



## Comparative analysis of stock and bond indices of the Belgrade stock exchange in comparison with world stock market indices

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### Article info

#### Original scientific paper

DOI:

<https://doi.org/10.46793/ICEMIT23.097V>

UDC/ UDK:

336.761.5(497.11 Beograd)

### Abstract

*The financial market, as an environment in which financial claims are issued and transferred, expresses and realizes supply and demand for financial instruments, facilitates the connection of sufficient and deficit economic entities and the population. A condition for the normal development of the national economy are the financial markets, which represent an increasingly important part of the economic and financial system. The subject of the paper presents the analysis of functioning and the methodology of calculating the value of stock market indices, in comparison with the indices of the Belgrade Stock Exchange. Furthermore, the general goal of the research is to point out the importance of the stock market and stock exchange operations for the entire society, whether we are on the side of the buyer or the supplier of securities. The results indicate that the original owners of financial savings do not participate in the work of the stock market, as well as that the development of the stock market conditioned the creation and development of stock market indices.*

**Keywords:** stock market indices, BELEX15, stock indices, bond indices

## 1. Introduction

For most of our lives we will earn and spend money (Dunn et al., 2008). Sometimes, we will have more money than we want to spend, and sometimes, we will spend more money than we can afford. When our income is greater than the desire to spend the excess money, we can save for "black days". How we save depends on various circumstances, one of the possibilities is to keep the money in a straw bag or bury it in the yard (if we have a house). Another option is to give up current spending for a larger amount of money that will be available for future spending. The difference between current consumption for a higher level of future consumption is the reason for saving (Aknin et al., 2020). What we do with our savings to grow them over time is investing. Investment is the giving up of money or other assets today in the expectation that it will bring benefits in the future. A person who decides to buy a security, let's say a share, expects that the income he gets from that share will justify the time during which the money was tied up as well as the risk taken by investing in the share.

Given that the investor's portfolio, most often, consists of various stocks, a typical question of investors is "What is happening in the market today?" (Aknin et al., 2011). There are several reasons why investors ask this question; first, bearing in mind that they own different stocks and bonds, it would be cumbersome for investors to track the value of each stock and bond in order to determine the composition of their portfolio; second, investors intuitively assume that the value of stocks and bonds moves in parallel with the value of the overall market. Therefore, if the market is growing, the value of the individual investor's portfolio will probably increase (Petkovic et al., 2018). In order to provide investors with comparative reports on market performance, some investment companies and financial publications have developed stock and bond indexes. Potential investors, in principle, are most interested in price changes and trading volume of each individual share. However, the movement of the market as a whole, its slow or accelerated growth, stagnation or dynamic decline is essentially a reflection of what is happening in the economy of the respective country.

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Investors always have the same goal: to buy as cheap as possible and sell as expensive as possible (Sovilj & Stojkovic-Zlatanovic, 2017). Since the stock market is a continuous market, so that price changes and determination of market prices of shares occur every day, investors on the stock market modify the basic trading principle of "buy as cheap as possible and sell as expensive" to the principle of "buy when the prices of securities reach their lowest value and sell them when they reach their highest value. In order to know when that moment will occur when the prices of securities will go up or down, it is necessary to analyze the movements of the prices of securities and make an investment decision based on these movements. It is important to know that indicators of the price movement of securities on the stock market do not show how the movement of these securities will take place in the future, but only how they have moved in the past. Therefore, the indicators of the movement of the prices of securities show, that is, they register the changes that happened in the past (ex post) approach. Although this characteristic of market indicators is very limiting, various stock market indicators have found their unavoidable application in the analysis of stock market trends. These indicators are indicators of the general state of the economy or its individual branches and sectors. Market indexes are important because they use: as benchmarks when evaluating the performance of individual portfolios:

- for creating and controlling index funds;
- for measuring the market rate of return in economic studies;
- to predict future market trends;
- as representatives of market portfolios of risky assets when calculating systemic risk.

