The Study of Correlation between Stock Market Dynamics and Real Economy

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Abstract. The current financial crises have determined many economists considering the source and cause of its development being the decorrelation between financial flows and real economy. In this paper, using ARIMA methodology we decompose the trend component of a stock index and apply Johansen cointegration test in order to find the measure of cointegration between capital markets' dynamics and economic growth. Our results show that most of the indices analyzed show no cointegration with economic growth. The study highlights one of the most important factors leading to the current financial and economic crisis, namely the decoupling of the financial sector from the real economy sector.

Keywords: trend; economic growth; cointegration

JEL Classification: G01; G10; O16

1. Introduction

The literature on financial globalization provides important evidence about the benefits and risks associated with this phenomenon. Under the impact of the financial crisis, the current debates on risks related to the liberalization and integration of financial markets have become particularly important in the context of systemic manifestation of the imbalances created in the global financial system and their contagion in the real economy. The current economic and financial situation is attributed to the de-correlation of financial flows from the real economy dynamics, leading to a system dominated by speculative interest of investors.

2. Literature Review

Studies on the correlation between financial development of markets and economic growth reveal a strong connection between these two. The first papers developed by researchers in the field are those of King and Levine (1993), who use a sample of 80 countries and show that in 1960 an important development of the financial sector led to significant economic growth. Subsequent studies confirmed these hypotheses, indicating that a doubling of private credit in emerging countries is associated with a 2% annual growth (Levine, Loayza, Beck, 2000). Companies and industries dependent on external financing register significant increases in countries with developed financial systems. Studies show that financial development induces economic growth rather through a more efficient allocation of capital than by means of investments (Beck, Loayza, Levine 2000, Levine 2004).

Although financial development improves the economic growth rate of an economy, the living levels of the population in most cases remain the same or decrease due to discrepancies in different social classes in terms of income. (Mishkin, 2007) Contrary to this hypothesis, Hongyi, Squire, and Zou, 2001, Beck, Demirguc-Kunt and Levine, 2004, Honohan, 2004, show that in countries with more developed financial systems, the income of the poorest five social classes is growing at a higher proportion than the average gross domestic product per capita, indicating that financial development is associated with poverty reduction (Dehejia and Gatti, 2002). This paper confirms the economic theory that financial development provides increased access to credit for poor countries, countries whose major drawback is the very absence of external financing

(Mishkin, 2007).

One of the issues addressed extensively by economists is the correlation between stock market cycles and the real economy. Using data from 24 countries for the period 1976 to 1993, Levin and Zevros show that stock market development is passively and strong correlated with economic growth and GDP dynamics (Levine, Zevros, 1996). In 1998, by extending the sample used to a number of 49 countries for the period 1976-1993, they concluded that several influencing factors of financial markets, such as liquidity, future growth rate and capital accumulation rate are passively interrelated.

In another study, using a sample composed of 70 countries for the period 1985-1997, Randall Filler shows that there is a weak correlation between stock market activity and future growth, especially in underdeveloped countries where stock market activity caused a re-appreciation of the currency (Filler, 2000). One of the most important works on the correlation between the activity and dynamics of stock markets and macroeconomic indicators is that of Fama, which using monthly, quarterly and annual data for the period 1953-1987, shows a positive relationship between stock returns and future output growth rate (Fama, 1981, 1990, 1991). In turn, Poon and Taylor (1991) demonstrate that there is no significant relationship between the stock returns registered on the London Stock Exchange and the economic activity reflected by GDP. Instead, Gjerd and Seaettem, analyzing Singapore stock market, show that its index dynamics is positively correlated with the gross domestic product (Bashiri, 2011).

Liang Ping, Feng Mi and Chaun Min studied the relationship between the degree of stock market development and economic growth in China and United States, using stock market indexes and the gross domestic product. They concluded that the stock market in China is not perfect because the degree of correlation between the stock market index and the gross domestic product is lower than in the United States.

In the research conducted, I propose myself to test the cointegration relationship between the dynamics of stock market indexes from 6 mature markets and the GDP dynamics of the countries considered, using the Johansen cointegration test.

