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Angyal (Apolzan), Carmen-Maria and Aniş, Cecilia–Nicoleta

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# Stock Market Cycles and Future Trend Estimation

Carmen-Maria Angyal (Apolzan)

Cecilia–Nicoleta Aniș

*Contemporary period was an unprecedented growth of stock markets in both developed economies and in emerging ones. The process of financial development has led to substantial changes in the behavior of the stock markets. Recent articles have been oriented to determine the relationship between financial liberalization and stock market cycles (Edwards et al. 2003; Kaminsky and Schmukler 2003). These articles have analyzed the stock exchanges in different countries focusing on the market movements in growth phases (bull) and downward (bear).*

*This study uses the ARIMA methodology, that consists in estimating Minimum Mean Square Error (MMSE - minimum mean square error or "signal extraction") of hidden and unobserved components existing in a time series as it is developed in the work of Cleveland and Tiao (1976), Burman (1980), Hillmer and Tiao (1982), Bell and Hillmer (1984) and Maravall and Pierce (1987).*

*The study uses data representing quarterly closing prices for the period 01.03.1998 – 01.06.2011 (52 observations) of a number of 5 european indices: AEX (Netherlands), ATX (Austria), CAC40 (France), DAX (Germany), FTSE (UK) and a US stock index – Dow Jones Industrial Average. Chosen indices characterize the evolution of mature stock markets. The data used are taken from Thompson Reuters database.*

*The study allows identification, for the mature stock markets, the three distinct cycles in the period 1998–2011, cycle I – 1998–2002, cycle II – 2003–2008, cycle III – 2009–present. The moments of instability triggered by the actual crisis and the dot.com crisis significantly influenced all stock markets, the effects of the latter influence and their future trend. Thus, we identify a medium-term downward trend for European indices CAC40 and AEX and short-term index ATX. The estimation for European indices DAX, FTSE and Dow Jones Industrial Average US shows a medium-term growth trend.*

**Keywords:** stock market, cycle stock, stock index, ARIMA model

## 1. Introduction

The contemporary period represented an unprecedented growth of stock markets in both developed and emerging economies. This process of financial development has led to substantial changes in the behavior of stock markets. A series of recent works has been oriented towards the determination of the relationship between financial liberalization and stock market cycles. (Edwards et al., 2003; Kaminsky and Schmukler, 2003). These studies have examined the stock exchanges of various countries, focusing the attention on market movements during bull and bear phases.

## 2. Literature review

The first works relating to stock market cycles date since 1923, when Joseph Kitchin studied the existence of cyclic movements in stock markets dynamics and he identified the existence of a 40-month cycle in a vast range of financial products, both in Great Britain and the United States, between 1890 and 1922. The 4-year cycle was found later with a strong presence in the stock markets of the 2

countries between 1868 and 1945. Although it is called "the 4-year cycle", the length of the cycle varies, in fact, between 40 and 53 months. In 1960, Clement Juglar found that the cycle of about 9 years existed in many areas of the economic activity. Subsequent investigations have found a strong presence of this cycle during 1840-1940 for the stock markets in the United States (Muntianu, 2005).

More recent studies conducted by Admiral Markets (2011) on the stock markets in the United States identify the existence of 34-year stock market cycles marked by significant events such as: 1914-1915 World War – the difficult conditions led to the closure of scholarships, reopened afterwards at a minimum level and the 1948-1949 Price/Earnings Report (Capitalization/Net Profit) reached the minimum of the century; the Dow Jones index in relation to the dollar's purchasing power reaches a minimum level, followed by the 1949-1982/1983 cycle, when a period of prolonged recession ends, where gold-quoted stock indexes (real money, those of paper being only means of payment) reach the minimum of the century, and the inflation and interest rates reach a record level. The third cycle begins in 1982 and ends in 2016. Each of the three cycles can be divided into two intermediate periods of 17 years, so: the first 34-year cycle covering the 1915-1948 period may divide into two separate periods of 17 years by the most severe financial crisis in history, known as the Great Depression of the 1930's, ending with the collapse of the banking system; in the second cycle there are also identified two periods of 17 years, divided by the 1965-1966 years, when a period of economic expansion ends, where the Dow Jones index reaches for the first time 1000 points. The overall economy is recovering upon the war, reaching the maximum, and the third cycle, marked by a first period of 17 years, which ends in 1999-2000, representing the end of the most favorable period from an economic point of view, recording a maximum of stock indexes, and more important, the biggest real value of history. (Admiral Markets, 2011).