Given that market indices are supposed to reflect the overall movements of groups of securities, it is necessary to consider factors that are significant when calculating indices that should represent the entire population. In this sense, the most important factors are: sample size, sample width and sample origin. A small percentage in the total sample population will provide valid indicators of the behavior of the total population if the sample is adequately selected. Basically, at a certain point, the costs of creating a larger sample will surely outweigh the benefits of increasing its size. The sample must be representative, otherwise its size will be insignificant. In this sense, a larger sample will not be better than a smaller sample (Pătraș et al., 2019). A sample can be created by completely random selection or a purposive selection technique to capture the characteristics of the desired population (Mijailovic & Mizdrakovic, 2023). Finally, the origin of the sample is significant if there are differences between segments of the population, in which case a sample of each segment is required. Financial institutions also perform many intermediary functions, but not every financial institution is an intermediary in the financial markets at the same time. Financial intermediaries connect other participants in the financial markets. Financial institutions include central banks, business (commercial) banks, credit and savings associations, savings banks, investment companies and funds, pension funds, insurance companies, financial companies, etc. Some of these institutions may be financial intermediaries, but brokers, dealers and investment bankers appear as special categories of financial intermediaries (Latkovic, 2022).

The topic of the paper is stock exchanges as special organizations, where transactions with instruments of securities and equity capital are effectively carried out. It is necessary to explain the concept, elements, and principle of working on the stock market to understand more easily the purpose of the existence of financial instruments (effects) as well as the importance and functions of the stock market, without which modern business is unthinkable in conditions of extremely rapid changes in the economic environment and frequent instability in international financial markets.

## **2. Methodology**

The starting basis of the research is a systematic approach to the method of system analysis in solving problems that define processes and decompose the stock market, as a business system, into subsystems. The subject of the paper is an analysis of the functioning of stock markets, with a focus on the most important stock market indices. Furthermore, the general goal of the research is to point out the importance of the stock market and stock exchange operations for the entire society, whether we are on the side of the buyer or the supplier of securities. On the subject of indicators that influence the performance of stock market indices, their growth, as well as predictions of future trends, several hypotheses can be put forward. However, in our work we focused on the development of stock market indices, which we believe are a consequence of the development of the stock markets themselves.

The effects of hypothesis testing and the use of research results in this work can influence the improvement of management quality (in all business segments, and above all in risk management and decision-making). With the desire to process the defined topic and subject of research as objectively, reliably and systematically as possible, the paper will use general-scientific methods (comparative and statistical methods) and scientific-research methods (qualitative and descriptive analyses). The analysis method will be used in considering individual phenomena, while the synthesis method will be used in the process of drawing conclusions about phenomena.

### 3. Stock market indices of shares

There are several types of market indices, and they differ from each other in the way they are calculated. The price-weighted market index is calculated by dividing the sum of share prices by a certain constant (divisor) (Djakovic, Indjic & Cicmil, 2022). The best-known price-weighted market index is The Dow Jones Industrial Average, which includes 30 stocks of large companies. The Dow Jones Industrial Average was constructed back in 1896. It is one of the most well-known and most frequently published indicators. At the time it was established, it included one group of shares, and it is calculated by dividing the total sum of share prices by the amount of the total number of shares. Today, this average is calculated by adding up the share prices of the 30 largest industrially renowned and high-quality companies, the so-called "blue chip stocks" listed on the NYSE, which is divided by a divisor that adjusts the deviations caused by the splitting (splitting) of shares carried out over the years or other changes that occurred by replacing one of the companies included in the average with another company. The index is simply calculated. All shares included in the index have the same weighting, regardless of their size or market capitalization. The weight is used as the price and not the market capitalization, so that the weights affect only the change in the share price, unlike the weighted indices, which are affected by both price changes and changes in the number of issued shares.

The DJIA is calculated as the ratio of the sum of the prices of 30 shares and the number of shares (30).

$$DJIA_t = \frac{\sum_{i=1}^{30} p_{it}}{D_{adj}} \quad (1)$$

where is:

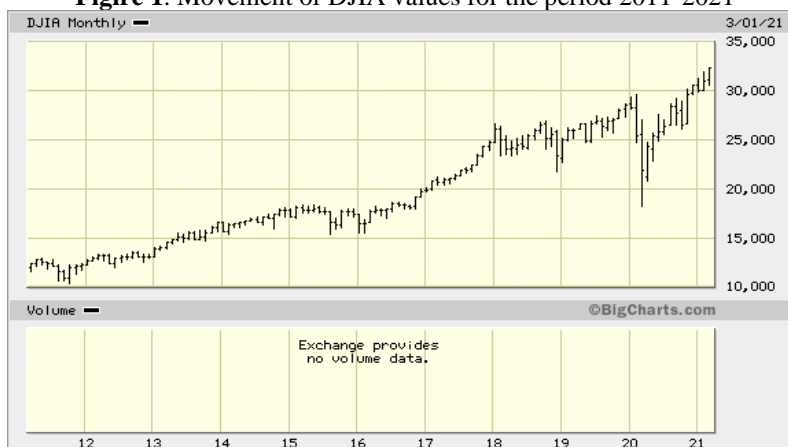
$DJIA_t$  - value of the index in the day  $t$ ;

$p_{it}$  - the price of the action during the day  $t$ ;

$D_{adj}$  - corrected divisor per day  $t$ .

