THE CO-MOVEMENT CONNECTION BETWEEN THE GDP AND THE MAIN STOCK MARKET INDEX. THE CASES OF USA AND ROMANIA

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Abstract:
A recurring problem among economists is that of the connection supposed to exist between the Gross Domestic Product and the main stock market index. Several studies have been conducted, trying to analyze the existence and the extent of this connection, most of them concluding the fact that this relation, if existing, is not a statistically significant one. The analyzed relations between a certain country’s Gross Domestic Product and its main stock market index are mainly concentrated with studying correlations, regressive dependencies or cointegration connections calculated by taking into consideration the level of both time series. The best measure of an economy’s performance and evolution is the Gross Domestic Product, an indicator that suggests every step taken by that economy, including its cyclical oscillations. Among specialists, the stock market is seen as a barometer of the global economy, as investors try to exit the stock market before recessions and conversely they return to the stock market just as economy starts to recover. Thus, we find appropriate to analyze the connection between the stock market and the global economy from a cyclical evolution point of view. Therefore, we will take into consideration both GDP’s and stock market index’ cyclical components, as extracted using the Hodrick Prescott filter. The cyclical components’ co-movement will then by studied using a procedure proposed in 2009 by Pirtea, Pătru, Dima and Cristea.

Keywords: Gross Domestic Product, stock market index, co-movement, stationarity, kurtosis, covariance

JEL Classification: C58, D53, E32

1. Introduction

The foreseeing of recession proximity will determine structural changes within individuals’ way of thinking, and, especially within their actions. Their goals change whenever they sense the vicinity of a crisis. Stock market investors will either take their exits or remain within the market expecting a major compensation for the new higher risk they accept to undertake. Whenever they will simultaneously decide to exit the market, at any costs, mass behaviors will appear inside the market, dramatically affecting the allocational efficiency of the market. Crashes of different dimensions will occur, amounts of money will vanish and people’s anticipation of the coming recession will become stronger and even more justified. Every additional loss and every bad news about the stock market will amplify individuals’ risk aversion, but not only the risk aversion regarding their investment activity. This risk aversion will gradually overtake all economic sectors of activity. People will become overprotective with their money and thus, the aggregate demand will enter a downward trend, beginning to fall more and more abruptly. The falling demand will rush the global economy into recession.

Conversely, optimistic predictions about the state of the economy will flood capital markets with investors eager to get back within the investment activity and to win some money after a period of recession. Increasing returns obtained within stock markets and positive valuations of listed companies will lower the cost of capital for those companies. Their productive activity will expand, positively influencing the GDP. Hence, one can observe an intuitive connection between the stock market performance and the general status of the economy.

Several researchers as well as practitioners tried to capture this connection which supposedly exists between the evolution of the global economy and the stock market performance, using the Gross Domestic Product as a measure of the economy’s performance, while the stock market evolution is indicated by the main stock market index (Avouyi-Dovi and Matheron, 2003 and Mulford and Jayaraman, 2011) or by the average returns obtained by investors (MSCI Barra Research Bulletin, 2010). These studies take into consideration cointegration connections between GDP and the stock market index, also verifying if turning points in GDP coincide with those present in the evolution of the stock market index. Among the approached methods, the mentioned studies check the existence of any correlation between the GDP and the stock market index, both in their levels and in their cyclical components. However, most of the studies conducted in this respect, showed poor statistical connections between the GDP level’s evolution and the stock market development. An exception occurs in the case of the United Stated of America GDP, where the analyses reveal correlations and conjugate evolution for the GDP and the average stock market returns.
2. Proposed Method and Results

The conducted study will continue with testing in a new manner the general belief of economists, who argue that over a certain period of time, there is a substantial connection between the business cycle and the stock market performance.

In order to carry out the proposed study, we chose to measure the global economic performance through the Gross Domestic Product. The stock market evolution will be quantified using the main market index of the analyzed country (United States of America and Romania). Quarterly data are used. In order to check the existence of a connection between the two time series, we resort to extracting the cyclical component of both series, then testing the existence of co-movement (as defined by Pirtea et al., 2009) relationship between the two extracted cyclical components. According to the cited paper, the existence of a co-movement connection between two time series means that if within one of the series occurs a shock that deviates the series from its historical variance, within the other series there will be a correction that will modify its variance in such a way that a certain combination of the two series’ variances would remain inside a so-called confidence interval.

