

## COMPARISON OF EUROPEAN STOCK EXCHANGES ONE- AND MULTI-DIMENSIONAL ANALYSIS

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### ABSTRACT

Financial systems in post-communist countries have been developing for two decades of market transformation. In 2004 and 2007, ten Central and Eastern European states became members of European Union (EU), and in majority of post-communist states capital markets had been created. The Federation of European Securities Exchanges (FESE) represents securities exchanges from European Union member states and Iceland, Norway and Switzerland as well as corresponding members from European countries that have not been negotiated yet to join EU. There have been numerous studies, which have examined the development of capital markets however investigation concerning the transition countries is not so often. Therefore the aim of the paper is analysis of the emerging markets position in comparison to stock exchanges affiliated with the FESE. The position of selected stock exchanges is evaluated employing multivariate statistical methodology. The research is provided on the basis of data provided by FESE for years 2000-2011.

**Keywords:** *Capital Market, Stock Exchange, FESE, Taxonomic Measure*

### INTRODUCTION

There have been numerous studies, which have examined the relations between transition economies and developed ones as well as among different sectors of the economy. Many studies have established strong linkages between financial sector development and economic growth (Greenwood and Jovanovic, 1990; Blackburn and Hung, 1998; King and Levine, 1993; Levine, Loayza and Beck, 2000; Koivu 2002). There are also some researches who describe and compare the financial markets in transition countries: Egert and Kocenda(2007), Foo and Witkowska(2008a and 2008b), Gilmore and McManus(2002), Gilmore et al. (2008), Kompa and Witkowska(2011), Krawczyk(2008), Shostya et al. (2008), Syriopoulos(2007), Voronkova(2004), Witkowska and Zdziarski(2008), to mention some examples. The aim of the paper is analysis of the development of European capital markets in years 2000-2011 with special attention paid to the position of stock exchanges from transitional European countries (i.e. emerging markets). The research concerns stock exchanges affiliated with The Federation of European Securities Exchanges (FESE). The position of selected stock exchanges is evaluated employing multivariate statistical analysis methodology. The research is provided on the basis of data provided by FESE.

### European Integration

Integration of European economies started in 1952 by establishing the European Coal and Steel Community (ECSC) that was the first step in the federalization of Europe. In 1957 six countries signed Treaty of Rome, which created European Economic Community, extending cooperation within ECSC. European Union (EU) was established under its current name in 1993 by the Maasstricht Treaty. The European economic and political union has been growing in size by the accession of new member states. At present European Union consists on 28 member states. Enlargements of the European organization took place in 1957, 1973, 1981, 1986, 1990, 1995, 2004, 2007 and 2013. The 2004 extension of the European Union was the largest single expansion of the EU, both in terms of territory and population, though it was (at the time) the smallest in terms of gross domestic product. The simultaneous accessions concerned: Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. In 2007 Romania and Bulgaria, and in 2013 Croatia joined European Union. Nine of these

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countries were members of the former Soviet bloc, with two from the former Yugoslavia and the remaining two being Mediterranean islands. Although to join the EU each country must meet the Copenhagen criteria (defined in year 1993), the new state members are characterized by different cultural, political and economic background.

During last three decades the essential changes in European economy took place and there is great literature describing different aspects of these changes (e.g. Roland, 2001; Svejnar, 2002; Brauers et al. 2007; Ginevicius and Podvezko, 2009; Kompa and Witkowska, 2010). From our perspective we mention only two aspects, the collapse of communist regime in Europe, and globalization of financial markets.

Transformation of economic and political systems in the European countries belonging to the former Soviet block, started in 1989 in Poland. Consequences of these reforms are economic, political and social. The aim of economic transition was to change the centrally planned economies into market-oriented ones. It caused privatization of state enterprises and other institutions (like banks, insurance companies, etc.) and introducing the indirect control of the economy. As a results of that essential changes in the financial system and labor market had to be introduced. From the economic point of view, privatization created capital markets, which did not exist in communist countries, and encouraged higher efficiency. While indirect control caused creation of the new fiscal and financial systems. From the social point of view, high unemployment and inflation were the most painful phenomena accompanying the economic transformation.

### **Capital markets development**

Development of computer sciences and telecommunication together with legislation changes caused globalization of financial markets, i.e. investors from any place in the world may make transactions on every market (to some extend of course since there are limitations on some markets and states). Thus the role and range of financial market have been changed. Considering capital markets, we observe that it lost its traditional functions such as reallocation of capital from investors to companies or evaluation the market value of companies listed on the stock exchange. It is the result of introduction of new electronic platforms, trading systems and techniques (HFT, mass trading, black-box or algo-trading, farming, etc.), as well as new investment instruments, which cause the increase of the role of big – institutional investors and decrease (or even practically eliminate) individual ones. In such a case financial institutions are focused on high profits regardless the risk of transactions and do not pay attention enough to the situation of their clients and/or the shareholders earnings. In result, in recent years we have been observing several financial crises, which had not their sources in economic problems but are caused taking too high risk by investors.

According to the general tendencies on capital markets, after the Second World War stock exchanges were present in all market-oriented economies, and they created domestic capital markets that are represented by one (like in Austria) or more stock exchanges (for instance there are six stock exchanges in Spain). Intensification of the integration process and financial market globalization in recent years, cause creation of regional stock exchanges in Europe like Euronext and OMX Exchanges being Pan-European institutions or CEE Stock Exchange Group (CEESEG), which is a holding. Euronext bases on Amsterdam, Brussels, London, Lisbon and Paris Stock Exchanges. OMX Exchanges operates eight stock exchanges in Nordic (i.e. Copenhagen, Stockholm, Helsinki and Iceland Stock Exchanges) and Baltic countries (i.e. Tallinn, Riga and Vilnius Stock Exchanges), together with Armenian Stock Exchange. While CEE Stock Exchange Group is a holding company comprising the stock exchanges of Vienna, Budapest, Ljubljana and Prague.

The Federation of European Securities Exchanges (FESE) now represents 41 Securities Exchanges (in equities, bonds, and derivatives) through 21 Full Members from 30 countries, as well as 2 Observer Members. FESE mission is:

- Advocacy of high-quality regulation.
- Promoting regulatory processes that make better regulation possible.
- Enhancing competition in securities markets on a level playing field.

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- Improving the efficiency of clearing and settlement of securities in Europe.
- Improving supervisory cooperation.
  - Enhancing exchanges’ ability to attract a broad range of issuers, including small and medium sized enterprises.
- Participating in the Trans-Atlantic and global financial sector dialogue.

In the years 2004, 2007 and 2013, eleven post-communist states (together with Malta and Cyprus) became members of European Union. Financial systems in transition countries in Europe have undergone over two decades of market transformation. Among emerging capital markets one can distinguish (Shostya et al. 2008) four groups (see Table 1):

1. early reformers i.e. countries that activated stock exchanges in years 1989 – 1992;
2. laggards i.e. countries that activated stock exchanges in years 1993 – 1996;
3. late reformers i.e. countries that activated stock exchanges in years 1998 – 2002;
4. countries with no stock exchange.