The DJIA is calculated by adding the current price of all 30 stocks and dividing the total by a divisor that has been adjusted to account for changes due to stock splits and changes in the pattern over time. The divisor is adjusted so that the value of the index remains unchanged before and after the stock split. Although the use of the DJIA is the most widespread of similar indicators of stock price changes, there have been numerous criticisms of this approach. First, the sample used is limited to 30 stocks of large, prestigious companies that may not be representative of the many stocks traded in the US. In addition, the stocks included in the index do not represent typical representatives of the sector, but the best participants in that sector (Malenkovic, 2022). Several studies have shown that the DJIA is not as volatile as other market indices, and that long-term returns are not comparable to other stock indices on the New York Stock Exchange. In addition, improvement or changes in the way of production can be reflected in sales and profit, i.e., the price of shares, only after a long time. The existence of a time lag has the effect that the DJIA does not reflect the current situation but represents the consequence of past flows. Regardless of the mentioned shortcomings, the DJIA is still the most popular and most significant indicator of changes in share prices on the stock market.

**Figure 1.** Movement of DJIA values for the period 2011-2021



Source: <https://bigcharts.marketwatch.com/>

The value-weighted market index is calculated by multiplying the number of issued shares by their current price, thus obtaining the total market value of the shares for that day. This amount is then divided by the market value of the shares on the day when the calculation of the index began, and multiplied by its initial value (100) (Ćirović, 1995).

$$Indeks_t = \frac{\sum P_t Q_t}{\sum P_b Q_b} \times \text{The initial value of the index} \quad (2)$$

gde je:

$Indeks_t$ - index value per day  $t$ ;

$P_t$  i  $Q_t$  - the market price per share and the number of issued shares for each share during the period  $t$ ;

$P_b$  i  $Q_b$  - market price per share and number of issued shares during the base period.

The best-known value-weighted index is the Standard & Poor's 500 Stock Price Index, which includes 500 shares of large companies (Benedict, 2021). The structure of the index consists of 400 shares of industrial companies, 20 transport companies, 40 shares from the public sector and 40 financial companies. This group of market indices also includes the NYSE Composite Index, which includes all shares listed on the New York Stock Exchange.

**Figure 2.** Movement of DJIA values for the period 2011-2021



Source: <https://bigcharts.marketwatch.com/>

An equally weighted index assumes equal cash investments in all the stocks it covers. This is achieved by giving appropriate values to the weights by which the share prices are multiplied, and by adding up the obtained values. The most well-known equally weighted index is the Indicator Digest index, which includes stocks listed on the New York Stock Exchange. There are also market indices that are not based on a weighting system. One such is the Value Line Composite Average, which is calculated using the geometric mean of the daily price ratios of the relevant shares for day  $t$ . The geometric mean of such price ratios is then multiplied by the index for day  $t$ .

BELEX15 is a market capitalization-weighted index, which is not adjusted for dividends paid, and is not protected against the dilution effect that occurs due to the payment of dividends (Vesic et al., 2021). BELEX15 is weighted exclusively by free float market capitalization. BELEX15 consists of shares that are traded using the continuous trading method and that have met the criteria for entering the index basket. The weighting of the components in the index is limited to a maximum of 20% in relation to the total market capitalization of the index on the revision date. The purpose of the index is to measure price changes (price index) of shares that are traded using the continuous trading method, and which previously met the criteria for inclusion in the index basket. The BELEX15 index is primarily intended to improve the investment process, by measuring the performance of the most liquid segment of the Serbian capital market, as well as by making it possible to compare potential investment strategies according to the index (Bozinovic, 2019). On the other hand, BELEX15 is designed in a way that describes the market movements of the most liquid shares as closely as possible and can serve as an underlying for the creation of structured products and derivatives on the domestic and foreign markets. It is intended to be an analytical tool for portfolio managers, professional analysts, the professional public, investors, and all others who study the dynamics of price movements in this market. The calculation and publication of the BELEX15 index is carried out every working day of the Stock Exchange, in real time, from the moment when the conditions for its calculation and publication are met, until the closing prices are formed.

