
Lina Zalgiryte, Andrius Guzavicius, Vidas Tamulis

Kaunas University of Technology
K. Donelaicio st. 73, LT-44029, Kaunas, Lithuania
E-mail. lina.zalgiryte@ktu.edu, andrius.guzavicius@ktu.lt, vidas.tamulis@gmail.com

crossref http://dx.doi.org/10.5755/j01.ee.25.1.1985

Many scientists have analyzed a relation among economic and financial market variables. One of the purposes of these researches, and probably the most important one, is to find a better prediction of future economic changes. Economic theory suggests a strong link between stock market and economic activity. The question is whether the stock market is a predictor of future economic activity measured as growth of country’s gross domestic product. In this paper we analyze which economic sectors, represented by stock market sector indices, could have most impact on GDP. The aim of this paper is to analyze whether some sectors are more important than others while analyzing GDP change. The study uses data for the period 2000 Q2 – 2012 Q1 of the U.S. seasonally adjusted GDP and Dow Jones indices and data for the period 2001 Q1 – 2012 Q1 of France seasonally adjusted GDP and Euronext CAC indices. In order to find a relation between selected stock market sector indices and GDP, we will use cross correlation analysis. Our findings support the theory that stock market is a leading indicator for economic growth. In France stock market appears to be a stronger indicator for economic growth compared to the U.S. The results revealed that seasonally adjusted GDP growth lagged behind changes in stock market indices four quarters in France and three quarter in the U.S. In the U.S. worst predictive capabilities for GDP growth come from utilities, oil and gas sectors. Industrial and financial sectors gave the best cross correlation results with GDP growth. In France telecommunication, utilities sectors have the worst predictive capabilities, and consumer services and health care sectors gave the best cross correlation results on GDP growth, compared with others.

Keywords: Economic growth, gross domestic product, stock market, sector indices, Cross correlation.

Introduction

Many scientists have analyzed a relation among various economic and financial market variables, for example export and economic growth (Lim, 1976); commodity prices and inflation (Surrey, 1989); unemployment and interest rate (Birens & Broersma,1993); budget deficit and interest rate (Correia-Nunes & Stembisiotis, 1995); human capital and economic growth (Gammell, 1996); FDI and economic growth (Nair-Reichert & Weinhold, 2001); macroeconomic volatility, inflation and interest rates (Spencer, 2012), yield and GDP (Ang et al., 2006). One of the purposes of these researches, and probably the most important one, is to find a better prediction of future economic changes (Marcellino & Schumacher, 2010; Zhang et al., 2009; Gong et al., 2004; Mariano & Murasawa, 2010 and others). Favero and Marcellino (2005) proposed small-scale forecast models for Euro area. Angelini et al., (2011) in their paper about Euro area GDP growth short-term forecasting concluded that “bridging via factors produces more accurate estimates than traditional bridge equations” and “that survey data and other ‘soft’ information are valuable for now-casting”. Banerjee et al. (2005) analyzed leading indicators for inflation and GDP in Euro area and concluded that “best indicator changes over time”. For Euro area inflation “labour market variables, prices, fiscal series and GDP growth rate on average outperform the autoregression”. For GDP growth “the best indicators on average are the short-term interest rate, public expenditure, total industrial production, and world GDP and demand growth”. Also “the set of good the US indicators includes the short and long-term interest rates, the growth in the NYSE share prices, labor market variables […], and the consumer confidence indicator”. The U.S. GDP and growth of industrial production were outperformed by the autoregression. Camba-Mendez et al., (2001) proposed an automatic leading indicator model tested on France, Germany, Italy and the United Kingdom forecasting performance of which “appears better than that of more traditional VAR and BVAR models”. Benerjee and Marcellino (2006) suggested a procedure allowing constructing indicator based forecasts.