**Table 1. Stock exchanges inception dates**

Early reformers	Laggards	Late reformers	Countries without stock exchange
Slovenia (1989)	Kazakhstan (1993)	Belarus (1998)	Albania
Serbia (1989)	Latvia(1993)	Georgia (1999)	Bosnia & Herzegovina
Hungary (1990)	Lithuania (1993)	Azerbaijan (2000)	Tajikistan
Bulgaria (1991)	Kyrgyzstan (1994)	Armenia (2001)	Turkmenistan
Croatia (1991)	Estonia (1995)	Ukraine (2002)	Uzbekistan
Poland (1991)	FYR of Macedonia (1995)		
Slovakia (1991)	Moldova (1995)		
Czech Republic (1992)	Romania (1995)		
	Russia (1995)		

**Source: Shostya et al. 2008.**

Note: In Bosnia & Herzegovina the Sarajevo Stock Exchange SASE has been operating since 2002, but with 5-day a week trading only from 2007. Tirana Stock Exchange was established in 1996 as department of Bank of Albania. Since 2002 it has been operating with full license working 2-day a week (two hours a day). In Turkmenistan only the State Commodity and Row Materials Exchange exist. The stock exchange in Uzbekistan – Toshkent Republican Stock Exchange (TRSE) was formally founded in the year 1991 with target closely to the performance of the market – selling shares of privatized enterprises (especially to the foreign investors). Real financial impact of TRSE shifts this exchange to the last group – in year 2005 only 5814 transactions with the shares of 643 joint-stock companies have been carried out.

The first group contains eight countries, which - except Serbia - became European Union members in 2004 (Slovenia, Hungary, Poland, Slovakia and Czech Republic), in 2007 (Bulgaria) and in 2013 (Croatia). The second group of countries is created by 6 countries that belonged to former Soviet Union (USSR) and 3 South - Eastern European countries. Among them Baltic states (Latvia, Lithuania and Estonia) joint EU in 2004 while Romania – in 2007. All countries in the third group together with Kazakhstan, Kyrgyzstan, Moldova and Russia from the second class, and Tajikistan and Turkmenistan from the last group were USRR republics in the past. These states have been members of the Commonwealth of Independent States (CIS), although Ukraine has never been a formal member of CIS and in March 2014 the Ukraine’s Parliament decided to withdraw from CIS. While Georgia made such decision in August 2008 and the withdrawal was effective in August 2009.

**METHODOLOGY -TAXONOMIC SYNTHETIC MEASURE**

In socio-economic research phenomena and objects, being under analysis, are usually described by many features, which may influence the development of the phenomenon (or the object) in different way.

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Therefore among descriptive variables we distinguish stimulants and de-stimulants. The increase of former is conducive to the development of the phenomenon while the increase of the latter negatively influences the level of development.

The methods that allow to compare different markets can be divided into two groups descriptive and evaluative. The former consists in discussion about the objects that are described by many features, and comparison using simple statistical tools as index numbers or averages and dispersion measures. The latter consists in construction of the synthetic measure that describes objects in multi-dimensional space. In our investigation the synthetic measure of development (following Hellwig, 1968 idea) was applied. The synthetic taxonomic measure  $SM$  is evaluated for each security exchange for years 2001-2010, and it defines the distance between the benchmark and analyzed stock exchange in the level of development. The benchmark is defined as the hypothetical object that is characterized by maximal values of stimulants and minimal values of de-stimulants. Maximal and minimal values are estimated for every year separately, taking into consideration all analyzed countries. Therefore the synthetic taxonomic measure is defined as (Luniewska and Tarczynski 2006):

$$SM_{it} = 1 - \frac{q_{it}}{\bar{q}_t + 2 \times S_{qt}} \quad i = 1, 2, \dots, n; \quad t = 1, 2, \dots, T \quad (1)$$

where for every period  $t$  and each  $i$ -th stock exchange:  $SM_{it}$  - value of the synthetic taxonomic measure,  $q_{it}$  - the distance from the benchmark,  $\bar{q}_t$ ,  $S_{qt}$  - average and standard deviation of distances  $q_{it}$ , respectively:

$$q_{it} = \frac{\sum_{i=1}^n q_{it}}{n}, \quad S_{qt} = \sqrt{\frac{\sum_{i=1}^n (q_{it} - \bar{q}_t)^2}{n}} \quad (2)$$

The distance measure between two objects is defined in terms of Euclidean distance:

$$q_{it} = \sqrt{\frac{\sum_{j=1}^k (z_{it}^j - z_{0t}^j)^2}{k}} \quad j = 1, 2, \dots, k \quad (3)$$

where  $z_{it}^j$  - is standardized variable describing  $j$ -th feature in the  $i$ -th stock exchange in time  $t$ ,  $z_{0t}^j$  - is value of the  $j$ -th variable of the benchmark that is defined for each year separately, and:

$$z_{it}^j = \frac{x_{it}^j - \bar{x}_t^j}{S_{xt}^j}, \quad \bar{x}_t^j = \frac{\sum_{i=1}^n x_{it}^j}{n}, \quad S_{xt}^j = \sqrt{\frac{\sum_{i=1}^n (x_{it}^j - \bar{x}_t^j)^2}{n}}, \quad z_{0t}^j = \begin{cases} \min_{i=1,2,\dots,n} \{z_{it}^j\} & \text{if } x_{it}^j \in D \\ \max_{i=1,2,\dots,n} \{z_{it}^j\} & \text{if } x_{it}^j \in S \end{cases} \quad (4)$$

while  $x_{it}^j$  - is observation of  $j$ -th variable in the  $i$ -th stock exchange in time  $t$ ,  $\bar{x}_t^j$  - average of  $j$ -th variable in time  $t$  and  $S_{xt}^j$  - is standard deviation of  $j$ -th variable in time  $t$ ,  $D$  and  $S$  - sets of de-stimulants and stimulants respectively.

The synthetic measure informs about the distance of the considered stock exchange from the benchmark i.e.  $SM_{it} \in [0; 1]$  and the bigger value of the measure the better position of the capital market is.

### EMPIRICAL RESULTS

Our investigation concerns 22 stock exchanges from European Union member states, Armenia, Iceland, Norway, Switzerland and Turkey (the list is presented in Table 1), being members of Federation of

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European Securities Exchanges. Since the research concerns 12 years, not all necessary data are available in FESE database thus in cases of missing observations data are imputed<sup>1</sup> (for instance in 2007 BorsaItaliana merged London Stock Exchange and seceded from FESE thus for these Securities Exchanges there is lack of data concerning last years).

The analysis is provided in two stages. The first one concerns the selected features that describe capital markets while the second one consists in construction and evaluation of aggregated measures.

### Single dimension analysis

There are some features such as capitalization, number of companies listed, number of initial public offerings (IPO) and turnover, which describe capital market that is represented and managed by the certain stock exchange. At present only selected European stock exchanges represent domestic markets (e.g. Athens Exchange, BME, Warsaw Stock Exchange) while others have wider range (e.g. OMX or Euronext). To assess the position of certain stock exchange in pan-European market liquidity ratio and average capitalization of the company is often used. In evaluation the importance of the market in the whole economy, capitalization to GDP ratio is usually employed which informs about the essential role of the stock exchange when its value exceeds 0.4.