In this section, we keep track of the study of the contemporary stock cycles' dynamics, by identifying periods ranging between two moments of stock minimum. The ARIMA methodology allows the identification of the trend component decomposed from the time series denoting quotations of the stock indexes selected.

### **3. Methodology**

This study is using the ARIMA methodology, which consists of Minimum Mean Square Error estimation (or "signal extraction") of hidden or unnoticed components existent in a time series, as it is developed in the works of the researchers Cleveland and Tiao (1976), Burman (1980), Hillmer and Tiao (1982), Bell and Hillmer (1984) and Maravall and Pierce (1987). Normally, the components (or signals) of a time series are: the seasonal, the trend-cycle and the irregular components, the last two series comprising the seasonally adjusted (SA) series. The three components are considered mutually orthogonal and follow a linear stochastic process, usually non-stationary for the case of the trend-cycle and seasonal component. The estimators of the components are computed through the so-called Wiener-Kolmogorov (WK) filter, as applied to non-stationary series (Bell, 1984).

The ARIMA methodology presents a series of advantages, rendered on one hand by the quality of the introduced data, which has to be initially processed, offering increased protection against false results, and on the other hand, the methodology used facilitates the analysis of time series inferences (for example Pierce (1979, 1980), Bell and Hillmer (1984), Hillmer (1985), Maravall (1987) and Maravall and Planas (1999)). The use of this methodology was facilitated by the appearance of the programs TRAMO and SEATS, programs that allow its use by a series of institutions worldwide.

In essence, given the vector of observations:

$$y = (y_{t1}, \dots, y_{tm}) \text{ where } 0 < t1 < \dots < tm \quad (1)$$

The TRAMO methodology corresponds to the regression model:

$$y_t = z_t \beta + x_t \quad (2)$$

Where  $\beta$  is the coefficient of the regression vector,  $z_t$  denotes a matrix of the variables regression and  $x_t$  follows the general stochastic process ARIMA

$$\Phi(B)\delta(B)x_t = \Theta(B)a_t \quad (3)$$

Where  $B$  is the backshift operator,  $a_t$  denotes the white-noise and assumes values between  $(0, V_a)$ , and  $\Phi(B)$ ,  $\delta(B)$ ,  $\theta(B)$  are finite polynomials in  $B$  and have the multiplicative form:

$$\delta(B) = (1 - B)^d(1 - B^s)^D; \quad (4)$$

$$\Phi(B) = (1 + \Phi_1 B + \dots + \Phi_p B^p)(1 + \Phi_1 B^s) \quad (5)$$

$$\Theta(B) = (1 + \Theta_1 B + \dots + \Theta_q B^q)(1 + \Theta_1 B^s) \quad (6)$$

where  $s$  shows the number of observations per year.

The SEATS program decomposes  $x_t$  as follows:

$$x_t = p_t + s_t + c_t + u_t \quad (7)$$

where:  $p_t$ ,  $s_t$ ,  $c_t$ ,  $u_t$  are the trend-cycle, the seasonal component, transitional component and the irregular component, which also follow the ARIMA model, with deterministic effects added. The seasonal adjustment shows the particular case in which:

$$x_t = n_t + s_t \quad (8)$$

With  $n_t = p_t + s_t + u_t$  representing the seasonally adjusted (SA) series.