Stock market and economy relation is also a topic of great interest (Beenstock & Chan, 1988; Beltratti & Morana, 2006). Economic theory suggests a strong link between stock market and economic activity. The question is whether the stock market is a predictor of future economic activity measured as growth of country’s gross domestic product. There are works analyzing impact of macroeconomic variables on stock market. Beltratti and Morana concluded that “causality direction is stronger from macroeconomic to stock market volatility”. Hsing and Hsieh (2012) found that Poland stock market index is positively affected by industrial production, real GDP, Germany stock market index, and negatively affected by government borrowing/GDP ratio, real interest rate, nominal effective exchange rate, expected inflation rate, and government bond yield in the euro area. Humpe and MacMillan (2005) analyzed the extent to which
Japanese industrial production and noticed that “GDP deflator, GDP, material investment, construction volume index […] are led by OMXV index”, “money supply, payment balance […].”

In this paper we will take a different approach. We will analyze which economic sectors, represented by stock market sector indices, could have the most impact on GDP. Our hypothesis is that analysis of stock market benchmark index might not give all information about possible changes in economic activity, and sector indices might provide additional useful information. This could be useful in constructing new GDP forecasting models.

The research objective is a relation between stock market and economic growth. The aim of this paper is to analyze whether some sectors are more important than others while analyzing GDP change. Hence the research tasks are:

- to analyze data of the U.S. and France GDP and stock market;
- to calculate the cross correlations between GDP change and stock market sector indices;
- to compare the results of the U.S. and France.

The research methods applied include analysis of scientific literature, statistical, time series cross correlation and comparative analysis.

This paper is organized as follows. The next section includes the methodology and data used in the analysis. Subsequently, the research findings are presented in Results section. The final section includes conclusions of the paper.

### Research Methodology and Data

Dow Jones indices for the U.S. and Euronext CAC indices for France, representing 10 sectors, will be used to see which sector can more accurately track the U.S. and France GDP change. Dow Jones Industrial Average is recognized as one of the best representatives of the U.S. economy and CAC 40 is a benchmark index of French stock market.

The study uses data for the period 2001 Q1 – 2012 Q1 (48 observations) of the U.S. seasonally adjusted GDP and Dow Jones indices and data for the period 2001 Q1 – 2012 Q1 (45 observations) of France seasonally adjusted GDP and Euronext CAC indices obtained from OECD database, Yahoo! Finance and Euronext. Sector indices used in this paper are presented in Table 1.

### Dow Jones and Euronext CAC Indices

<table>
<thead>
<tr>
<th>Index</th>
<th>Symbol</th>
<th>Index</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Jones Industrial average</td>
<td>DJI</td>
<td>CAC 40 Index</td>
<td>CAC40</td>
</tr>
<tr>
<td>Dow Jones the U.S. Utilities Index</td>
<td>DJUSUT</td>
<td>Euronext Paris CAC Utilities Index</td>
<td>EPSPUB</td>
</tr>
<tr>
<td>Dow Jones the U.S. Telecommunications Index</td>
<td>DJUSTL</td>
<td>Euronext Paris CAC Telecommunication Index</td>
<td>EPSNCY</td>
</tr>
<tr>
<td>Dow Jones the U.S. Technology Index</td>
<td>DJUSTC</td>
<td>Euronext Paris CAC Technology Index</td>
<td>EPTEC1</td>
</tr>
<tr>
<td>Dow Jones the U.S. Oil &amp; Gas Index</td>
<td>DJUSEN</td>
<td>Euronext Paris CAC Oil &amp; Gas Index</td>
<td>EPRESS</td>
</tr>
<tr>
<td>Dow Jones the U.S. Industrials Index</td>
<td>DJUSIN</td>
<td>Euronext Paris CAC Industrials Index</td>
<td>EPGENE</td>
</tr>
<tr>
<td>Dow Jones the U.S. Health Care Index</td>
<td>DJUSHC</td>
<td>Euronext Paris CAC Health Care Index</td>
<td>EPBNCY</td>
</tr>
<tr>
<td>Dow Jones the U.S. Financials Index</td>
<td>DJUSEN</td>
<td>Euronext Paris CAC Financials Index</td>
<td>EPSFIN</td>
</tr>
<tr>
<td>Dow Jones the U.S. Consumer Service Index</td>
<td>DJUSCY</td>
<td>Euronext Paris CAC Consumer Services Index</td>
<td>EPSCYC</td>
</tr>
<tr>
<td>Dow Jones the U.S. Consumer Goods Index</td>
<td>DJUSNC</td>
<td>Euronext Paris CAC Consumer Goods Index</td>
<td>EPBCYC</td>
</tr>
<tr>
<td>Dow Jones the U.S. Basic Materials Index</td>
<td>DJUSBM</td>
<td>Euronext Paris CAC Basic Materials Index</td>
<td>EPBASE</td>
</tr>
</tbody>
</table>

In order to find a relation between selected stock market sector indices and GDP, we will use cross correlation analysis.