The share price used to calculate the BELEX15 index is any share price that was formed in the trading of shares that make up the index basket, except for the prices that were realized in block transactions. The first value of the BELEX15 index of the day is determined in real time at the moment when at least 30% of the shares that make up the index basket make the first transaction of the day (opening price). If more than 70% of the shares that make up the index basket are not opened (do not close any transactions) by the time the closing prices are determined, the BELEX15 index is not calculated in real time, but the value of the index is determined according to the closing prices of the shares that make up the index basket, without regardless of how many index components have transacted on the day in question (Radivojac et al., 2021). When calculating the value of the index at any time, the relevant number of shares of a certain issuer used in the calculation includes the total number of ordinary shares multiplied by the free float factor (FFc) on the day of the last revision of the

index basket. Free float factor (FFc) is the percentage of shares that are in free circulation and that are publicly available to potential investors. FFc is obtained when non free float shares are subtracted from the total number of shares.

$$BELEX15(t) = \frac{\sum_{i=1}^n C(i, t) * K(i, t) * FFc * Ai}{d(t)} \quad (3)$$

When revising the index basket, the divisor is calculated as follows.

$$\begin{aligned} d(t) &= \frac{\sum_{i=1}^n Cp(i, t) * Kp(i, t) * FFc(t) * Ai(t)}{\sum_{i=1}^n C(i, t-1) * K(i, t-1) * FFc(i, t-1) * Ai(t)} * d(t-1) \\ &= \frac{\text{Nova indeksna korpa}}{\text{Stara indeksna korpa}} * d(t-1) \end{aligned} \quad (4)$$

where is:

$BELEX15(t)$  – the value of the index of selected securities that are traded using the continuous trading method at time  $t$ , rounded to two decimal places;

$n$  - the number of issuers whose shares are in the index basket - the selected securities are unchanged until the moment of revision;

$i$  - counter, which takes values from 1 to 15 and represents a certain issuer whose shares are in the index basket;

$C(i, t)$  – the price of shares of issuer  $i$ , at time  $t$ , which is taken in real time from the trading system;

$K(i, t)$  – amount of shares of issuer  $i$ , at time  $t$ ;

$d(t)$  – the value of the divisor at the moment  $t$ .

$FFc(i, t)$  - free float factor of issuer  $i$ , at time  $t$ ;

$A(i)$  – adjusting factor of issuer  $i$  (weight);

In order to avoid the deviation of the index value from the real values, the divisor is adjusted due to the change of the index basket, as well as due to the change within the components of the index basket. The divisor is adjusted in such a way that if there is no change in the prices of the shares included in the index basket on the next working day, the value of the index remains the same.

**Figure 3.** BELEX15 value trends for the period 2011-2021



Source: <https://www.belex.rs/trgovanje/indeksi/belex15/istorijski/3y>

BELEXline is an index that has replaced the BELEXfm index since May 2008. BELEXline is an index that is weighted by market capitalization that is in free float, which is not adjusted for dividends paid, and is not protected from the dilution effect that occurs due to the payment of dividends. BELEXline consists of shares that are traded on the markets of the Belgrade Stock Exchange and that have met the criteria for entry into the index basket (Matic et al., 2022). The weight of the components in the index is limited to a maximum of 10% in relation to the free-float market capitalization of the index.

The purpose of the index is to measure price changes (price index) of shares traded on the Belgrade Stock Exchange, which previously met the criteria for inclusion in the index basket (Malekovic, 2022). The BELEXline index was designed as a basic benchmark for tracking price movements on the Serbian capital market. On the other hand, BELEXline is designed in a way that describes the overall (broad market) market trends as closely as possible and can serve as an underlying for the creation of structured products and derivatives on the domestic and foreign markets. It is expected to be an analytical tool for portfolio managers, professional analysts, the professional public, investors, and all others who study the dynamics of price movements on the Serbian market. The BELEXline index is calculated and published every working day of the Stock Exchange (Jaksic & Puric, 2017), after the end of all scheduled trading for that day (Dzeletovic & Milosevic, 2017). In the event that trading of an individual security included in the index basket is suspended on a