3. Methodology

This study uses the ARIMA methodology which consists in the Minimum Mean Square Error (*MMSE or signal extraction*) estimation of the hidden and unnoticed components existing 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: seasonal, trend-cycle and the irregular component, the last two series including the seasonally adjusted series (SA). The three components are considered mutually orthogonal and follow a linear stochastic process, usually non-stationary in the case of trend-cycle and seasonal components. Estimators of the components are compiled by the so-called Wiener-Kolmogorov filter (WK), applied to non-stationary series (Bell, 1984). The use of this methodology was facilitated by the emergence of TRAMO and SEATS, programs that allow its use by a number of institutions worldwide.

In essence, given the vector of observations

$$y = (yt1, \dots , ytm) \text{ where } 0< t1< \dots < tm,$$

TRAMO methodology corresponds to the regression model:

$yt = zt\beta+xt$

Where β is a vector of regression coefficients, zt is a matrix of regression variables and general xt follows the general ARIMA stochastic process

$\Phi(B)\delta(B)xt=\theta(B)at,$

Where B is the backshift operator, a_t is the white noise and takes values between $(0, V_a)$, and Φ (B), δ (B), θ (B) are finite polynomials in B that have multiplicative form:

δ(B) = (1-B)d(1-Bs)D;

Φ(B) = (1+ Φ1B+......+ ΦpBP)(1+ Φ1Bs);

θ(B) = (1+ θ1B+......+ θqBq)(1+ θ1Bs),

Where s indicates the number of observations per year

SEATS decomposes xt as follows:

xt = pt+st+ct+ut,

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

xt = nt+st

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

To study the relationship of cointegration between stock market indexes trend and gross domestic product, I will use the Johansen test which consists in identifying *r* linear combinations of cointegration among the integrated variables *k*, and their incorporation into a dynamic model. Johansen (1988) obtained estimates for α (kxr) and β (kxr) using the procedure known as reduced rank regression. Maximum likelihood estimators for β are obtained as eigenvectors corresponding to the largest eigenvalues *r*.

The tests are based on the estimation of the vector error-correction model (VECM) representation:

$$\Delta Y_t = \Pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + B + \varepsilon_t$$

and are defined by using the largest eigenvalues of the matrix Π. In order to determine the number of cointegration relationships, the eigenvalues (or characteristic roots) of the matrix Π are being estimated: $\hat{\lambda}_1 \geq \hat{\lambda}_2 \geq \ldots \geq \hat{\lambda}_{k-1}$. These eigenvalues are also equal to the square of the canonical correlation between ΔY_t şi Y_{t-1}, corrected by the differences ΔY_{t-i}, so they have values between 0 and 1. The number of eigenvalues significantly different from zero indicates the number of cointegration relationships. The rank of matrix Π is equal to the number of nonzero eigenvalues.

The next two LR-type tests (likelihood ratio) are used to determine the number *r* of the eigenvalues significantly different from zero, i.e. the number of cointegration relationships:

1. Trace Statistic or Trace Test

$$LR_{trace}(r) = -T \sum_{i=r+1}^{k} \ln(1-\hat{\lambda}_i)$$

There are being tested successively for r=0, 1,…, k-1 the following hypotheses: H_0 : at most *r* cointegration relationships (the matrix rank is at most *r*) to the first *r* for which the null hypothesis is accepted. When the null hypothesis H_0 is accepted, the value of LR statistic is close to zero, i.e. the last k-r Eigenvalues are insignificant $\lambda_{r+1}, \ldots, \hat{\lambda}_k$. Null hypothesis is rejected when the calculated value is higher than the critical one.

2. Maximum Eigenvalue Test

$$LR_{\max}(r, r+1) = -T \ln(1-\hat{\lambda}_{r+1})$$

$$LR_{\max}(r, r+1) = LR_{trace}(r) - LR_{trace}(r+1)$$

In the null and alternative hypotheses respectively, there are:

H_0 : *r* cointegration relationships (the matrix rank is at most *r*)

H_1 : *r+1* cointegration relationships

for r=0,1, ..., k-1.