**Table 2a. Market capitalization- end of the year 2000 - 2005 (in EUR million)**

Stock Exchanges	2000	2001	2002	2003	2004	2005
AthensSE	117,956	96,950	65,760	84,547	92,140	123,033
BME (Spain)	537,044	525,840	443,097	575,766	692,053	813,812
BorsaItaliana	818,384	592,319	457,992	487,446	580,881	676,606
Bratislava SE	3,556	3,890	2,514	2,204	3,239	3,729
BucharestSE	451	1,361	2,646	2,991	8,819	13,535
BulgarianSE	145	572	704	1,397	2,062	4,312
CEESEG - Budapest	12,810	11,565	12,493	13,228	21,039	27,586
CEESEG - Ljubljana	3,335	3,839	5,355	5,660	7,115	6,697
CEESEG - Prague	12,313	8,999	9,796	12,288	21,720	31,059
CEESEG - Vienna	31,884	28,307	32,235	44,811	64,577	107,036
Cyprus Stock Exchange	12,402	6,572	4,505	3,807	3,588	5,580
DeutscheBörse	1,352,936	1,203,681	627,283	802,224	849,717	1,019,171
Irish Stock Exchange	87,212	84,567	57,540	67,444	83,933	96,722
Istanbul Stock Exchange	199,029	123,950	137,327	73,145	56,164	33,783
London Stock Exchange	2,744,691	2,413,272	1,708,260	1,923,168	2,071,775	2,592,623
LuxembourgSE	36,231	26,711	23,569	29,598	36,891	43,448
Malta Stock Exchange	2,169	1,528	1,319	1,467	2,090	3,474
NASDAQ OMX Nordic	786,479	580,449	385,247	468,199	542,290	704,678
NYSE Euronext	2,483,040	2,122,048	1,477,108	1,646,178	1,796,036	2,294,828
Oslo Børs	70,477	78,372	65,271	75,779	104,051	161,934
SIX Swiss Exchange	845,865	591,961	521,560	576,462	609,929	793,019
Warsaw Stock Exchange	33,761	28,846	27,055	29,350	51,888	79,353
FESE average	463,281	387,982	275,847	314,871	350,091	438,001

Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)

Table 2. contains values of the market capitalization that are observed at the end of the year. The world financial crisis is visible by declining of capitalization of all stock exchanges after the year 2007, except Istanbul Stock Exchange, which has been intensively developing, obtaining in 2011 the increase of the market capitalization by 97% in comparison to the base from the year 2007. FESE average capitalization

<sup>1</sup>We employ data from other sources such as the websites of stock exchanges, as well as from Eurostat and World Bank.

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decreased in 2008 by 47%, in 2009 by 28%, in 2010 by 16.5% and in 2011 by 27% in comparison to the year 2007. The biggest loses are observed at Cyprus Stock Exchange: 72%, 64.5%, 75% and 89% from the capitalization in the years 2007-2011, respectively. Full recovery from the crisis is visible in 2010 for three securities exchanges:

1. SIX Swiss Exchange which capitalization increased in 2010 by 5.4% in comparison to 2007,
2. London Stock Exchange which capitalization increased in 2010 by 2.2% in comparison to 2007, and
3. Warsaw Stock Exchange which capitalization in 2010 was smaller only by 1.4% in comparison to 2007.

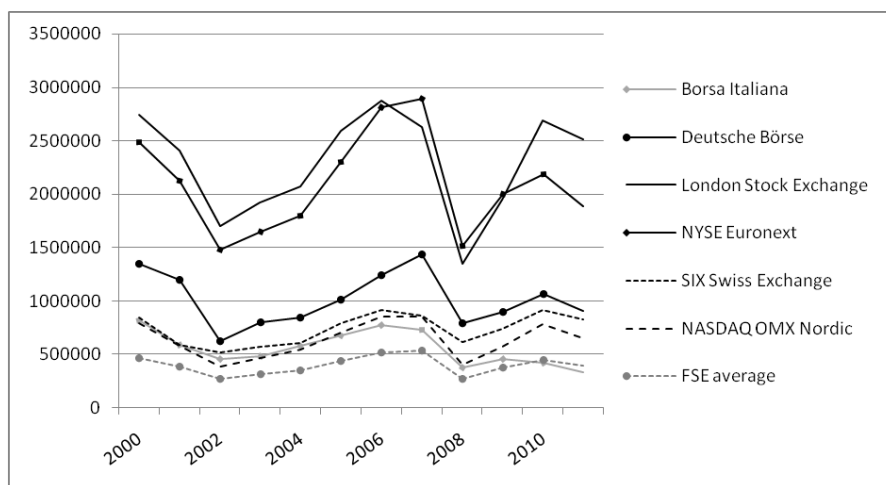
However the situation in 2011 was not as good as in the previous year, and capitalization of the majority of European markets essentially decreased. Figures 1 and 2 compare market capitalization of the most developed markets and markets in the post-communist states to the FESE average.

**Table 2b. Market capitalization- end of the year 2006 - 2011 (in EUR million)**

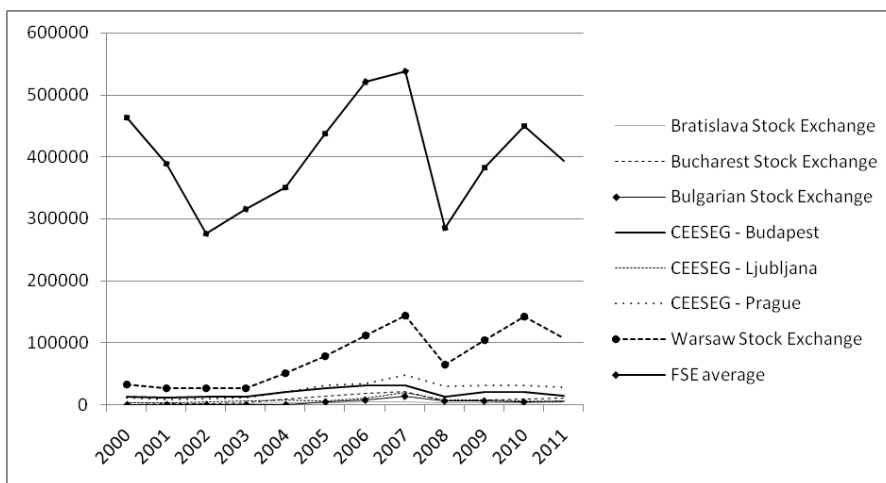
<b>StockExchanges</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Athens Exchange	152,208	181,233	64,737	78,505	50,379	26,020
BME (Spain)	1,003,299	1,231,086	680,632	999,875	873,329	794,170
BorsaItaliana	778,501	733,614	374,702	457,126	425,099	332,374
Bratislava SE	4,214	4,555	3,907	3,614	3,380	4,183
BucharestSE	18,858	21,524	6,474	8,402	9,776	10,818
BulgarianSE	7,830	14,821	6,371	6,031	5498	6,358
CEESEG - Budapest	31,687	31,528	13,326	20,888	20,624	14,630
CEESEG - Ljubljana	11,513	19,740	8,468	8,462	7,028	4,873
CEESEG - Prague	34,693	47,987	29,615	31,266	31,922	29,203
CEESEG - Vienna	151,013	161,731	54,752	79,511	93,944	65,683
CyprusStock Exchange	12,254	20,160	5,733	7,157	5,094	2,198
DeutscheBörse	1,241,963	1,439,955	797,063	900,772	1,065,712	912,420
IrishStock Exchange	123,824	98,431	35,519	42,720	44,999	83,495
Istanbul Stock Exchange	53,440	77,463	85,279	163,576	229824	152,453
London Stock Exchange	2,876,986	2,634,577	1,352,327	1,950,048	2,693,178	2,516,122
Luxembourg SE	60,303	113,597	47,809	73,219	75,381	52,093
Malta Stock Exchange	3,416	3,854	2,567	2,844	3,222	2,641
NASDAQ OMX Nordic	851460	849,923	404,137	569,604	776,821	648,670
NYSE Euronext	2,812,261	2,888,313	1,508,423	1,999,967	2,184,076	1,884,745
Oslo Børs	212,272	241,683	101,982	157,774	219,512	170,048
SIX Swiss Exchange	919,342	869,377	616,234	738,707	916,707	835,090
WarsawStock Exchange	112,826	144,323	65,178	105,157	142,272	107,483
FESE average	521,553	537,704	284,783	382,056	448,990	393,444

**Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)**

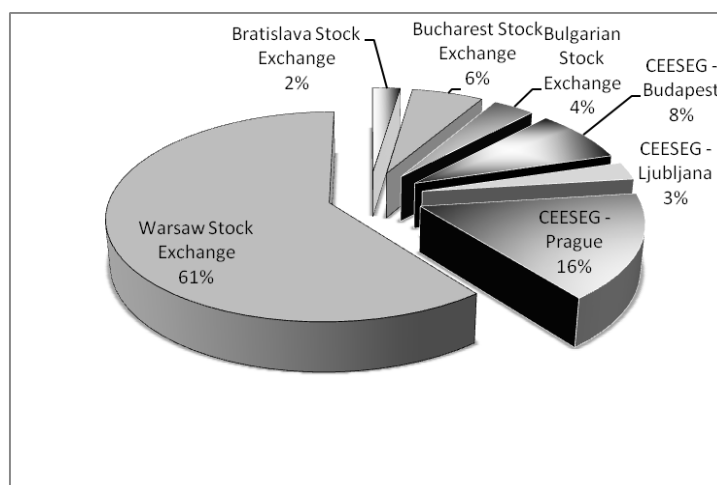
The biggest capitalization is visible in London, Frankfurt and Euronext stock exchanges, and the plot of FESE average is located on the bottom of the Figure 1 while it is on the top of the Figure 2, which contains data concerning capital market in the former Soviet block countries. Among these states it is visible that Warsaw Stock Exchange is the biggest among new European capital markets. It is even more visible on Figure 3, which contains comparison of capitalization in the year 2011 since WSE capitalization is 61% of all markets in post-communist block.



**Figure 1. Market capitalization (in EUR million) of the most developed stock exchanges in Europe**  
 Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)



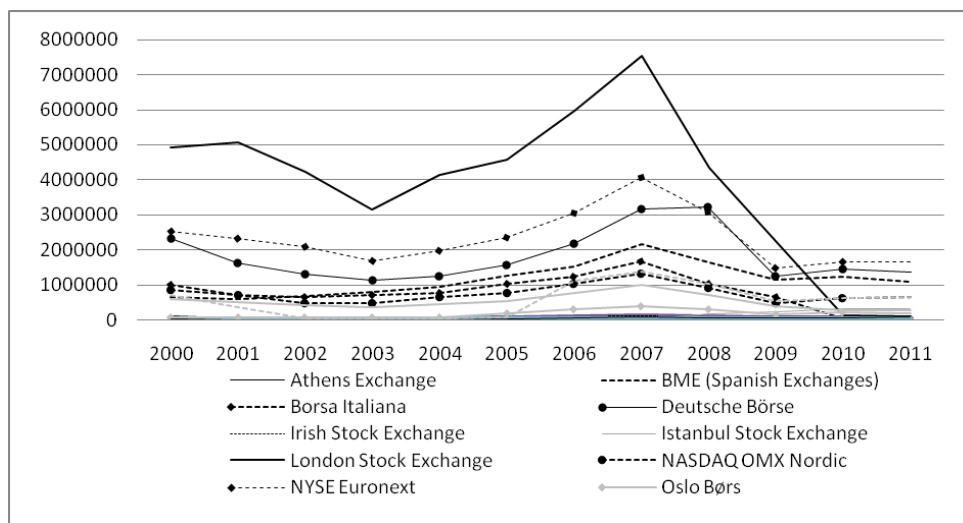
**Figure 2. Market capitalization (in EUR million) in the post-communist states.**  
 Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)



**Figure 3. Comparison of market capitalization in post-communist countries in the year 2011.**  
 Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)

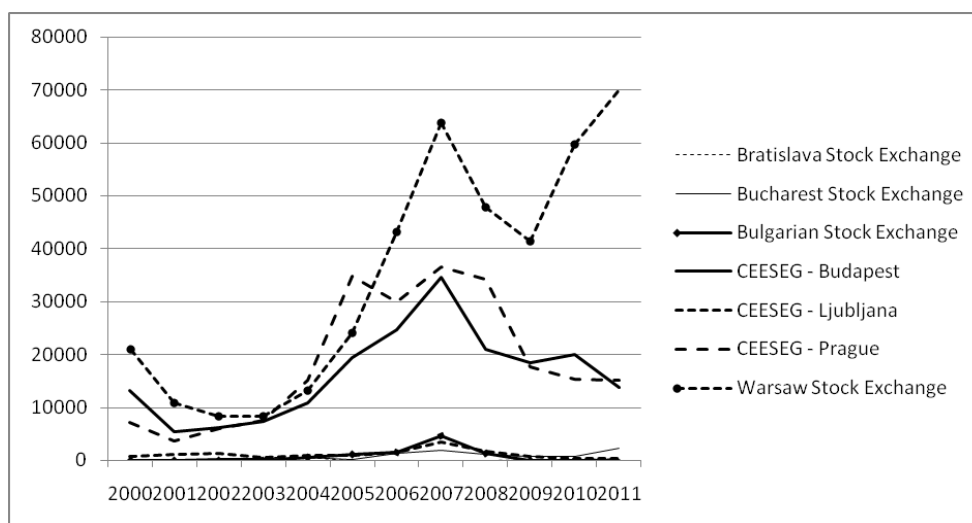
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Another important feature that describes capital market is turnover. As one can notice on Figure 4, the biggest turnover is observed for London Stock Exchange, NYSE Euronext and Deutsche Börse. Again the world financial crisis is visible beginning from the year 2008 when turnover declined dramatically till 2009 and 2010, with the exception of Istanbul Stock Exchange. Observing capital markets in post-communist states we notice that the biggest turnover is observed in Poland, Hungary and Czech Republic (Figure 5).