The reason for choosing this type of co-movement connection is that it provides a connection testing tool not requiring stationarity conditions for the analyzed time series, as done by Søren Johansen’s cointegration test (Johansen, 1991). The chosen co-movement captures both long term connections and short term connections, giving the advantage of time invariance. The main drawback of the method, which is to have a sufficiently large number of observations, is overcome by the existence of two series of 275 values for the US case analysis and two series of 62 values in Romania’s case. Taking into account all the above, the link between the two sets of time series analysis is established if covariance is stationary and if it is higher arching specific normal distribution (3).

The procedure involves constructing a moving window covariance series between the two analyzed sets of data. In this respect, the moving window covariance series was built on a four quarters moving window, corresponding to a whole calendar year. A covariance maintaining within a confidence interval suggests the concept of stationarity (Maddala, 1992).

So, in order to prove the existence of a co-movement connection (within the meaning given to the term by the cited reference) we should start by proving the stationarity of the moving window covariance series. Secondly, for a sufficiently large number of observations, the analyzed covariance series will overlap to the form of the normal distribution. This reasoning occurs due to the fact that for a large number of observations the principles of the Central Limit Theorem will apply. But the maintenance of the covariance series within a certain confidence interval leads to the conclusion that the distribution has very few extreme values. The fact that there are very few extreme values and the existence of a Gaussian distribution, determine the distribution to agglomerate around its average value, as for a sufficiently long analysis period, the Law of Large Numbers applies. We will, thus, reach a leptokurtic distribution characterized by a kurtosis far superior to that of a normal distribution (a normal distribution having a kurtosis of 3).

Taking into consideration all the aspect presented above, the connection between the two analyzed time series analysis will be proved if the covariance time series will be stationary and if its kurtosis will be higher than the one specific for a normal distribution (3).

2.1. Testing the Co-Movement Connection between the United States GDP and Dow Jones Industrial Average

The first analysis will be centered on the performance of the US economy. The stock market evolution will be quantified using the main market index of the United States of America, Dow Jones Industrial Average. The analyzed period is January 1st, 1947 – September 30th, 2015 and quarterly data are used.

The cyclical component of each time series was extracted using the Hodrick – Prescott filter (Hodrick and Prescott, 1997). By applying the Hodrick-Prescott filter the trend component of the analyzed time series is obtained, and by the difference between the original series and the trend component, the cyclical component is obtained. Within the following, we present the cyclical components of the analyzed time series.
The stationarity of the covariance series was analyzed by using the Augmented Dickey Fuller unit root test. In order to apply the Augmented Dickey Fuller test, it’s necessary to determine the covariance series’ autoregressive order, starting from order 6 to order 1. The autoregressive order of 6 is not confirmed with or without constant, but order 5 is confirmed, as the Student test reveals estimation accuracy for all model parameters (Table 1).

![Fig.1. The Cyclical Component for Dow Jones Industrial Average](image1)

(Source: made by the author, based on own calculations)

![Fig.2. The Cyclical Component for United States of America GDP](image2)

(Source: made by the author, based on own calculations)

The stationarity of the covariance series was analyzed by using the Augmented Dickey Fuller unit root test. In order to apply the Augmented Dickey Fuller test, it’s necessary to determine the covariance series’ autoregressive order, starting from order 6 to order 1. The autoregressive order of 6 is not confirmed with or without constant, but order 5 is confirmed, as the Student test reveals estimation accuracy for all model parameters (Table 1).

**Table 1. The Coefficients and Student Test for the order 5 autoregressive model**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-Statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lag 1 term</td>
<td>-0.347619</td>
<td>0.058515</td>
<td>-5.940709</td>
<td>0.000000</td>
</tr>
<tr>
<td>Lag 2 term</td>
<td>0.665026</td>
<td>0.064270</td>
<td>10.347315</td>
<td>0.000000</td>
</tr>
<tr>
<td>Lag 3 term</td>
<td>-0.578224</td>
<td>0.076560</td>
<td>-7.552543</td>
<td>0.000000</td>
</tr>
<tr>
<td>Lag 4 term</td>
<td>0.322305</td>
<td>0.061757</td>
<td>5.218875</td>
<td>0.000000</td>
</tr>
<tr>
<td>Lag 5 term</td>
<td>-0.146249</td>
<td>0.061903</td>
<td>-2.362555</td>
<td>0.018898</td>
</tr>
</tbody>
</table>

(Source: calculations made by the author)

For the autoregressive order of 5, the Augmented Dickey Fuller test is constructed and run, confirming the stationarity property of the analyzed covariance time series, calculated between the cyclical component of DJIA and the cyclical component of the US GDP. The statistical value of the test is -5.940709 (at a critical value of 2.254113933225, for a 0.95 probability), leading to the rejection of the random walk null hypothesis of ADF test, and thus, to the acceptance of alternative hypothesis of stationarity. The value of the kurtosis of the covariance series is equal to 98.223899719563.