Critical values are induced by several authors, including Johansen and Juselius (1990), MacKinnon-Haug-Michelis (1999). Critical values differ as series have constant and/or deterministic trend and respectively, cointegration equations contain constant and/or deterministic trend.

The general form of the model:

$$\Delta Y_t = \Pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{p-1} \Delta Y_{t-p+1} + Bx_t + \varepsilon_t$$

may include deterministic trends, *t*-type, by means of the vector of deterministic variables x_t.

To select the number of lags, in VECM-type analyses (vector error-correction model) or VAR (value at risk), we can use the AIC criteria (Akaike Information Criterion), SIC (Schwarz Information Criterion), and HQ (Hannan-Quinn Information Criterion). It shall be chosen for *p* that value that minimizes the value of these functions, in the VAR model.

This approach facilitates the testing of some restrictions, using LR-type tests (likelihood ratio) distributed following the law λ^2, restrictions possibly suggested by the economic theory, on the elements of the matrix of cointegration vectors or the matrix of adjustment coefficients α; we also find here the exogeneity tests (weak or strong).

If this test reveals the existence of a (or more) cointegration relationships, a Vector Error Correction Model estimation (VECM) can be applied. The dynamic VECM model can be used to generate predictions and to analyze the impact of random disturbances (shocks) on the system's variables (Lazar, 2009).

4. Database Used

The study uses data representing cyclical trends induced by following the ARIMA model for the period 01.03.1998 - 06.01.2011 (52 observations) of 5 European stock market indexes: AEX (Netherlands), ATX (Austria), CAC40 (France), DAX (Germany), FTSE (UK) and a U.S. stock market index - Dow Jones Industrial Average and quarterly gross domestic product for the period 01.03.1998-31.12.2010 for the Netherlands, Austria, France, Germany, Great Britain and United States, obtained from the Eurostat database.

5. Data Characteristics

Analyzing the statistical properties of the data representing the GDP of the United States, we note that the Skewness parameter of GDP has a negative asymmetric distribution. The Kurtosis parameter shows a value below 3 and indicates a platykurtic distribution of the data. For the Dow Jones Industrial index, the value of the Skewness parameter is positive, indicating a positive asymmetric distribution. Kurtosis parameter registers a value close to 3, indicating a distribution close to the normal value.

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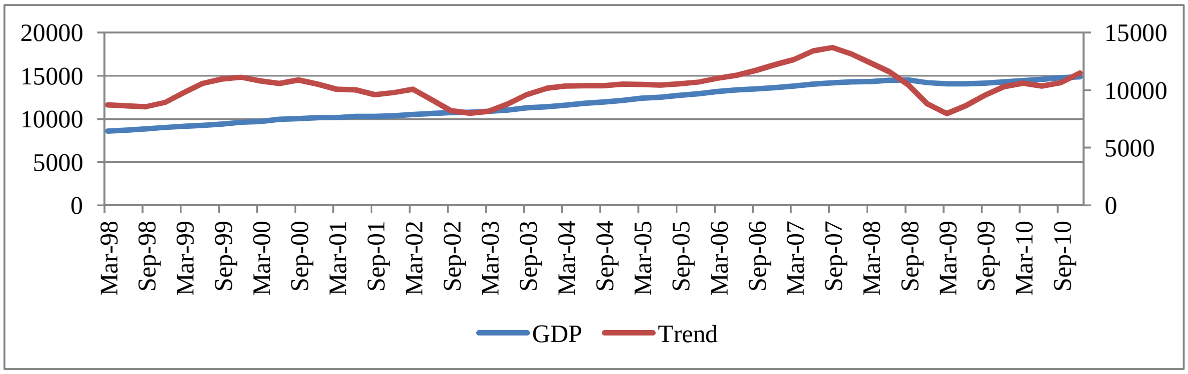

Chart no. 1. Dynamics of the Dow Jones Industrial Index and U.S. Gross Domestic Product during Quarter I 1998 - Quarter I 2010

The value of Skewness parameter for the time series representing the gross domestic product of the Netherlands shows a left-skewed distribution and the Kurtosis parameter, with a value below 3 indicates a platykurtic distribution of the data. The value of skewness parameter for the time series representing the AEX index trend shows a right-skewed distribution of the data. Kurtosis parameter registers a high value indicating a leptokurtic distribution.