**Figure 4. Turnover of European markets in EUR million**

Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)

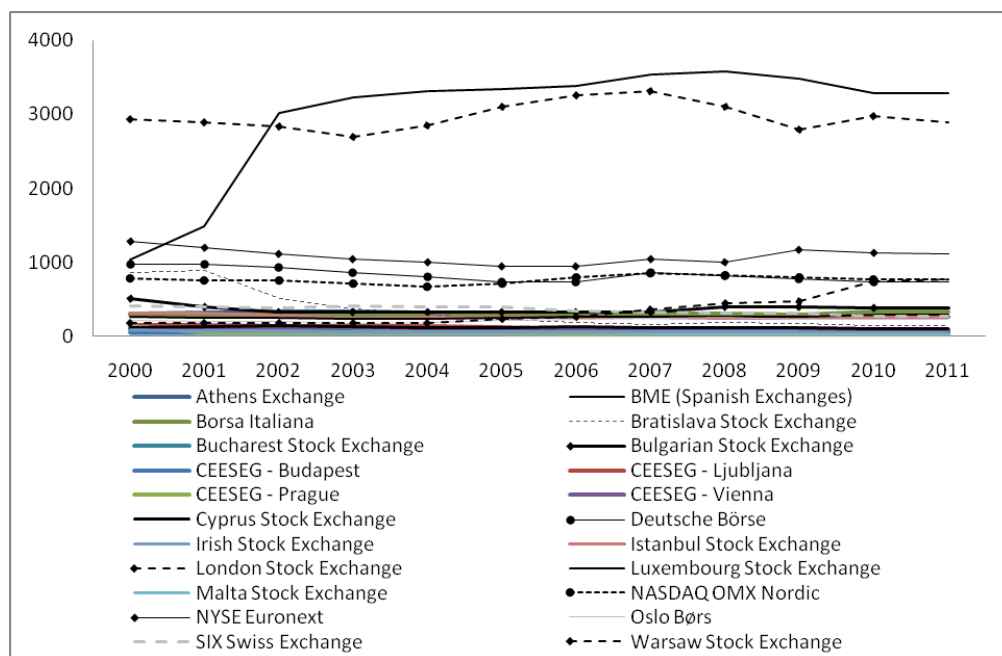


**Figure 4. Turnover in post-communist states in EUR million**

Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)

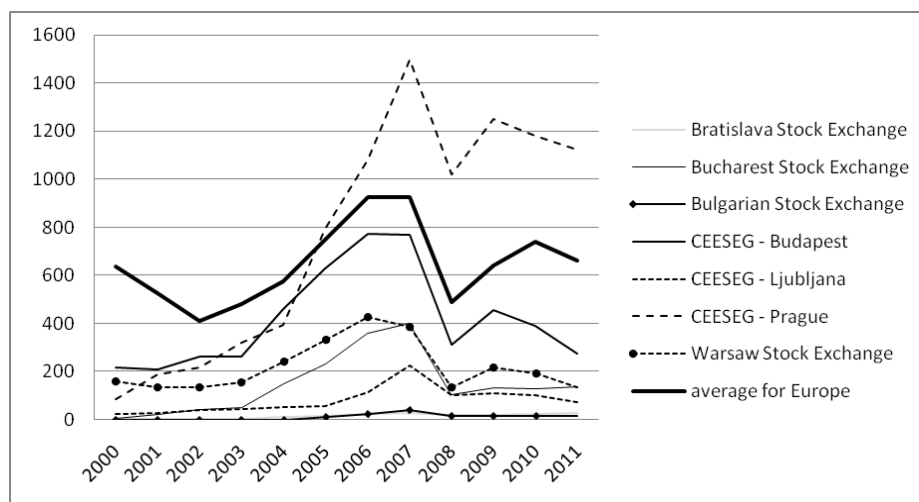
Number of companies listed on the stock exchange gives information about the capital market (Figure 6). This feature is the biggest for Spanish Exchanges (beginning from 2002), London Stock Exchange, Euronext, German market and Warsaw Stock Exchange. Malta Stock Exchange has the smallest number of companies listed (from 10 in 2000 to 21 in 2011).





**Figure 6. Number of companies listed**  
**Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)**

Number of companies listed gives general information about the market however it does not inform about the economic potential of the enterprises and institutions listed on the stock exchange. Therefore the average capitalization per company ratio (in EUR million) is often used in analysis. The smallest firms are observed in Bulgarian and Bratislava Stock Exchanges (0.28 in 2000 to 16.18 in 2011) while the biggest in Borsa Italiana in 2000-2005 (from 1555 to 2755.5), Euronext in 2006-2007 (from 2769 to 2948), and SIX Swiss Exchange in 2008-2011 (1908 to 3251). The smallest FESE average was observed in 2002 (411) and 2008 (489), while the biggest in 2006 and 2007 (923 and 924). New capital markets are characterized by smaller than average value of this ratio with the exception of Czech market for which the ratio has been exceeding the FESE average since 2005 (Figure 7).



**Figure 7. Average capitalization per company ratio (in EUR million) evaluated for transitional economies.**  
**Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)**

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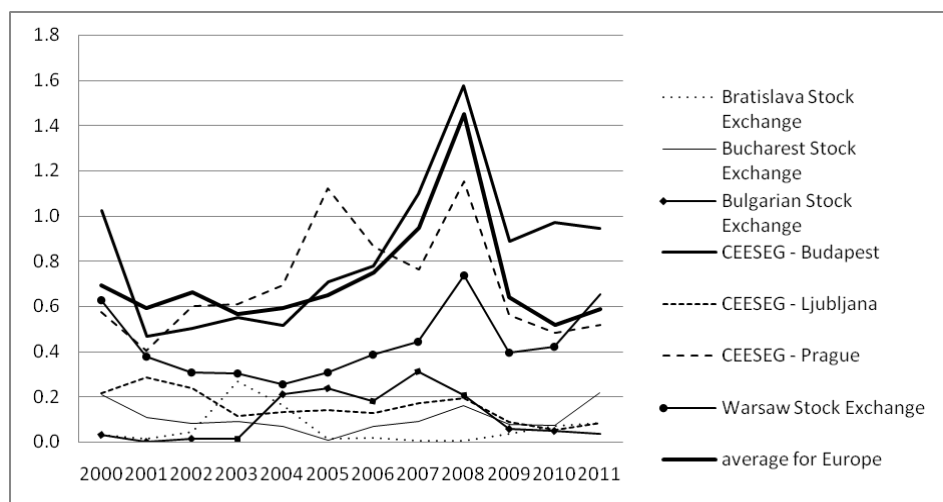
Number of IPOs informs about “popularity” of the certain stock exchange, which assures gaining capital via public offering. This feature is often used as an essential descriptor of the capital market development. Unfortunately data regarding this variable is not available for many stock exchanges. Thus Table 3 contains only data concerning information available from FESE. The biggest number of IPOs has been observed in London Stock Exchange, Euronext and Warsaw Stock Exchange, which became a leader in 2011. The most accepted definition of liquidity is ability to convert stocks into cash and vice versa without affecting the price or with minimal impact on price (Bogdan et al., 2012). Liquidity is the ease of trading a security (Amihud et al., 2005) that just makes it one of the key elements upon which the investor will decide whether or not to invest, very important is quick execution of orders and ability to convert in cash at lowest costs. Selling an illiquid stock quickly can be difficult or even impossible without accepting the lower price. The least liquid (i.e. ratio not bigger than 0.003) stock exchanges were in Bratislava in years 2000 and 2008, in Bulgaria 2001-2002 and Luxemburg in years 2003-2007 and 2009-2011. While the most liquid stock exchanges obtained the ratio value from 1.4 (in 2010) to 4.0 (in 2008). The first place was hold by London Stock Exchange in years 2000-2007, the capital market in Germany – 2008, Italy – 2009, Spain - 2010 and Istanbul Stock Exchange in 2011. Among economies in transition (Figure 8) the most liquid markets are in Budapest and Prague for which liquidity ratios oscillate around the FESE average, and Warsaw (below FESE average).

