eq. (1) the crisis (or recession) dummy variable, which takes the value 1 for the recession period (1/1/2008-31/12/2012) and the value 0 for the growth period (1/1/2002-31/12/2008).

For the total period the conditional variance is given by the following TGARCH (2, 1) equation.

$$\sigma_t^2 = a_0 + a_1u_{t-1}^2 + a_2u_{t-1}^2 + \beta\sigma_{t-1}^2 + \gamma u_{t-1}^2 I_{t-1} + \\ + \delta crisis_i\,, \quad (2)$$

where u_{t-2}^2 and u_{t-2}^2 are the ARCH terms, which capture the volatility during the previous period (order 1 and 2 respectively), and σ_{t-1}^2 is the GARCH term, which indicates that the value of the variance depends on the past value of the variance itself. The difference between a simple GARCH and the T-GARCH model is the dummy variable I_{t-1} which takes the value 1, if $u_{t-1} < 0$, and zero otherwise. The crisis dummy variableindicates how the crisis influences on the volatility (this variable is included only when the total period is examined). Positive δ coefficient means that crisis increases the volatility (and vice versa). In this case positive returns will have impact α_1, and negative returns will have impact $\alpha_1 + \gamma$. If $\gamma > 0$ we conclude that there is asymmetry and that a negative return tends to increase subsequent volatility much more than a positive return of the same magnitude.

In order to find the optimal T-GARCH lag order we use the Schwarz and Akaike, while we test if the selected lag orders completely resolve autocorrelation and ARCH effect issues. The results suggest for the first period a simple TGARCH (2, 1) model.

$$\sigma_t^2 = a_0 + a_1u_{t-1}^2 + a_2u_{t-2}^2 + \beta\sigma_{t-1}^2 + \gamma u_{t-1}^2 I_{t-1}\,. \quad (3)$$

While for the second period we employ a TGARCH (1, 1) model:

$$\sigma_t^2 = a_0 + a_1u_{t-1}^2 + \beta\sigma_{t-1}^2 + \gamma u_{t-1}^2 I_{t-1}. \quad (4)$$

5. Empirical results' discussion

In this section we present not only the empirical findings of this study (Table 5), but we extend our discussion by including previous empirical literature's findings in the analysis. This way the results' discussion enables us: (1) to present the current study's DOW findings, (2) to present the existence/fade of the DOW effect during an extended (1985-2012) period, and (3) to draw conclusions if in the Greek stock market there is a long-term tendency for positive/negative returns depending on the weekday.

Table 5. The day of the week effect in return and volatility equations

Mean equation			
	Total period (3/1/2002-31/12/2012)	Growth sub-period (3/1/2002-27/12/2007)	Recession sub-period (2/1/2008-31/12/2012)
Monday	-0.000984 (0.0553)***	-0.000822 (0.1405)	-0.003913 (0.0011)*
Tuesday	-0.000257 (0.5853)	-0.000331 (0.5111)	-0.001385 (0.2473)
Wednesday	0.001041 (0.0395)**	0.000762 (0.1557)	0.000475 (0.7388)
Thursday	0.001130 (0.0247)**	0.001174 (0.0230)**	-0.002077 (0.1669)
Friday	0.001642 (0.0037)*	0.001306 (0.0299)**	0.001339 (0.3585)
Return $_{t-1}$	0.061143 (0.0017)*	0.092389 (0.0001)*	0.036574 (0.2158)
Crisis	-0.001646 (0.0082)*		
Volatility equation			
Constant	6.74E-06 (0.0000)*	7.97E-06 (0.0000)*	3.17E-05 (0.0000)*

[1] The standard T-GARCH model is better than the T-GARCH in mean model, because it allows the returns on a security to be influenced by its risk.

[2] We include the previous day's return (R_{t-1}) term in order to resolve autocorrelation issues (Kenourgios and Samitas, 2008).

Table 5 (cont.). The day of the week effect in return and volatility equations

Volatility equation			
	Total period (3/1/2002-31/12/2012)	Growth sub-period (3/1/2002-27/12/2007)	Recession sub-period (2/1/2008-31/12/2012)
α_1	-0.002335 (0.7687)	-0.060890 (0.0025)*	0.041819 (0.0041)*
α_2	0.054780 (0.0000)*	0.106600 (0.0000)*	
γ	0.097558 (0.0000)*	0.120104 (0.0000)*	0.096074 (0.0002)*
β	0.834276 (0.0000)*	0.818620 (0.0000)*	0.852653 (0.0000)*
crisis	2.92E-05 (0.0000)*		

Note: In parentheses we present the *p*-values.*, ** and *** represent 1%, 5% and 10% statistical significance level.