## 4. The database used

The study is using data representing the quarterly closing prices for the period 01.03.1998 – 01.06.2011 (52 observations) of a number of 5 European stock indexes: AEX (Netherlands), ATX (Austria), CAC40 (France), DAX (Germany), FTSE (Great Britain) and one stock index in the United States – Dow Jones Industrial Average. The indexes selected characterize the evolution of some mature stock markets. The data used is taken from the Thompson Reuters database.

## 5. Results

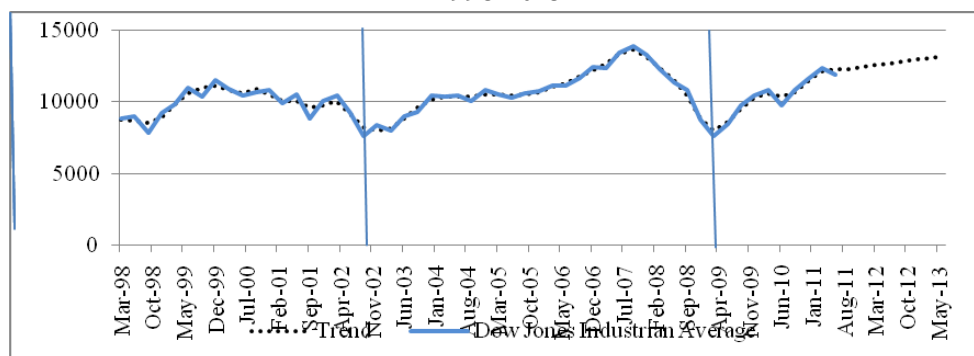
For the Dow Jones Industrial Average index, we decompose the time series by using the ARIMA model and we obtain its cyclical trend. We can distinguish 3 different periods in dynamics, each of them being characterized by a phase of growth followed by a phase of decline.

The period of quarter III 1998 – quarter IV 2002, marked by the Asian crisis effects in 1997-1998 when the trend's level reaches a minimum of 8545 points, and by the major impact of the dot.com crisis in 2001-2002, with the minimum level being reached in December 2002, the trend of the Dow Jones Industrial Average index reaching a value of 7986 points, by 39,19 % lower against the maximum of the analyzed period of 11116 points. The Asian crisis impact was felt at the level of capital markets in the United States due to the large exposures of American companies to Asian countries, exposures representing speculative investments. A dramatic drop in the prices of shares in the Asian zone caused massive losses for the foreign investors, particularly for the Americans. The cycle ends with a new period of stock minimums due to the bursting of the speculative bubble of companies geared toward the Internet field, the crisis being felt particularly in stock markets due to the previous significant increase in the prices of .com shares, judging by the significant interest shown by investors and their trust in the growth potential of the sector. Once the investors focused their attention on the financial position of these companies, positions which reflected the overvaluation of stock market prices, the trend of massive withdrawal from this sector prevailed, yielding an increasing volatility of stock quotations.

Quarter I 2003 – quarter I 2009, in March 2009 the index trend reaches a minimum of 7968 points under the impact of the major turbulences caused by the contemporary economic and financial crisis. This quotation represents a correction of 41.74 % compared to the highest level reached in September 2007 of 13679 points. The period is dominated by an unprecedented growth of stock markets and an impressive development of financial tools and institutions. The decorrelation of financial flows from the real economy, the unprecedented growth of financial innovation combined with regulatory systems that have not taken into account the newly emerged tools have greatly contributed to the occurrence of the first turbulences in the subprime markets of the United States at the end of 2007. What followed was considered to be an unprecedented economic-financial crisis.

The period of quarter II 2009 – quarter IV 2010 is marked by an ascendant trend, with the index trend quotation reaching a value of 11473 points at the end of 2010, with 43.98 % higher than it was at the beginning of the reporting period. For the Dow Jones Industrial Average index, the future trend estimation for the period January 2011 – 31.03.2013 indicates a trend of steady increase in the prices of shares in the United States. The period is marked by the effects of the current crisis, dominated by moments of extreme volatility. Although 2009 and 2010 have represented a recovery phase of the stock markets, the current crisis' impact continued to be felt on all financial markets globally. The sovereign debt crisis triggered in 2010 in Europe has caused new moments of instability and an important descendent trend in the second half of 2011.