Given two time series, \(x_t\) and \(y_t\), for data pairs \((x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)\) an estimate of lag \(k\) cross covariance is calculated as follows:

\[
c_{xy}(k) = \frac{1}{n-k} \sum_{t=k+1}^{n} (x_t - \bar{x})(y_{t-k} - \bar{y}), \quad k = 0, 1, 2, \ldots
\]

(1)

where \(\bar{x}\) and \(\bar{y}\) are sample means of the time series \(x_t\) and \(y_t\).

The estimate of the cross correlation function between two time series \(x_t\) and \(y_t\) is expressed as

\[
r_{xy}(k) = \frac{c_{xy}(k)}{s_x s_y}, \quad k = 0, \pm 1, \pm 2, \ldots
\]

(2)

where \(s_x = \sqrt{c_{xx}(0)}\), \(s_y = \sqrt{c_{yy}(0)}\) are sample standard deviations of the time series \(x_t\) and \(y_t\).

### Research Results

Analyzing the statistical properties of the data representing the seasonally adjusted GDP of the U.S., we note that the skewness parameter of GDP indicates a
“negative asymmetric” distribution. The kurtosis parameter shows a value of 5 and indicates a “peaked” distribution of the data. For DJI index, the value of the skewness parameter is also negative. Kurtosis parameter has a value less than 1, indicating “flatter” distribution than that of GDP. Negative skewness parameter indicates left asymmetry of distribution for all sector indices except DJUSTL and DJUSUT. Negative kurtosis parameter indicates a relatively flat distribution for DJUSCY, DJUSIN indices. For other sector indices kurtosis parameter values are positive, indicating relatively “peaked” distributions.

Similarly analyzing the data of France, we note that the skewness parameter of GDP also indicates a “negative asymmetric” distribution. The kurtosis parameter shows a value close to 5 and also indicates a “peaked” distribution of the data. For CAC40 index, the value of the skewness parameter is also negative. Kurtosis parameter has a value close to 0, indicating “flatter” distribution than that of France GDP. Negative skewness parameter indicates left asymmetry for all sector indices. Negative kurtosis parameter indicates a relatively flat distribution for EPRESS, EPGENE indices. For other sector indices kurtosis parameter values are positive, indicating relatively “peaked” distributions.

The plots of changes in GDP and indices (Figure 1, Figure 2) did not reveal much information about the strength of cross correlation between these pairs of data series or number of lag structures involved. However, it appears that peaks and bottoms in countries’ stock markets were followed by similar peaks and bottoms in economic growth. This is more evident in the U.S. than in France data plot.

**Figure 1.** Change, %, of U.S. seasonally adjusted GDP (right axis), Dow Jones Industrial Average (DJI) and Dow Jones sector indices (left axis) in 2000 Q1/Q2 – 2012 Q1.

![Figure 1](image1)

**Figure 2.** Change, %, of France seasonally adjusted GDP (right axis), CAC 40 and Euronext CAC sector indices (left axis) in 2001Q1 – 2012 Q1.

![Figure 2](image2)
Table 2 shows the results of cross correlation analysis of the U.S. data for lags of 0 to 10. Analysis of changes in stock market sector indices lagged on seasonally adjusted GDP changes revealed that DJI and all sector indices except DJUSTL index showed maximum positive cross correlation coefficients for lag 0, while maximum negative correlation coefficients for all indices except DJUSEN and DJUSTL appeared for lag 3. For lag 2, we see a change from positive to negative correlation for almost all indices. Similarly, a change from negative to positive correlation is seen for lag 10. DJUSTL DJUSUT, DJUSEN did show a relatively weakest correlation with GDP.