**Table 3. Number of IPOs**

Exchange	2003	2004	2005	2006	2007	2008	2009	2010	2011
Athens Exchange	na	2	2	1	3	na	1	na	na
BME (Spanish Exchanges)	2	3	1	10	12	1	3	12	9
Borsa Italiana	5	8	15	21	29	6	6	8	na
CEESEG - Vienna	6	1	6	7	6	na	na	na	2
Deutsche Börse	1	5	23	84	62	12	5	23	18
Irish Stock Exchange	na	2	3	8	10	1	na	na	1
London Stock Exchange	94	305	354	297	324	99	25	114	107
Luxembourg Stock Exchange	na	na	31	25	13	19	22	36	20
NASDAQ OMX Nordic	na	na	27	35	85	26	11	24	30
NYSE Euronext	29	48	64	116	127	65	9	32	25
Oslo Børs	3	2	30	14	na	14	2	16	13
SIX Swiss Exchange	2	4	10	8	10	6	4	4	2
Warsaw Stock Exchange	6	36	35	33	104	91	38	112	203

*Note: na means not available.*

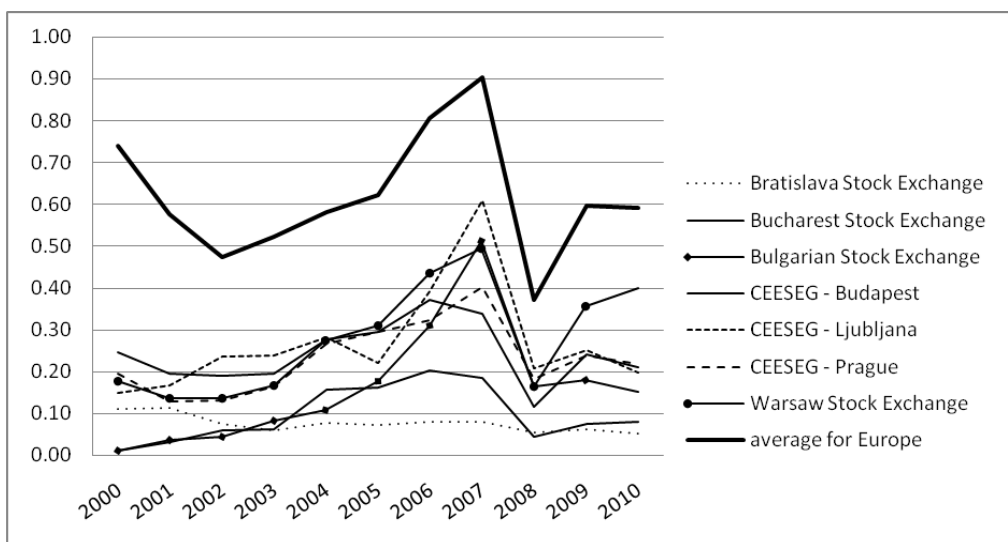
**Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)**



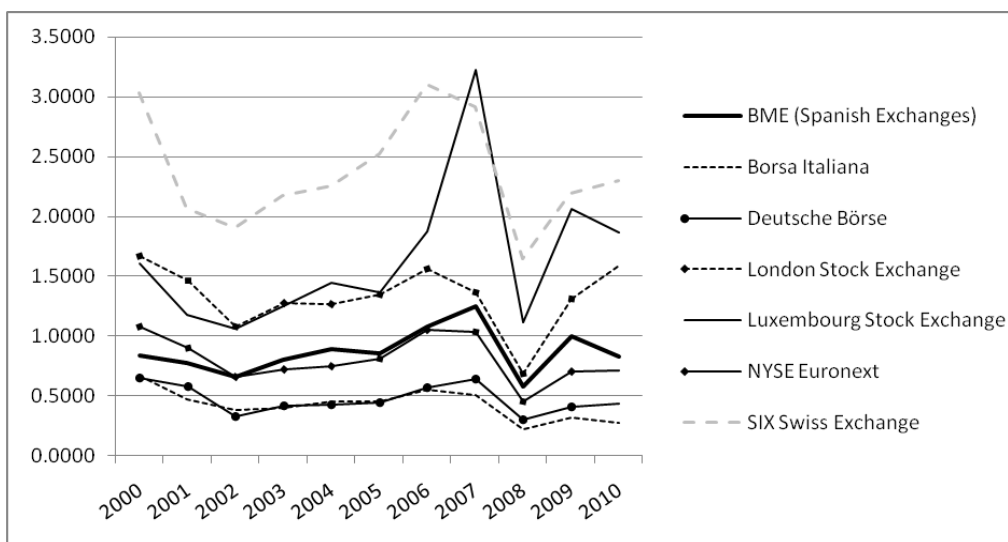
**Figure 8. Liquidity ratios evaluated for transitional economies.**  
**Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)**

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To describe the role of capital market in the economy the ratio describing the share of market capitalization in GDP is used. This ratio is not less than 0.2 for the most developed capital markets (Figure 10), and it obtains value from 1.65 to 3.25 for the SIX Swiss Exchange and Luxemburg Stock Exchange. While for the economies in transition this ratio is much smaller (see Figure 9) obtaining the biggest value for stock exchanges in Budapest in years 2000-2001 (value from 0.20 to 0.25), Ljubljana in years 2001-2004 and 2007-2008 (from 0.23 to 0.61), and Warsaw in years 2005-2006 and 2009-2010 (from 0.31 to 0.44).



**Figure 9. Market capitalization to GDP ratio in post-communist states**  
 Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)



**Figure 10. Market capitalization to GDP ratio on developed markets.**  
 Source: Own elaboration on the basis of [www.fese.be](http://www.fese.be)

**Multidimensional analysis**

To construct synthetic taxonomic measure six variables is applied:

1. capitalization,

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2. number of companies listed,
3. turnover,
4. liquidity ratio i.e. turnover/capitalization,
5. capitalization to GDP ratio,
6. average capitalization of the company i.e. capitalization/number of companies listed.

All of them are stimulants i.e. the increase of them positively influence the development of the analyzed capital market. Thus the benchmark is the hypothetical object that consists of the maximal values of each variable observed in every year of investigated period.

Table 4 contains values of the synthetic measure (1) that let us evaluate the level of development of each considered stock exchanges in all investigated years. It is worth mentioning that benchmark is defined for every year separately. The bigger value of  $SM_t$  means the smaller distance to the benchmark, and higher position in the ranking of capital markets.