Monday is the negative returns weekday, especially during the total and the recession period, in which there is increased statistical significance. The Mondays' mean returns in our sample are constantly negative, even during the growth period. These negative Monday returns are similar to the findings by Alexakis and Xanthakis (1995) and Kenourgios and Samitas (2008)[1].

On the other hand, we may characterize Friday as the positive returns day of the week. During the whole period and its sub-periods the empirical findings suggest positive returns, which are statistically confirmed during the total and the growth periods. The positive returns predisposition during Fridays is confirmed in all the sub-periods. At this point we should stress that even during the recession period Fridays are positive returns days. The positive returns on Fridays are similar to Alexaki's and Xanthaki's (1995) and Mills et al. (2000) results.

Tuesdays and Wednesdays are negative and positive returns days, respectively. However, only the Wednesdays during the total period statistically confirm these results. These results are consistent to the findings by Kenourgios and Samitas (2008), Alexakis and Xanthakis (1995).

Thursday is the weekday that presents significant changes in the returns. Particularly, the empirical findings suggest positive and statistically significant returns for the growth period, however during the recession period we find a negative correlation.

The *x* coefficients of the previous days' returns are positive and statistically significant for the total and the growth period[2], which means that the previous days' returns influence the current returns. This may be due to non-synchronous trading, which is likely to characterize the less developed markets and has been documented in previous studies' results (Alexakis and Xanthakis, 1995; Kenourgios and Samitas, 2008). All these findings may mean that in the Greek stock market there is a long term pattern, according to which current returns are positively influenced from the previous day's returns. However, during the recession period the statistical significance of the x coefficients weakens and this may happen due to the changes of the categorized investors' participation (Figure 3). The decreased differences may reduce the non-synchronous trading effect[3].

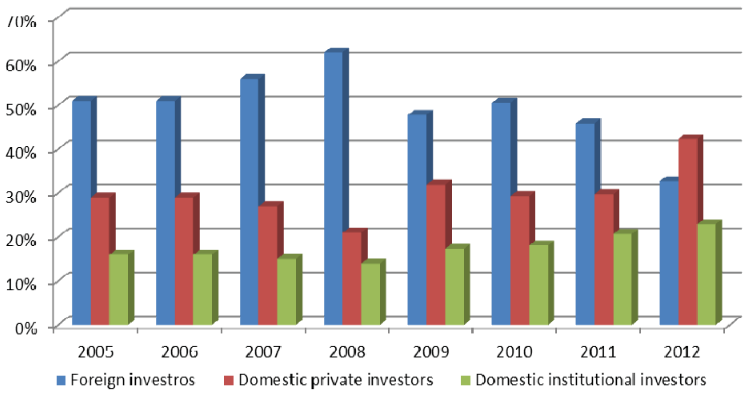


Fig. 3. Investors' participation in ASE (% of total turnover)

[1] This holds the second sub-period 2001-2005, which covers a part of their sample. Moreover, Alexakis and Xanthakis (1995) show that during the 1988-1994 Monday returns are negative.
[2] The positive coefficient holds for the recession period, but it is not statically significant.
[3] Vasileiou (2014) analyzes the specific issue under a behavioral analysis view.

The empirical findings suggest that the financial crisis influences the Greek stock market's returns and volatility. Particularly, crisis significantly reduces the returns (negative and statistically significant coefficient on the mean equation) and increases the volatility ($\delta > 0$ and statistically significant on the variance equation).

The aforementioned findings may suggest that in the Greek stock market there are signs for long-live DOW patterns, because if we combine all the previous empirical findings we may see that similar results hold for a long-term period (e.g. the turn of the week effect).

According to the variance equations (4)-(6) we should stress that: (1) the crisis definitely increases the ATHEX return volatility (eq. (5), $\delta > 0$ and statistically significant), (2) there are asymmetries in the news, which are confirmed by the positive and statistically significant γ coefficient for all the models of this paper. The $\gamma > 0$ means that bad news has a larger effect on the volatility of the series than good news. (3) The sum of the variance coefficients is less than one for all the periods, which means that the conditional variances are always positive and satisfy the non-explosiveness in our samples.