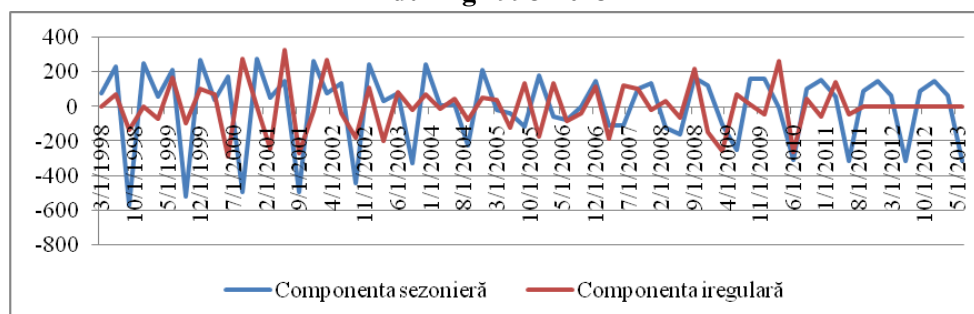
**Figure 1: The dynamics of the Dow Jones Industrial Average index and trend component during 1998-2013**



Source: author's own based on Thompson Reuters database

The irregular component shows the influence of the factors of instability which significantly affects the dynamics of the Dow Jones index. We notice their significant influence in quarter III 1998, in 2001 and 2002 and in the quarter I 2009, corresponding to the minimum periods reached by the quotation of the index analyzed.

**Figure 2: The dynamics of the seasonal and the irregular components of the Dow Jones index during 1998-2013**

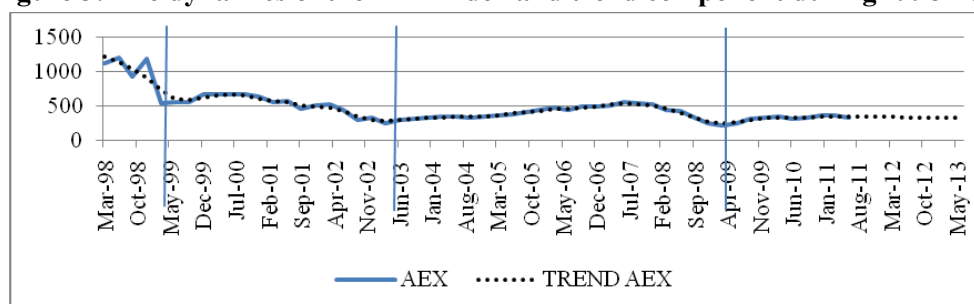


Source: author's own based on Thompson Reuters database

For the AEX index, the 3 cycles fall within the following periods:

- Quarter I 1999 – quarter I 2003. The index trend reaches a minimum in March 1999 due to the impact of the Asian crisis on stock markets. The period ends in March 2003, when a new minimum of the period is registered with a value of 280 points, at a distance of 58.46 % compared to the maximum of the period of 674 points reached in quarter II of the year 2000.
- Quarter II 2003 – quarter I 2009. In March 2009, the AEX index trend reached a value of 248 points, with 53.29 % lower than the maximum of the period analyzed. This dynamic is given by the effects of the contemporary economic and financial crisis that have significantly influenced the dynamics of stock markets worldwide.
- Quarter II 2009 – quarter IV 2010 represents a period of recovery, with the analyzed trend recording a positive evolution. In the quarter IV of the year 2010, the trend recorded an increase of 39.11 % compared to the beginning of the cycle. The future trend estimation of the AEX index for the period January 2011 – March 2013 shows a moderate decline.