**Table 4. Values of taxonomic measures  $SM_{it}$  for markets in years 2000 - 2011**

Exchange	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
ATHEX	0.279	0.272	0.243	0.256	0.239	0.241	0.243	0.243	0.221	0.233	0.197	0.209
BME	0.377	0.423	0.429	0.474	0.466	0.458	0.453	0.474	0.476	0.539	0.477	0.496
Borsa	0.398	0.391	0.387	0.395	0.389	0.379	0.375	0.380	0.363	0.388	0.251	0.246
BSSE	0.202	0.218	0.180	0.188	0.168	0.149	0.140	0.132	0.135	0.145	0.129	0.146
BVB	0.163	0.176	0.165	0.168	0.167	0.159	0.158	0.154	0.140	0.152	0.135	0.161
BSE-Sofia	0.178	0.188	0.169	0.175	0.175	0.173	0.170	0.178	0.164	0.166	0.145	0.155
BSE	0.215	0.217	0.210	0.214	0.216	0.217	0.215	0.214	0.200	0.226	0.204	0.214
LJSE	0.174	0.201	0.191	0.187	0.179	0.165	0.166	0.174	0.162	0.164	0.139	0.145
PSE	0.196	0.208	0.205	0.217	0.221	0.236	0.224	0.229	0.240	0.253	0.225	0.241
VSE	0.191	0.210	0.199	0.213	0.218	0.232	0.243	0.242	0.222	0.236	0.223	0.218
CSE	0.255	0.246	0.205	0.191	0.174	0.174	0.203	0.205	0.172	0.182	0.152	0.149
DBAG	0.497	0.504	0.437	0.456	0.434	0.424	0.434	0.470	0.484	0.471	0.466	0.517
ISE	0.242	0.278	0.274	0.284	0.274	0.265	0.261	0.248	0.227	0.235	0.216	0.243
BIST	0.237	0.247	0.260	0.223	0.193	0.182	0.165	0.164	0.237	0.295	0.300	0.312
LSE	0.725	0.800	0.742	0.746	0.725	0.716	0.692	0.670	0.618	0.682	0.472	0.422
BdL	0.243	0.251	0.251	0.257	0.249	0.244	0.246	0.253	0.250	0.254	0.232	0.161
MSE	0.185	0.195	0.188	0.189	0.188	0.198	0.182	0.170	0.176	0.174	0.157	0.141
OMXN	0.420	0.428	0.389	0.398	0.399	0.397	0.399	0.389	0.369	0.404	0.414	0.406
EURONEXT	0.587	0.601	0.583	0.579	0.557	0.552	0.547	0.555	0.543	0.580	0.574	0.609
OSE	0.244	0.275	0.257	0.269	0.279	0.286	0.298	0.297	0.281	0.305	0.307	0.291
SIX	0.452	0.414	0.387	0.392	0.371	0.385	0.481	0.461	0.495	0.486	0.508	0.453
WSE	0.207	0.215	0.197	0.202	0.202	0.202	0.206	0.205	0.198	0.228	0.226	0.240
$SM_t$	0.303	0.316	0.298	0.303	0.295	0.293	0.296	0.296	0.290	0.309	0.280	0.281
$S_{SM_t}$	0.152	0.158	0.149	0.152	0.147	0.146	0.148	0.148	0.145	0.155	0.140	0.140

Source: Own elaboration. Note – markets name abbreviations:

ATHEX – Athens Stock Exchange, BdL – Luxembourg Stock Exchange, BIST – Istanbul Stock Exchange, BME – Spanish Exchanges, Borsa – Italian Stock Exchange, BSE – CEESEG-Budapest SE, BSSE – Bratislava SE, BVB – Bucharest Stock Exchange, BSE-Sofia – Bulgarian Stock Exch, CSE – Cyprus Stock Exchange, DBAG – Deutsche Börse, EURONEXT – NYSE Euronext, ISE – Irish Stock Exchange, LJSE – CEESEG-Ljubljana SE, LSE – London Stock Exchange, MSE – Malta Stock Exchange, OSE – Oslo Stock Exchange, OMXN – NASDAQ OMX Nordic, PSE – CEESEG-Prague SE, SIX – SIX Swiss Exchange, VSE – CEESEG-Vienna,

WSE – Warsaw Stock Exchange

**Table 5. Ranking of stock exchanges**

Rank	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1	LSE	LSE	LSE	LSE	LSE	LSE	LSE	LSE	LSE	LSE	NEXT	NEXT
2	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	SIX	DBAG
3	DBA G	DBA G	DBAG	BME	BME	BME	SIX	BME	SIX	BME	BME	BME
4	SIX	OMX	BME	DBA G	DBA G	DBA G	BME	DBA G	DBA G	SIX	LSE	SIX
5	OMX	BME	OMX	OMX	OMX	OMX	DBA G	SIX	BME	DBA G	DBAG	LSE
6	Borsa	SIX	SIX	Borsa	Borsa	SIX	OMX	OMX	OMX	OMX	OMX	OMX
7	BME	Borsa	Borsa	SIX	SIX	Borsa	Borsa	Borsa	Borsa	Borsa	OSE	BIST
8	ATEX	ISE	ISE	ISE	OSE	OSE	OSE	OSE	OSE	OSE	BIST	OSE
9	CSE	OSE	BIST	OSE	ISE	ISE	ISE	BdL	BdL	BIST	Borsa	Borsa
10	OSE	ATEX	OSE	BdL	BdL	BdL	BdL	ISE	PSE	BdL	BdL	ISE
11	BdL	BdL	BdL	ATEX	ATEX	ATEX	ATEX	ATEX	BIST	PSE	WSE	PSE
12	ISE	BIST	ATEX	BIST	PSE	PSE	VSE	VSE	ISE	VSE	PSE	WSE
13	BIST	CSE	BSE	PSE	VSE	VSE	PSE	PSE	VSE	ISE	VSE	VSE
14	BSE	BSSE	PSE	BSE	BSE	BSE	BSE	BSE	ATEX	ATEX	ISE	BSE
15	WSE	BSE	CSE	VSE	WSE	WSE	WSE	WSE	BSE	WSE	BSE	ATEX
16	BSSE	WSE	VSE	WSE	BIST	MSE	CSE	CSE	WSE	BSE	ATEX	BdL
17	PSE	VSE	WSE	CSE	MSE	BIST	MSE	Sofia	MSE	CSE	MSE	BVB
18	VSE	PSE	LJSE	MSE	LJSE	CSE	Sofia	LJSE	CSE	MSE	CSE	Sofia
19	MSE	LJSE	MSE	BSSE	Sofia	Sofia	LJSE	MSE	Sofia	Sofia	Sofia	CSE
20	Sofia	MSE	BSSE	LJSE	CSE	LJSE	BIST	BIST	LJSE	LJSE	LJSE	BSSE
21	LJSE	Sofia	Sofia	Sofia	BSSE	BVB	BVB	BVB	BVB	BVB	BVB	LJSE
22	BVB	BVB	BVB	BVB	BVB	BSSE	BSSE	BSSE	BSSE	BSSE	BSSE	MSE

Source: Own elaboration. Note – markets name abbreviations:

ATEX – Athens Stock Exchange, BdL – Luxembourg Stock Exchange, BSE – CESEEG-Budapest SE,  
 BSSE – Bratislava SE, BIST – Istanbul Stock Exchange, BME – Spanish Exchanges,  
 Borsa – Italian Stock Exchange, BVB – Bucharest Stock Exchange, CSE – Cyprus Stock Exchange,  
 DBAG – Deutsche Börse, ISE – Irish Stock Exchange, LJSE – CESEEG-Ljubljana SE,  
 LSE – London Stock Exchange, MSE – Malta Stock Exchange, NEXT – NYSE Euronext,  
 OMX – NASDAQ OMX Nordic, OSE – Oslo Stock Exchange, PSE – CESEEG-Prague SE,  
 Sofia – Bulgarian Stock Exchange, SIX – SIX Swiss Exchange, VSE – CESEEG-Vienna SE,  
 WSE – Warsaw Stock Exchange

On the basis of the  $SM_{it}$  values it is possible to construct a ranking of stock exchanges, which is presented in Table 5. In the years 2000-2009 the first place was hold by London Stock Exchange, and the second by Euronext, which became a leader in years 2010-2011. Other the most important European stock exchanges are BME and Deutsche Börse. In transitional countries the best position has been hold by stock exchanges in Budapest, Prague and Warsaw, which has kept the position from the 11-th to the 18-th in analyzed years.