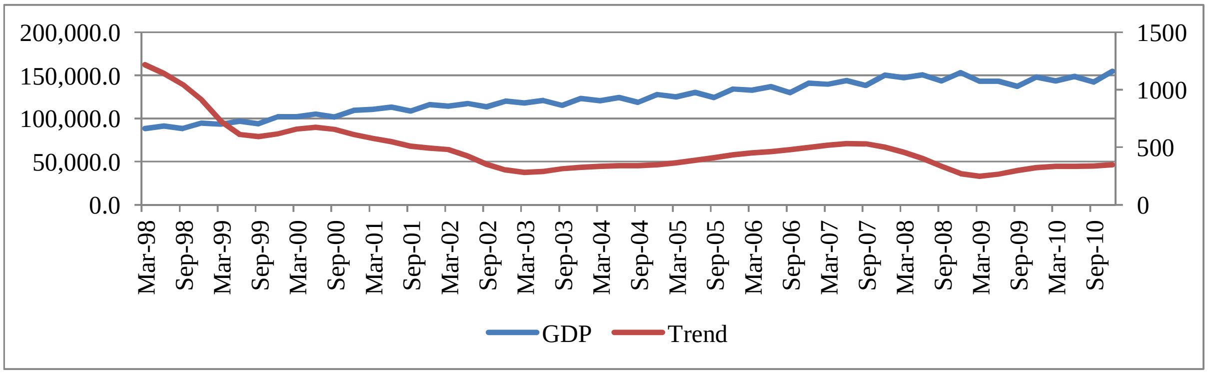

Chart no. 2. Dynamics of the AEX Index and GDP of the Netherlands during Quarter I 1998 - Quarter IV 2010

For the data representing the gross domestic product of Austria, the Skewness parameter indicates a left-skewed distribution, while the Kurtosis parameter indicates a platykurtic distribution. Data representing the AEX index trend, interpreted in terms of statistical properties have a right-skewed distribution and platykurtic distribution.

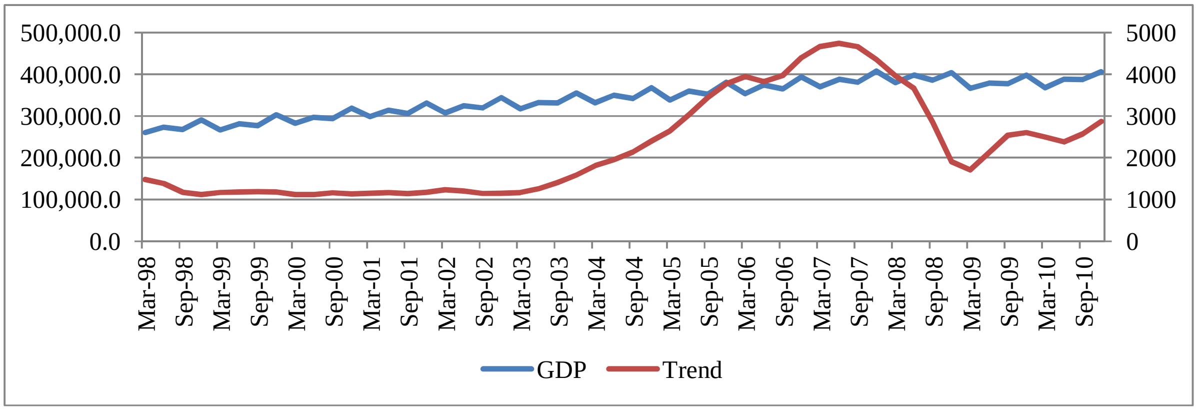

Chart no. 3 Dynamics of the ATX Index and Gross Domestic Product of Austria during Quarter I 1998 - Quarter IV 2010

For the time series representing GDP of France and the CAC40 index trend, the dynamics' distribution of the variables considered suggests the existence of imperfections. This parameter indicates a left-skewed distribution for the GDP and a right-skewed distribution for the trend. The Kurtosis parameter, through its values below 3 in both cases indicates that time series have platykurtic distribution.