Table 6. Autocorrelation and ARCH-LM tests

	Total period (3/1/2002-31/12/2012)	Growth sub-period (3/1/2002-27/12/2007)	Recession sub-period (2/1/2008-31/12/2012)
Q (5)	7.1799 (0.208)	0.3079 (0.503)	4.9600 (0.421)
Q (10)	11.480 (0.321)	6.6179 (0.761)	9.9788 (0.442)
Q (15)	20.321 (0.160)	10.134 (0.811)	16.864 (0.327)
Q (20)	21.441 (0.372)	12.954 (0.879)	19.854 (0.467)
Q (25)	23.399 (0.554)	16.984 (0.882)	22.796 (0.589)
Q (30)	24.786 (0.735)	21.909 (0.857)	25.882 (0.681)
ARCH (5)	2.342977 (0.7999)	2.682788 (0.7487)	3.526511 (0.6194)
ARCH (10)	5.085166 (0.8854)	4.954997 (0.8942)	8.821034 (0.5492)
ARCH (15)	8.955705 (0.8798)	7.685018 (0.9358)	12.52198 (0.6392)
ARCH (20)	13.37155 (0.8609)	21.01207 (0.3964)	15.37633 (0.7545)
ARCH (25)	17.31809 (0.8699)	32.63351 (0.1405)	25.56852 (0.4309)
ARCH (30)	24.55235 (0.7465)	38.27271 (0.1429)	31.75817 (0.3789)

Note: In parentheses we present the *p*-values.

Table 6, presents the autocorrelation and ARCH effect tests in order to complete the empirical findings section, including the econometric tests that are usually applied is these studies. We report the Ljung-Box Q-statistics for the normalized residuals and Engle's ARCH-LM test at 5-, 10-, 15-, 20-, 25- and 30-day lags. None of these coefficients are statistically significant. Therefore, we cannot reject the null hypothesis that the residuals are not autocorrelated. Furthermore, there is no significant ARCH effect in any of the empirical models, which indicates that the standardized residuals terms have constant variances and do not exhibit autocorrelation.

6. Further detailed discussion on the study's empirical findings

In this section we try to combine the empirical findings and the descriptive statistics we have presented above in order to reach some useful conclusions. Generally, the discrimination in growth and recession periods is confirmed in Table 3, which suggests that: (1) the mean returns are positive during the growth period and negative during the recession, (2) the volatility has increased since the crisis emerged, and (3) the economic psychology is depicted in the positive (negative) returns sessions to total sessions which is increased during the growth (recession) days.

The descriptive statistics suggest that in the Greek stock market there is a long-term tendency in favor of the turn of the week pattern (Table 4). The fact that Mondays, even during the growth period, present negative return days on 55.48% of the trading days, when the respective ratio for the rest of the weekdays is 45% approximately, may be an indication that on Mondays there is a "predisposition" for negative returns. On the other hand, the opposite happens on

Fridays. Even during the long term recession period 52% of Fridays' trading days are positive, while the other days' corresponding ratio is 45%[1].

The statistical significance in the TGARCH models (Table 5) may be influenced by each period's volatility and financial trend. In particular, if we examine the DOW effect, taking as a sample the total period, we may assume that there is a turn of the week effect in the Greek stock market. However, during the long term growth period the Monday effect is not statistically significant and during the long term recession period the Friday effect is statistically weak. These results appear to be reasonable, because when Greece is in recession and its economy's outlook is negative how strong could the Friday effect be in order to overcome this negative environment?[2] Therefore, a strategy which takes into account the Friday effect during the recession period will not be profitable. In contrast, when positive outlooks for the Greek economy appear, an investment strategy buying stocks (or index derivatives) after prices fall (e.g. Thursdays close prices) and selling on Fridays could be profitable.

Apart from the aforementioned investment policy implications, some important deductions could be drawn for scholars. Firstly, changes in the financial trend may be an explanation as to why the calendar anomalies seem to fade/change through the years[3]. Secondly, the periods of long term growth/recession do not influence the stock market's efficiency, at least for the Greek case. The existence of DOW patterns in both periods (growth and recession) confirms this. Thirdly, utilizing a similar approach we may examine, by using other stock markets as a sample, if there is a long term predisposition for the turn of the week effect. Fourthly, at least for the Greek case, the changes of the Monday and Friday effects' strength may be a leading indicator for the financial trend (e.g. when the Friday effect is strengthened that may be an indicator for a growth period and vice versa). Further research on the specific issue may be useful for scholars and traders.