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Since position of the certain capital market changes in time it is convenient to create classes of homogenous objects. Therefore after evaluation of the synthetic measures  $SM_{it}$ , we classify the stock exchanges into four groups according to the different levels of development, from the least developed belonging to the class 1 to the most developed - class 4. The class construction is as follows:

$$\begin{aligned} \text{class 1: } SM_{it} &< SM_t - S_{SMt} \\ \text{class 2: } SM_t > SM_{it} &\geq SM_t - S_{SMt} \\ \text{class 3: } SM_t + S_{SMt} &> SM_{it} \geq SM_t \\ \text{class 4: } SM_{it} &\geq SM_t + S_{SMt} \end{aligned}$$

where for each period  $t$ :  $SM_t$  and  $S_{SMt}$  are average and standard deviation of the synthetic measure  $SM_{it}$ .

As one can notice in Table 6, Euronext together with London, Spanish, German and Swiss Stock Exchanges are the most developed since they belong to the 4-th class. The capital markets in transitional economies usually belongs to the second class, although stock exchanges in Bratislava, Bucharest, Sofia and Ljubljana, together with Cyprus and Malta Stock Exchanges belongs in selected years to the first class i.e. they are the least developed ones.

**Table 6. Clustering of the stock exchanges: class IV – the best, class I– the worst**

Cluster	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
IV	LSE	LSE	LSE	LSE	LSE	LSE	LSE	LSE	LSE	LSE	NEXT	NEXT
	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	NEXT	SIX	DBAG
	DBAG	DBAG	DBAG	BME	BME	BME	SIX	BME	SIX	BME	BME	BME
III	SIX	OMX	BME	DBAG	DBAG	DBAG	BME	DBAG	DBAG	SIX	LSE	SIX
	OMX	BME	OMX	OMX	OMX	OMX	DBAG	SIX	BME	DBAG	DBAG	LSE
	Borsa	SIX	SIX	Borsa	Borsa	SIX	OMX	OMX	OMX	OMX	OMX	OMX
II	BME	Borsa	Borsa	SIX	SIX	Borsa	Borsa	Borsa	Borsa	Borsa	OSE	BIST
	ATEX	ISE	ISE	ISE	OSE	OSE	OSE	OSE	OSE	OSE	BIST	OSE
	CSE	OSE	BIST	OSE	ISE	ISE	ISE	BdL	BdL	BIST	Borsa	Borsa
	OSE	ATEX	OSE	BdL	BdL	BdL	BdL	ISE	PSE	BdL	BdL	ISE
	BdL	BdL	BdL	ATEX	ATEX	ATEX	ATEX	ATEX	BIST	PSE	WSE	PSE
	ISE	BIST	ATEX	BIST	PSE	PSE	VSE	VSE	ISE	VSE	PSE	WSE
	BIST	CSE	BSE	PSE	VSE	VSE	PSE	PSE	VSE	ISE	VSE	VSE
	BSE	BSSE	PSE	BSE	BSE	BSE	BSE	BSE	ATEX	ATEX	ISE	BSE
	WSE	BSE	CSE	VSE	WSE	WSE	WSE	WSE	BSE	WSE	BSE	ATEX
	BSSE	WSE	VSE	WSE	BIST	MSE	CSE	CSE	WSE	BSE	ATEX	BdL
	PSE	VSE	WSE	CSE	MSE	BIST	MSE	Sofia	MSE	CSE	MSE	BVB
	VSE	PSE	LJSE	MSE	LJSE	CSE	Sofia	LJSE	CSE	MSE	CSE	Sofia
	MSE	LJSE	MSE	BSSE	Sofia	Sofia	LJSE	MSE	Sofia	Sofia	Sofia	CSE
	Sofia	MSE	BSSE	LJSE	CSE	LJSE	BIST	BIST	LJSE	LJSE	LJSE	BSSE
	LJSE	Sofia	Sofia	Sofia	BSSE	BVB	BVB	BVB	BVB	BVB	BVB	LJSE
BVB	BVB	BVB	BVB	BVB	BSSE	BSSE	BSSE	BSSE	BSSE	BSSE	MSE	

Source: Own elaboration. Note – markets name abbreviations:

ATEX – Athens Stock Exchange, BdL – Luxembourg Stock Exchange, BSE – CESEEG-Budapest SE, BSSE – Bratislava SE, BIST – Istanbul Stock Exchange, BME – Spanish Exchanges, Borsa – Italian Stock Exchange, BVB – Bucharest Stock Exchange, CSE – Cyprus Stock Exchange, DBAG – Deutsche Börse, ISE – Irish Stock Exchange, LJSE – CESEEG-Ljubljana SE, LSE – London Stock Exchange, MSE – Malta Stock Exchange, NEXT – NYSE Euronext, OMX – NASDAQ OMX Nordic, OSE – Oslo Stock Exchange, PSE – CESEEG-Prague SE, Sofia – Bulgarian Stock Exchange, SIX – SIX Swiss Exchange, VSE – CESEEG-Vienna SE, WSE – Warsaw Stock Exchange

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### **CONCLUSIONS**

Development of the financial sector influences the economic development thus capital market plays an important role in market-oriented economies. In the past, London Stock Exchange was the most important financial institution in Europe, and other domestic capital markets were far away from it. Creating pan-European stock exchanges, which applies the trading platform for some domestic markets changed situation in Europe. Although London Stock Exchange together with Euronext have been still one of the most developed. At present majority of stock exchanges in Europe lists domestic and foreign enterprises, which are often double-listed i.e. on domestic capital market and in selected stock exchanges. However it could be distinguished two types stock exchanges i.e. the ones that operate mostly on domestic market or even on the part of it, and the ones that operate on several markets. Istanbul Stock Exchange (BIST) seems to be the most interesting among all investigated stock exchanges because it has been improving its position since 2008, and it was not suffering from the world financial crisis. Capital markets in post-communist countries have quite short history but they adopted solutions from the developed ones and their position is visible in Europe. Stock exchanges in Baltic States belong to NASDAQ OMX Nordic, creating Baltic market while stock exchanges in Budapest, Ljubljana and Prague created a holding together with Vienna Stock Exchange. Warsaw Stock Exchange represents the biggest capital market in European transitional economies. Consolidation of these two markets – Austrian and Polish – seems inevitable and it is completely justified by our research.

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