certain day or in a certain period, the index is calculated on the basis of the last price of the given security on the last trading working day preceding the suspension of its trading. The share price used to calculate the BELEXline index is the prevailing one, that is, the closing price that was formed in the trading of the shares that make up the index basket. When calculating the value of the index at any time, the relevant number of shares of a certain issuer used in the calculation includes the total number of ordinary shares multiplied by the free float factor (FFc) on the day of the last revision of the index basket (Knezevic et al., 2017). Free float factor (FFc) is the percentage of shares that are in free circulation and that are publicly available to potential investors. FFc is obtained when non free float shares are subtracted from the total number of shares. Under the term shares that are not in free circulation are considered shares that are owned by: persons who individually own more than 5% of the total issued shares of the issuer (Krsikapa-Rasajski & Rankov, 2016), excluding shares that are owned by investment and pension funds, as well as other shares in custody accounts, fund management companies, insurance companies, broker-dealer companies and other investment companies with short-term investment strategies.

#### **4. Stock indices of bonds**

Creating and calculating bond market indicators is more varied and difficult than stock market series for several reasons (Gradojevic & Dobardzic, 2013). First, the universe of bonds is much broader than the universe of stocks. Also, the bond universe is constantly changing, as bond maturities change over time. Furthermore, the volatility of bond prices is affected by the average duration of payment (duration), which is also constantly changing due to changes in coupon maturity, market yield, etc. Finally, there may be significant problems in correctly pricing individual bond issues in one series of indicators.

The Merrill Lynch Taxable Bond Indexes (TBIs) track more than 5,000 bonds. Merrill Lynch TBIs include US government and government agency securities, investment grade corporate bonds, mortgage-backed securities, Eurodollar securities and the like. The Ryan Index is a series of total daily returns derived by calculating an equally weighted average of the daily returns of the 7 most recently issued government bonds with the following maturities: 2, 3, 4, 5, 7, 30 years. The index level is calculated every day by adding the previous day's index to the current day's total return. Only government issues are used as they are considered to be a good reflection of the prevailing risk-rewarding climate for the bond market. Salomon Brothers (SB) Broad Investment-Grade Bond Indexes - bond indexes that include approximately 3,800 individually rated government, corporate and mortgage-backed securities with criteria such as maturity of one year or longer and a minimum volume of \$25 million. The Shearson Lehman Hutton (SLH) Indexes. Over 4,000 shows are included in the SLH indices. Total returns are weighted by market value. Merrill Lynch Convertible Securities Indexes. In March 1988, Merrill Lynch introduced a group of indexes linked to convertible securities with a base date; January 1987. Salomon Brothers International Bond and Money Market Performance Indexes. These indices aim to measure the total return performance of high-quality securities in the major international bond and money markets. The indices were introduced in September 1981 with historical data dating back to January 1, 1978 = 100. There is also a market value weighted and unweighted composite world bond index and money market index. The levels of these indices are reported monthly by Global Investor.

#### **4. Conclusion**

In the paper, an overview of the most important world stock market indices and indices of the Belgrade Stock Exchange was carried out. The general characteristics of stock markets and the role and function of indices in financial markets were observed. The work was developed in the function of reviewing the calculation of the observed stock market indices. Since there is no primary, but only secondary buying and selling of financial instruments on the stock exchanges, this means that the original owners of financial savings do not participate in the work of the stock exchanges. Also, the direct participants are not even the end users of financial savings, since instead of them, stock market material, and thus sell money, stock market intermediaries - banks and other financial organizations, through authorized participants in the work of the stock market meeting. At the very beginning, the stock market was often identified with the market, where a small number of HOVs were traded. Today, we are in a situation where we can trade at almost any time, from any part of the planet, with almost infinite combinations of basic and derivative HOVs. From the above, we can confirm the hypothesis that the development of the stock market conditioned the creation and development of stock indices. The further development of financial markets has contributed to the existence of a greater number of stock exchanges in more developed areas. Stock exchanges have a huge importance in the development of the market economy. They represent the basic mechanism for the functioning of the capital market, its heart. Without stock exchanges, the capital market in a country cannot function adequately and in its full form. The research showed that the condition for the normal development of the national economy is the financial markets, which represent an integral part of the economic and financial system of every country. The premise of this claim certainly lies in the fact that a developed financial market as such exists within a national economy.



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