Analysis of seasonally adjusted GDP changes lagged on stock market indices shows relatively stronger cross correlations. Seasonally adjusted GDP growth lagged behind stock market indices by about one to three quarters. For lag 1, the weakest correlation was with DJUSHC index, for lag 2 – with DJUSUT, DJUSEN, DJUSTC, and for lag 3 – with DJUSBM, DJUSEN, DJUSUT, DJUSHC indices.

For lag 1, the strongest correlation was with DJUSIN and DJUSCY, for lag 2 – with DJUSCY, DJUSIN, DJUSIN, for lag 3 – with DJUSTL, DJUSIN, DJUSCY indices.

Table 2

Results of the U.S. data cross correlation analysis

| Lag | DJI   | DJUSBM | DJUSCY | DJUSEN | DJUSFN | DJUSHC | DJUSIN | DJUSNC | DJUSTC | DJUSTL | DJUSUT | DJUSHC | DJUSIN | DJUSNC | DJUSTC | DJUSTL |
|-----|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0   | 0.427690 | 0.40192 | 0.32245 | 0.48016 | 0.40281 | 0.41802 | 0.45409 | 0.40258 | 0.25799 | 0.09984 | 0.37169 |
| 1   | 0.122428 | -0.01606 | 0.00084 | 0.15825 | 0.23346 | 0.04165 | 0.12741 | 0.15930 | -0.14488 | 0.08784 | 0.27828 |
| 2   | -0.065177 | -0.05139 | -0.13638 | 0.09886 | -0.15858 | -0.02235 | -0.09727 | -0.12583 | -0.16413 | -0.00995 | 0.05133 |
| 3   | -0.219669 | -0.17502 | -0.19651 | 0.03441 | -0.21011 | -0.20903 | -0.22480 | -0.19137 | -0.24226 | 0.07657 | -0.02270 |
| 4   | -0.039268 | -0.04347 | -0.03461 | 0.11112 | -0.00595 | -0.05765 | 0.00272 | -0.12142 | 0.00035 | 0.08167 | 0.10023 |
| 5   | -0.094304 | -0.14321 | -0.12681 | -0.01188 | -0.09240 | 0.02738 | -0.12529 | -0.01415 | -0.14690 | 0.03444 | -0.03476 |
| 6   | 0.059658 | -0.00063 | 0.01452 | 0.11743 | -0.03837 | 0.05227 | 0.00456 | -0.03266 | 0.14621 | 0.02346 | 0.08812 |
| 7   | -0.108127 | -0.16663 | -0.13366 | -0.10404 | -0.02472 | -0.03349 | -0.14777 | -0.04862 | -0.08456 | -0.30599 | -0.05949 |
| 8   | -0.124431 | -0.06840 | -0.18511 | -0.13380 | -0.03978 | -0.17666 | -0.13283 | -0.11241 | -0.11756 | -0.08457 | 0.06003 |
| 9   | -0.142193 | 0.00486 | -0.12988 | -0.10480 | -0.05269 | -0.10076 | -0.08340 | -0.15162 | -0.04813 | -0.19398 | -0.17304 |
| 10  | 0.118876 | 0.14318 | 0.01946 | 0.11260 | 0.16018 | 0.01469 | 0.13975 | 0.04243 | 0.06846 | 0.18727 | -0.07287 |

Table 3 shows the results of cross correlation analysis of France data for lags of 0 to 10. Analysis of stock market sector indices lagged on seasonally adjusted GDP changes revealed that more than a half of chosen indices showed maximum positive cross correlation coefficients for lag 0, while maximum negative correlation coefficients for 8 indices out of 11 appeared for lag 3. For lag 2, we see a change from positive to negative correlation for almost all indices. Similarly, a change from negative to positive correlation is seen for lag 10. DJUSTL and DJUSEN indices did show a relatively weakest correlation with GDP. Analysis of GDP changes lagged on stock market indices show relatively stronger cross correlations compared to the results of the U.S. data analysis. Seasonally adjusted GDP growth lagged behind stock market indices by about one to four quarters. For lag 1, the weakest correlation was with EPSNCY index, for lag 2 – with EPSCY, EPBNCY, EPSUB, for lag 3 – with EPBASE, EPSNCY, EPRESS, EPSUB, and for lag 4 – EPSNCY, EPBASE, EPTECI, EPRESS, EPBCYC, EPSUB indices. For lag 1, the strongest correlation was with EPBASE and EPGENE, for lag 2 – with EPGENE, EPSCYC, EPBASE, for lag 3 – with EPBNCY, EPGENE, EPBCYC, EPSYC, and for lag 4 – EPBNCY, EPSFIN, EPGENE, EPSCYC indices.