Conclusions

This study's objective is to present a new alternative explanation for the CAs conflicting findings through time. Using the ATHEXGI as a sample for the period 2002-2012 and examining the day of the week effect during growth and recession periods we may briefly conclude that there is a clear tendency for negative returns on Mondays and a positive on Fridays. We may assume that the weekend (or turn of the week) effect exists in the Greek stock market, but its strength depends on the financial trend. Tuesdays and Wednesdays seem to be the negative and the positive return days of the week, while Thursday may be characterized as the weekday that is most significantly influenced by the financial trend. The literature review suggests that there is a long-term predisposition in favor of specific DOW patterns.

Moreover, the empirical findings suggest that: (1) the previous day's returns significantly influence the current returns, due to the non-synchronous trading (2) the leverage effect exists in all the periods, and (3) the crisis influences the returns by reducing the returns and by increasing the volatility.

Apart from the practical implications, the empirical findings are limited to the Greek case, which satisfies the assumptions we initially set. However, with the appropriate modifications we may examine the calendar anomalies-financial trend relationship in deeper financial markets in order to draw more generalized conclusions on whether the financial trend influences not only a stock market's returns, but also its anomalies. This way the aforementioned findings may pave the way for an alternative calendar anomalies methodological approach, and may be an alternative explanation for the calendar anomalies' controversial findings through the time.

References

1. Agrawal, A. and Tandon, K. (1994). Anomalies or illusions? Evidence from the stock markets in eighteen countries, *Journal of International Money and Finance*, 13 (1), pp. 83-106.
2. Alexakis, P. and Xanthakis, M. (1995). Day of the week effect on the Greek stock market, *Applied Financial Economics*, 5, pp. 43-50.
3. Alford, A. and Guffey, D. (1996). A re-examination of international seasonalities, *Journal of Financial Economics*, 5 (1), pp. 1-17.
4. Apolinario, R.M.C., Santana, O.M., Sales, L.J., Caro, A.R. (2006). Day of the week effect on European stock markets, *International Research Journal of Finance and Economics*, 2, pp. 53-70.
5. Basher, S., and Sadorsky, P. (2006). Day-of-the-week effects in emerging stock markets, *Applied Economics Letters*, 13, pp. 621-628.

[1] Similarly, we may analyze the other weekdays' results, but we do not include this analysis in our study, in order to save space.
[2] The investors' tendency to be influenced from the financial trend has been documented a long time ago (De Bondt, 1993).
[3] e.g. the total period's trend may be characterized as neutral and the results suggest a turn of the week effect, which during the sub-periods is not confirmed. Furthermore, we should take into serious consideration some structural, regulatory and economic reforms that may violate the ceteris paribus principle and may influence the CAs.