By cumulatively achieving the condition of stationarity for the moving window covariance series calculated between the cyclical components of the DJIA and the GDP of the United States and the condition of a kurtosis value higher than the one specific to the Gaussian distribution, we come to the conclusion that the co-movement connection...
between the Dow Jones Industrial Average and the US GDP exists. This result also confirms the connection between the evolution of the stock market and the succession of the economic cycle phases for the US economy, as we consider that the cyclical component of the GDP is the best barometer for the cyclical oscillations. It is thus econometrically proved, that any deviation or shock registered by either one the two time series, will cause a deviation within the other series, which will maintain a stationary combination of variances of the two time series. In other words, this co-movement connection, as defined by its authors succeeds in demonstrating the interdependence between the stock market and the cyclical fluctuations of economic activity for the American economy.

Figure 3 presented below shows the two cyclical components that have been analyzed, proving once more the common pattern of evolution for the two data series.

2.2. Testing the Co-Movement Connection between the Romanian GDP and BET Index

Within the following, we analyze the connection between the cyclical component of Romania’s GDP and the BET Index, the main indicator of the Romanian stock market. The studied series also include quarterly data, just like in the US analysis case. The analyzed period is the 1st of January 2000 – 30th of June 2015. The time series have also been decomposed using the Hodrick - Prescott filter, into the trend and the cyclical components. Within the following, we displayed the charts for the cyclical components of the Romanian GDP and the BET Index.
The autoregressive order for the covariance series is found to be 1, for the Romanian case (Table 2). For the covariance series calculated between the cyclical components of Romanian GDP and the BET Index, an ADF unit root test was applied, confirming the existence of stationarity. The statistical value of the test is -5.45839748543819 (at a critical value of 2.304426, for a 0.95 probability), a value which leads to the rejection of the random walk null hypothesis of ADF test, and, thus, to the acceptance of the alternative hypothesis of stationarity. The kurtosis of the covariance series is equal to 6.353442.

By complying the conditions imposed by the approached co-movement test (the stationarity of the moving window covariance series calculated between the cyclical components of BET Index and of Romania's GDP and a kurtosis value above the normal distribution one), the existence of a co-movement connection between BET Index and Romania's GDP is proven, confirming a close relation between the cyclical movements of the stock market and the cyclical evolution of the global economic system.

3. Conclusions

Although most analysis conducted in order to analyze the existing connections between the Gross Domestic Product of a country and the evolution of the stock market display poor connections that lack statistical significance, some of those studies prove the existence of a powerful relation in the case of the United States of America. On the other hand, the analyses that exceed the classical statistical methods, resorting to spectral analysis show strong
underlying connections between the two economic fields, using the US GDP and the main American Stock Market Index.

But few of these analyses capture and study the connections established between the cyclical components of the GDP and of the analyzed market index. Most of them take into account the level of the indicators, failing to filter the data into trend and cycle. The presented study tries to capture the connection established between these two cyclical components, by analyzing the evolution of their covariance.

The study concludes with the fact that in both cases, United States and Romania, the co-movement connection (as defined by Pirtea et al., 2009) exists. This means that any shock or deviation in one of time series’ variance will determine a proper correction within the other time series’ variance that will manage to keep inside a certain confidence interval a combination of the two variances.

In economic terms, the presence of such a connection is translated by successive adaptations made both by the GDP and by the stock market, while continuously influencing one another. The Stock Market influences the macroeconomic systems from two different perspectives. In the first place, the Stock Market “feels” the future direction of the economy and amplifies, urges and augments this evolution trend, as inside the Stock Market everything happens faster and more intensely, due to the electronic systems supporting the trading activity. Secondly, through the process of formation and then bursting speculative bubbles, the Stock Market can determine the accumulation or the evaporation of capital, with dramatic effects on consumption and aggregate demand, causing the succession of business cycle phases. The Gross Domestic Product and through it, the phase of the business cycle induces the degree of investment as well as the behavior within the Stock Market though different channels. The level of individuals’ income, the money available for investments in an economy, the measures taken by governments and central banks, the degree of peoples’ confidence in the Stock Market system and legislation – all these are determining influence factors derived from the state of the global economy, that act upon the Stock Market evolution.

Therefore, the interdependence between the macroeconomic status and the evolution of stock markets is not only confirmed by the mathematical, statistical and econometrical reasoning presented above, but also by the real economic system and its daily developments.

4. Bibliography

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