Table 3

Results of France data cross correlation analysis

<table>
<thead>
<tr>
<th>Lag</th>
<th>CAC40</th>
<th>EPBASE</th>
<th>EPSCYC</th>
<th>EPRESS</th>
<th>EPSFIN</th>
<th>EPBNCY</th>
<th>EPGENE</th>
<th>EPBCYC</th>
<th>EPTECI</th>
<th>EPSNCY</th>
<th>EPSUB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.21318</td>
<td>0.35060</td>
<td>0.09412</td>
<td>0.11683</td>
<td>0.24767</td>
<td>0.08157</td>
<td>0.28474</td>
<td>0.20423</td>
<td>0.04755</td>
<td>-0.05387</td>
<td>0.34614</td>
</tr>
<tr>
<td>1</td>
<td>0.12198</td>
<td>0.19858</td>
<td>0.13069</td>
<td>0.11208</td>
<td>-0.00477</td>
<td>0.07852</td>
<td>0.12528</td>
<td>0.06064</td>
<td>-0.10615</td>
<td>0.04982</td>
<td>0.24417</td>
</tr>
<tr>
<td>2</td>
<td>-0.20617</td>
<td>-0.14030</td>
<td>-0.17364</td>
<td>-0.12278</td>
<td>-0.30181</td>
<td>-0.27886</td>
<td>-0.23340</td>
<td>-0.19606</td>
<td>-0.19209</td>
<td>0.01427</td>
<td>-0.03626</td>
</tr>
</tbody>
</table>
Conclusions and Discussion

Our findings support the theory that stock market is a leading indicator for economic growth. In France stock market appears to be a stronger indicator for economic growth compared to the U.S.

The results of ten analyzed stock market sector indices revealed that:
- Seasonally adjusted GDP growth lagged behind changes in stock market sector indices four quarters in France and three quarters in the U.S.
- Both for the U.S. and France sector indices gave better cross correlation results than stock market benchmark indices DJI and CAC40.
- In the U.S. best predictive capabilities for GDP growth come from financials and industrials sectors. Consumer goods, consumer services and health care sectors also gave good cross correlation results with GDP growth.
- In France best predictive capabilities for GDP growth come from industrials sector. Consumer goods, consumer services, financials and basic materials sectors gave good cross correlation results on GDP growth, compared with others.

It is proven that market is a leading indicator for country’s GDP. We also know that changes in sector of economy directly affect the same sector’s stock market sector index. Knowing this, we can assume that the influence of sectors of economy on country’s GDP can be evaluated using stock market sector indices.

We analyzed which economic sectors, represented by stock market sector indices, have most impact on GDP. These results support our hypothesis that stock market benchmark index might not give all information about possible changes in economic activity, and sector indices provide this additional useful information.

Our empirical study on the U.S. and France shows that we can find the most influential sectors of country’s economy. What’s more, our analysis reveals the time frame of influence, i.e. we can find a number of quarters this influence continues.

These findings suggest that the use of selection of stock market sector indices instead of one index like DJI or CAC40 might mimic the changes in country’s GDP more accurately. This could be used in construction of GDP forecasts. Theoretically, if we find a set of stock market sector indices that have a high cross correlation with country’s GDP and the number of periods GDP lags behind stock market, we can construct a new weighted index from selected sector indices.

Stock market indices are an important measure to forecast GDP, but having a new composite index containing data from main sectors of country’s economy could forecast GDP changes more accurately. More research has to be done to examine different ways of constructing new GDP forecast model.

References


- 51 -


Yahoo! Finance. // finance.yahoo.com/

Akcijų rinka ir ekonomikos augimas JAV ir Prancūzijoje: akcijų rinkos sektorių indeksų panaudojimo rezultatai

Santrauka