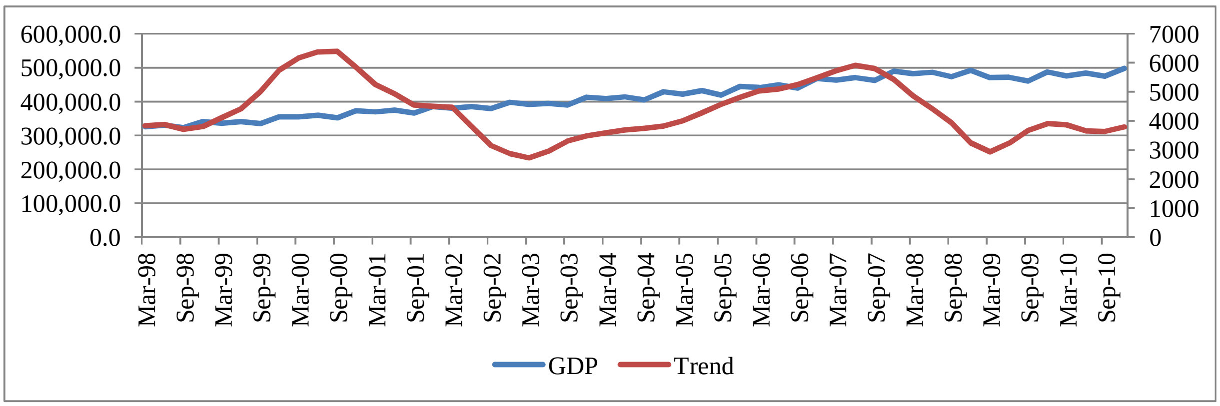

Chart no. 4. Dynamics of the CAC40 Index and Gross Domestic Product of France during Quarter I 1998 - Quarter IV 2010

Statistical properties of time series representing the GDP of Germany and the DAX index trend, by means of Skewness and Kurtosis parameters, indicate that the data representing the GDP in the period analyzed have a right-skewed and platykurtic distribution, while the DAX index trend distribution is left-skewed and platykurtic.

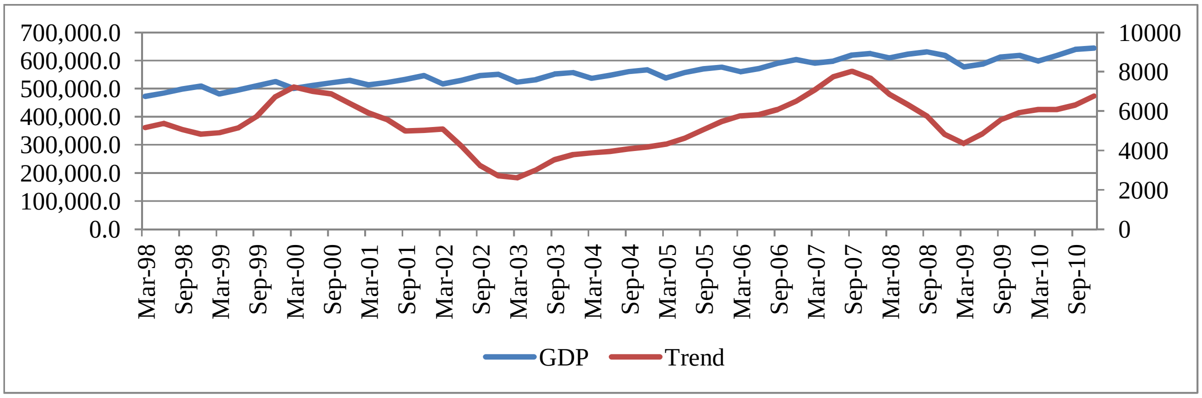

Chart no. 5. Dynamics of the DAX Index and Germany's Gross Domestic Product during Quarter I 1998 - Quarter IV 2010

The value of Skewness parameter for the time series representing the GDP of Great Britain shows a left-skewed distribution and the kurtosis parameter, with a value below 3, indicates a platykurtic distribution of the data. The value of Skewness parameter for the time series representing the FTSE index trend shows a left-skewed distribution of the data. Kurtosis parameter shows a low value indicating a platykurtic distribution.