**Figure 3: The dynamics of the AEX index and trend component during 1998-2013**



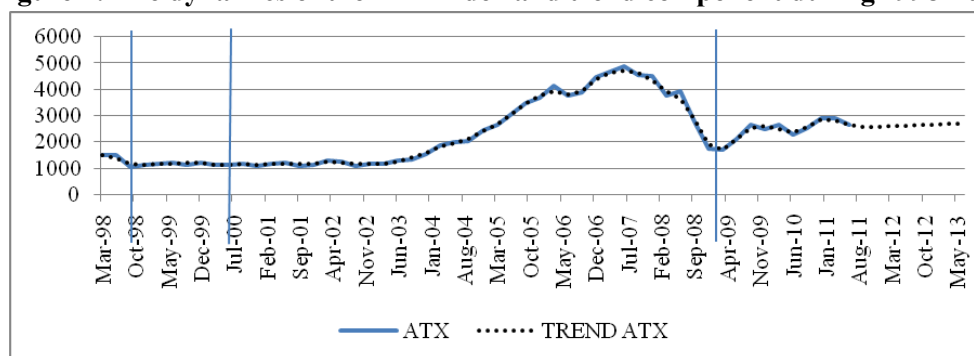
Source: author's own based on Thompson Reuters database

For the ATX index, the 3 cycles fall within the following periods:

- Quarter III 1998 – quarter II 2000, the index trend keeps a neutral evolution, with the minimum reached in the quarter II 2000 belonging to only 4.92 %, compared to the maximum of the quotation reached by the index trend in the period analyzed. Unlike the situations previously approached, the ATX index does not record a major influence under the impact of the crisis dot.com crisis, this aspect being explained by the low interest of Austrian investors

- in investments in companies that have the Internet as object of activity, on the one hand, and reduced exposure to American investors' placements.
- Quarter III 2000 – quarter I 2009; unlike the previous period, the globalization of financial system both regionally and globally, the multiple interconnections achieved between investors and markets globally have caused disastrous effects on all capital markets in Europe. The ATX index trend recorded in the quarter I 2009 a minimum of the period of 1705 points, with 63.98 % lower than the maximum reached in June 2007.
- Quarter II 2009 – quarter IV 2010 represents a period of steady growth, 2010 being closed at a value of 2638 points, with 54.72 % higher than it was at the beginning of the cycle. For the ATX index, a correction is considered by the end of 2011, followed by a moderate increase by the end of quarter II 2013.

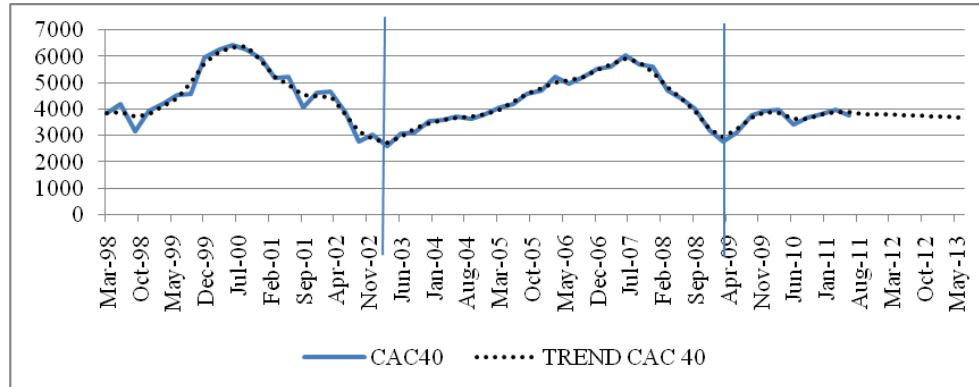
**Figure 4: The dynamics of the ATX index and trend component during 1998-2013**



Source: author's own based on Thompson Reuters database

For the CAC40 index, the 3 cycles fall within the following periods:

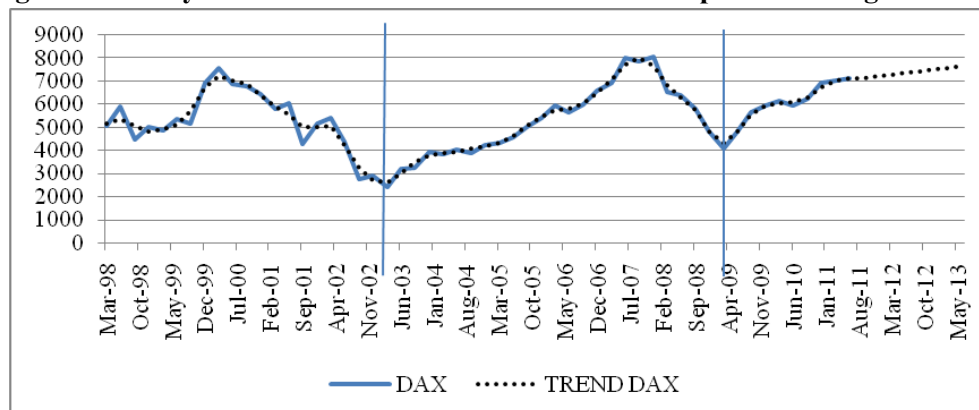
- Quarter III 1998 – quarter II 2003, the minimum values of the index trend being determined by the two moments of financial instability caused by the Asian crisis in 1997-1998 and the dot.com crisis. In June 2003, the minimum value reached by the trend of the index analyzed belongs to a value of 2618 points, with 59.39 % lower than the maximum value reached during this period in June 2000.
- Quarter II 2003 – quarter I 2009, a period characterized by the boom and bust phenomenon, by the excessive increase in the prices of shares, especially after December 2004. The start of the contemporary economic and financial crisis has led to the stock markets' collapse, the trend of the CAC40 index reaching a minimum in March 2009, with a lower value of 53.75 % compared to the maximum of the period reached in June 2007.
- Quarter II 2009 – quarter IV 2010, a period characterized by a trend recovery of the CAC40 index. For the CAC40 index, after the recovery period in 2011, a period of decline is estimated, reaching in quarter II 2013 a lower level than that reached at the beginning of 2011.

**Figure 5: The dynamics of the CAC40 index and trend component during 1998-2013**


Source: author's own based on Thomson Reuters database

For the DAX index, the 3 cycles fall at the following periods:

- Quarter IV 1998 – quarter I 2003, the cycle's ends representing the minimum values of the DAX index trend within the period analyzed, under the influence of instability factors occurred in most developed stock markets. March 2003 ended by a minimum reached by the trend, situated at a distance of 68.11 % from the maximum of the period reached in June 2000. We notice that the stock market of Germany recorded the highest correction associated with the first cycle from the sample studied.
- Quarter II 2003 – quarter I 2009, the minimum reached in March 2009 is situated at a distance of 50.99 % from the maximum reached in June 2007. We notice that in case of Germany, similarly to other stock indexes analyzed, the end of the second stock market cycle takes place in March 2009.
- Quarter II 2009 – quarter IV 2010, representing a recovery period of the trend, with the estimations resulted in the month of the study indicating that during January 2011 – June 2013, the index trend is characterized by powerful ascendancy.

**Figure 6: The dynamics of the DAX index and trend component during 1998-2013**


Source: author's own based on Thomson Reuters database

For the FTSE index, the 3 cycles fall within the following periods:

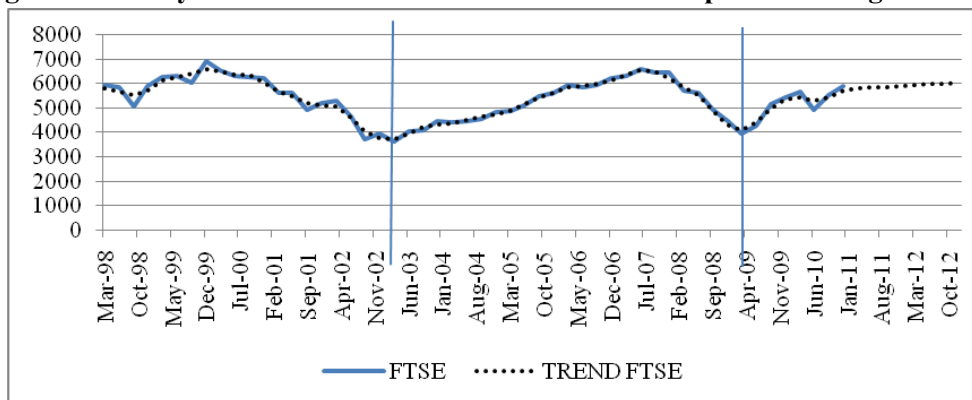
- Quarter III 1998 – quarter 2003, with ends representing minimum values of the index, thus, at the end of March 2003 the trend reaches the value of 3613 points, with 47.86 % lower than the maximum of the period from December 2009.
- Quarter II 2003 – quarter I 2009, the minimum reached in March 2009 is situated at a distance of 59.41 % from the maximum reached in June 2007. We notice that in Great Britain, similarly



to other stock indices analyzed, the end of the second stock market cycle takes place in March 2009.

- Quarter II 2009 – quarter IV 2010, the registered trend is an increasing one, with the study's results estimating a trend similar to the index DAX, marked by sustained growth for the period of January 2010-December 2012.

**Figure 7: The Dynamics of the FTSE index and trend component during 1998-2013**



Source: author's own based on Thomson Reuters database

## 6. Conclusions

The study achieved allows the identification, for the mature stock markets analyzed, of 3 distinct cycles during 1998-2011, cycle I – 1998 – 2002, cycle II – 2003 – 2008, cycle III – 2009 – 2012. The moments of instability triggered by the dot.com crisis and the current crisis have influenced significantly all the stock markets, the effects of the latter influencing also their future trend. Thus, we seize a decreasing trend in the medium term for the European indexes AEX and CAC40, and in the short-term for the ATX index. The estimation resulted in the case of the European indexes DAX and FTSE and the American Dow Jones Industrial Average index shows an increasing trend in the medium term.

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## References

1. Admiral Markets (2011): *Analiza ciclurilor bursiere (The analyse of the stock market cycles)*, available at [www.admiralmarkets.com](http://www.admiralmarkets.com).
2. Bell, W.R. (1984): Signal Extraction for Nonstationary Time Series. *Annals of Statistics*, 12, pp. 646-664.

3. Bell, W.R. – Hillmer, S.C. (1984): Issues involved with the Seasonal Adjustment of Economic Time Series. *Journal of Business and Economic Statistics*, 2, pp. 291-320.
4. Burman, J.P. (1980): Seasonal Adjustment by Signal Extraction. *Journal of the Royal Statistical Society A*, 143, pp. 321-337.
5. Cleveland, W.P. – Tiao, G.C. (1976): Decomposition of Seasonal Time Series: A Model for the X-11 Program. *Journal of the American Statistical Association*, 71, pp. 581-587.
6. Edwards, S. – Biscarri, J.G. – Gracia, F.P. (2003): Stock market cycles, financial liberalization and volatility. *Journal of International Money and Finance*, 22.
7. Hillmer, S.C. – Tiao G.C. (1982): An ARIMA-Model Based Approach to Seasonal Adjustment. *Journal of the American Statistical Association*, 77, pp. 63-70.
8. Kaminsky, G. – Schmukler, S. (2003): Short-Run Pain, Long-Run Gain: The Effects of Financial Liberalization. *NBER Working Paper*, 9787.
9. Muntianu, S. (2005): *Ciclurile si dinamica pietelor (The cycles and the stock markets dynamics)*, Vanguard.