6. Brooks, C. (2008). *Introductory econometrics for finance*, Cambridge University Press, Cambridge.
7. Brusa, J., Omar, R., Liu, P., Schulman, C.T. (2003). The weekend and 'reverse' weekend effects: an analysis by month of the year, week of the month, and industry, *Journal of Business Finance and Accounting*, 30, pp. 863-890.
8. Cadsby, C.B., V. Torbey (2003). Time-of-month anomaly: Reality or Mirage? *Applied Economic Letters*, 10 (1), pp. 741-745.
9. Chan, S.H., Leung, W.K., Wang, K. (2004). The impact of institutional investors on the Monday seasonal, *Journal of Business*, 77, pp. 967-986.
10. Chen, H., Singal, V. (2003). Role of speculative short sales in price formation: the case of the weekend effect, *Journal of Finance*, 58 (2), pp. 685-706.
11. Cho, Y.H., Linton, O., Whang, Y.J. (2007). Are there Monday effects in stock returns: a stochastic dominance approach, *Journal of Empirical Finance*, 14, pp. 736-755.
12. Connolly, R. (1989). An examination of the robustness of the weekend effect, *Journal of Financial and Quantitative Analysis*, 24 (2), pp. 133-169.
13. De Bondt, W. (1993). Betting on trends: Intuitive forecasts of financial risk and return, *International Journal of Forecasting*, 9 (3), pp. 355-371.
14. Engle, R. (1982). Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation, *Econometrica*, Vol. 50, pp. 987-1006.
15. Engle, R.F. & Ng, V.K. (1993). Measuring and testing the impact of news on volatility, *Journal of Finance*, 48, pp. 1749-1778.
16. Fama, E.F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work, *Journal of Finance*, 25 (2), pp. 383-417.
17. Floros, C. and Salvator, E. (2014). Calendar anomalies in cash and stock index futures: International evidence, *Economic Modelling*, 37, pp. 216-223.
18. French K. (1980). Stock returns and the weekend effect, *Journal of Financial Economics*, 8, pp. 55-69.
19. Gaunersdorfer, A. and Hommes, C.H. (2000). A nonlinear structural model for volatility clustering CeNDEF Working Paper 00-02, University of Amsterdam.
20. Glosten, L.R., Jagannathan, R. and Runkle, D.E. (1993). On the Relation Between the Expected Value and the Volatility of the Nominal Excess Return on Stocks, *The Journal of Finance*, 48, pp. 1779-1801.
21. Jacobs, B.I. and Levy, K.N. (1988). Calendar anomalies: abnormal returns at calendar turning points, *Financial Analysts Journal*, 44 (6), pp. 28-39.
22. Jaffe, J. and Westerfield, R. (1985). The week-end effect in common stock returns: the international evidence, *Journal of Finance*, 40, pp. 433-454.
23. Kenourgios, D. and A. Samitas (2008). The Day of the Week Effect Patterns on Stock Market Return and Volatility: Evidence for the Athens Stock Exchange, *International Research Journal of Finance and Economics*, 15, pp. 78-89.
24. Kohers, T. and Patel, J. (1999). A new time-of-the-month anomaly in stock index returns, *Applied Economic Letters*, 6, (2), pp. 115-120.
25. Lakonishok, J. and Smidt, S. (1988). Are Seasonal Anomalies Real? A Ninety-Year Perspective, *The Review of Financial Studies*, 1 (4), pp. 403-425.
26. Levine, R. & Zervos, S. (1998). Stock markets, banks and economic growth, *The American Economic Review*, 88 (3), pp. 537-558.
27. Levine, R. (2005). Finance and growth: Theory and evidence. In Aghion, Philippe, Durlauf, Steven (Eds.), *Handbook of Economic Growth*. North-Holland, Amsterdam, pp. 865-934.
28. Lim, S.Y., Ho, C.M., Dollery, B. (2010). An empirical analysis of calendar anomalies in the Malaysian stock market, *Applied Financial Economics*, 20, pp. 255-264.
29. Lintner, J. (1965). Security Prices, Risk, and Maximal Gains From Diversification, *Journal of Finance*, 20 (4), pp. 587-615.
30. Mandelbrot, B. (1963). The Variation of Certain Speculative Prices, *Journal of Business*, 36, pp. 394-419.
31. Mills, T.C., Siriopoulos, C., Markelos, R.N., Harizanis, D. (2000). Seasonality in the Athens Stock Exchange, *Applied Financial Economics*, 10, pp. 137-142.
32. Nelson, D.B. (1991). Conditional Heteroskedasticity in Asset Returns: A New Approach, *Econometrica*, 59, pp. 347-370.
33. Pagan, A.R. & Schwert, G.W. (1990). Alternative models for conditional stock volatility, *Journal of Econometrics*, 45, pp. 267-290.
34. Schwert, G.W. (2003). Anomalies and Market Efficiency, In: G. Constantinides et al. (Eds), *Handbook of the Economics of Finance*, Chapter 17. North Holland: Amsterdam.
35. Sharpe, W. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, *Journal of Finance*, 19 (3), pp. 425-442.
36. Tsangarakis, N.V. (2007). The day-of-the-week effect in the Athens stock exchange (ASE), *Applied Financial Economics*, 17 (17), pp. 1447-1454.
37. Vasileiou, E. (2013). "Are the Turn of the Month" Days Profitable Even during Severe Financial Crisis? Evidence from the Greek Stock Market during the "Euro Era (2002-12)", Working paper, available at: http://dx.doi.org/10.2139/ssrn.2363855.

38. Vasileiou, E. (2015). Is Technical Analysis Profitable Even for an Amateur Investor? Evidence from the Greek Stock Market (2002-12), in Copur, Z., Ed., Behavioral Finance and Investment Strategies: Decision Making in the Financial Industry, IGI Global Publishers, pp. 255-269.
39. Vasileiou, E. and Samitas, A. (2015). Does the financial crisis influence the month and the trading month effects?: Evidence from the Athens Stock Exchange, *Studies in Economics and Finance*, 32 (2), pp. 181-203.
40. Wolford, G., Miller, M. and Gazzaniga, M. (2000). The left hemisphere's role in hypothesis formation, *The Journal of Neuroscience*, 20 (6), RC64.
41. Zweig, J. (2000). The trouble with humans: why rats and pigeons might make better investors than people do, *Money*, pp. 67-70.