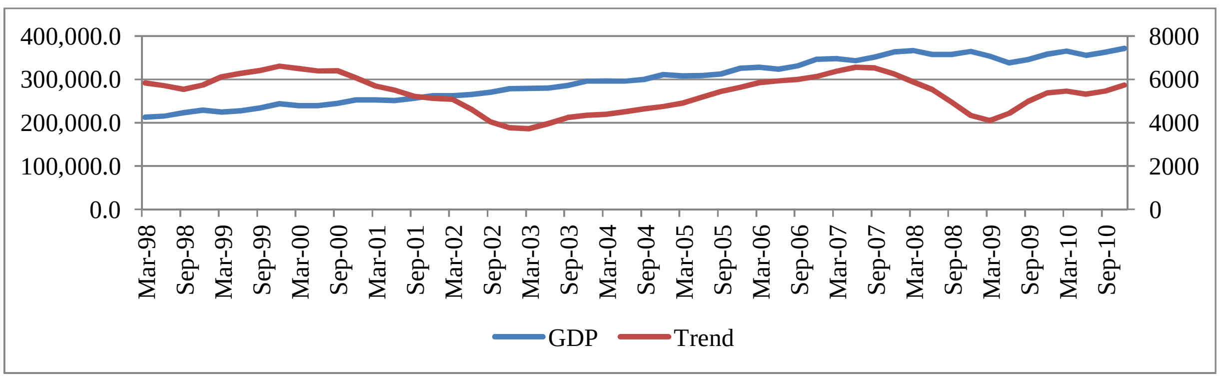

Chart no. 6. Dynamics of the FTSE index and Gross Domestic Product of Great Britain during Quarter I 1998 - Quarter IV 2010

Thus, analyzing the statistical properties of the data representing the gross domestic product of the U.S., Netherlands, Austria, Germany, France, Great Britain and the stock market indexes Dow Jones Industrial Average, AEX, ATX, CAC40, DAX and FTSE, it can be concluded that:

- In terms of Skewness and Kurtosis parameters, the dynamics' distribution of the variables considered suggests the existence of imperfections that encumber these dynamics.
- In terms of variation coefficient, the a-dimensional parameter that can serve as a measure of volatility, dynamics of indexes appear to be volatile, with possible "points of structural failure".

6. Results

To test econometrically an association between the two variables, we use the Johansen cointegration test (linear deterministic trend in data-persistency and trend in the relationships of cointegration without trend in the VAR model).

The test indicates that: i)there is no cointegration relationship between the U.S. GDP dynamics and the Dow Jones index dynamics; ii) there is a cointegration relationship between the GDP of the Netherlands and the AEX index trend. By applying a Vector Error Correction model and impulse functions, we can reveal the intensity and direction of these connections. Impulse functions reflect the fact that for the simulation period, the index registers a downward trend, due to the emergence of a negative shock in GDP dynamics.

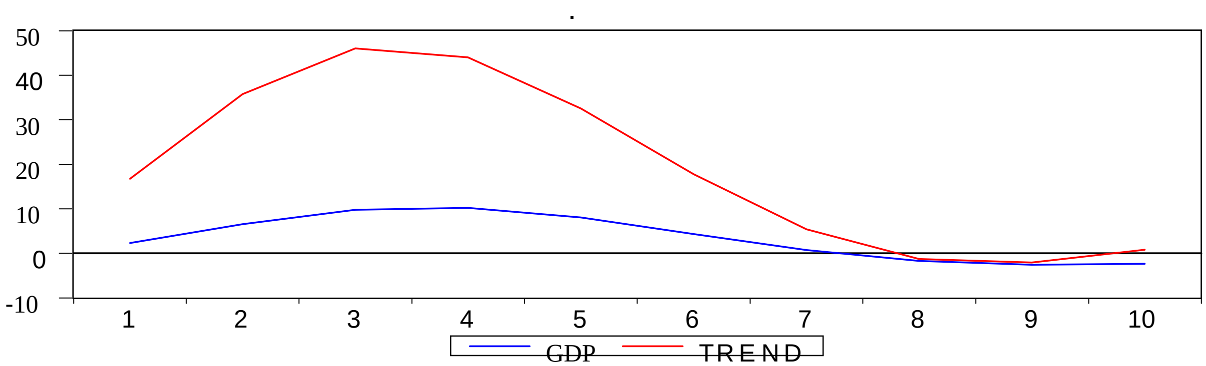

Chart. no.7. EX Cumulative Response to Generalized One S.D. Innovations

iii) there is no cointegration relationship between Austria's GDP dynamics and the ATX index dynamics; iv) there is no cointegration relationship between French GDP dynamics and the CAC40 index dynamics; v) there is a cointegration relationship between Germany's GDP and the DAX index trend. By applying a Vector Error Correction model and impulse functions, we can reveal the intensity and direction of these connections. Impulse functions reflect the fact that for the simulation period, the index registers an upward trend due to the emergence of a positive shock in GDP dynamics;

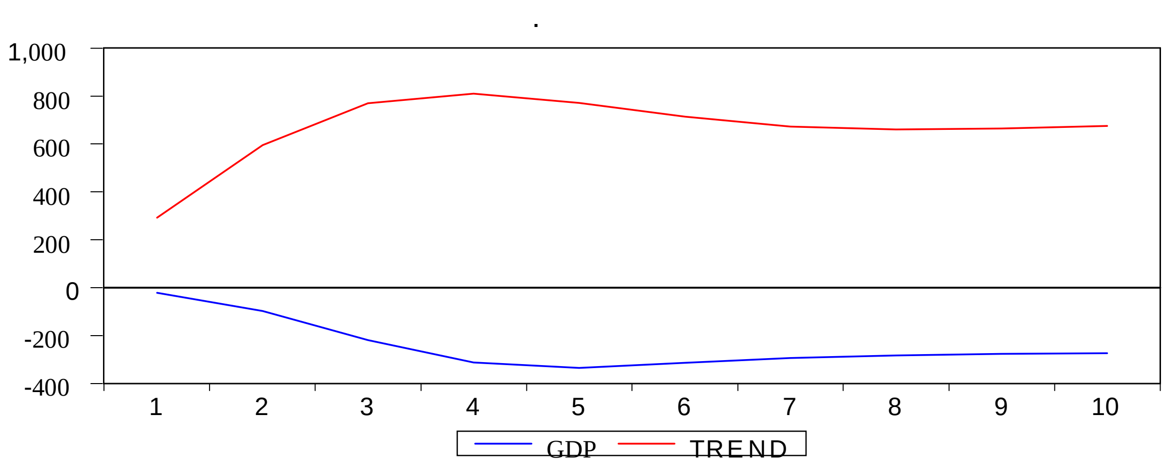

Chart no. 8. DAX Cumulative Response to Generalized One S.D. Innovations

vi) there is no cointegration relationship between the dynamics of Great Britain's GDP and the FTSE index dynamics.

7. Conclusions

The study shows that in most developed countries considered, there is no cointegration relationship between stock markets dynamics and economic growth. The increase in liquidity worldwide caused the decoupling of financial asset prices from the real economy's cycle, having an important role in the inefficient allocation of savings in favor of speculative assets. This highlights the very nature of the current financial system, dominated by the decoupling of financial flows from the real economy, a system that stimulated the occurrence of speculative bubbles in recent years. Hence, stock markets dynamics in the context of financial globalization, of the increase in cross-border portfolio flows and internationalization of portfolio investors led to the decoupling of financial markets from the countries' economies. The study highlights one of the most important factors leading to the current financial and economic crisis, namely the decoupling of the financial sector from the real economy sector.

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