

ANALYSIS OF PROFITABILITY AND RISK-TAKING IN AMERICAN, EUROPEAN AND ASIAN STOCK MARKETS

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Abstract

Major global stock indices for different regions are dealt in this scientific article. American, European, Asian stock indices are explored according to profitability and risk. The British and German stock indices are detailed and compared to global stock indices as the most important stock indices in the European region. The price trend, profitability, volume, and risk of these stock indices over a single day are explored in more detail from January 4, 1999 to March 22, 2018, with a total time horizon of 4460 days, using Bloomberg terminal. The main purpose of the article is to analyze the profitability and risk of stock indices, to compare these indices and to forecast the trend of stock price changes. Comparison, systematization, logical grouping, methods for calculating profitability, risk, standard deviation are used in this article. Also, moving averages (short (MA21) and long periods (MA365)) are counted. The average profitability per day was the highest for the DAX stock index and the lowest for the UKX stock index. However, the highest profitability for the all analyzed period was the SPX stock index. Interestingly, that the loss would have been obtained from the UKX index over the same analysed period from 1999 to 2018. The NKY stock index was the most risky over the analyzed period, according to the standard deviation. According to the coefficient of variation, the UKX equity index had the highest risk. Floating averages reflect the correct buying and selling signals based on historical data. According to 2018 historical data, moving averages do not show optimistic forecasts, so 2018 may be particularly risky for investors. Also after analyzing the stock index price trend in 1999-2018, it can be concluded that all stock indices (SPX, SXXP, DAX, UKX, NKY) were strongly affected by the dot com bubble and the global economic crisis. The dot com bubble was the strongest hit by the DAX index price (almost four times). The lowest price for SXXP index fell (almost twice). During the global economic crisis, the price of the SPX index fell the most. The lowest price for the NKY index fell. During the period of 1999-2018, the highest upward trend was the SPX and DAX indexes. The UKX Indesque did not have a long-run trend. The highest average daily yield was the DAX index. The highest risk was the NKY index. The 2018 stock price index does not show optimistic expectations.

Keywords

stock indices, profitability, risk, moving averages

JEL Classification: G15, G17, F37

Introduction

Stock indices best reflect the stock market. Careful monitoring and in-depth analysis can help predict the stock market trend. This prediction is very important for investors who buy, sell, and expect to earn a profit from the price difference. The Standard and Poor's 500 Index (SPX), STOXX Europe 600 Index (SXXP), German Stock Index (DAX), FTSE 100 Index (UKX) and Nikkei-225 Stock (NKY) are the most well-known stock indices among investors. Each of these indexes represents a different region and companies.

SPX index is a capitalization-weighted index of 500 stocks. The index is designed to measure performance of the broad domestic economy

through changes in the aggregate market value of 500 stocks representing all major industries. Booking Holdings (BH), Amazon (AM) and Alphabet (AL) are the three largest companies in the SPX index. BH operates as an online travel company. It offers a platform that allows to make travel reservations with providers of travel services. AM is an online retailer that offers a wide range of products: books, music, videotapes, computers, electronics, home and garden, and numerous other products. AL operates as a holding company. SXXP index represents large, mid and small capitalization companies across 17 countries of the European region. Chocoladefabriken Lindt & Sprungli (CS), Lindt & Spruengli (LS), Sika (SK) are the three largest companies in the SXXP index. CS manufactures a broad range of chocolate. The Company markets

its products through its own specialty stores and boutiques, as well as through retail outlets. LS operates subsidiaries in Europe, North America and Asia and also sells its products through various distributors in other world region. SK manufactures construction materials and offers related services. The Company produces concrete and mixtures, mortar, sealants and adhesives, tooling resins, anti-static industrial flooring, acoustic materials for automobiles, and waterproof membranes. DAX index is a total return index of 30 selected German blue chip stocks traded on the Frankfurt Stock Exchange. The equities use free float shares in the index calculation. SGS, Adidas (AD) and MunichRe (MR) are the three largest companies in the DAX index. SGS provides industrial inspection, analysis, testing, and verification services. AD manufactures sports shoes and sports equipment. MR provides financial services. UKX index is a capitalization-weighted index of the 100 most highly capitalized companies traded on the London Stock Exchange. The equities use an investibility weighting in the index calculation. Paddy Power Betfair (PPB), DCC and Reckitt Benckiser Group (RBG) are the three largest companies in the UKX index. PPB is a betting and gaming company. The Company provides online betting and gaming products. DCC is a sales, marketing, distribution, and business support services company. The Company operates in the following sectors, energy, IT, and entertainment products, healthcare, environmental services, and food and beverage. RBG manufactures and distributes a wide range of household, toiletry, health, and food products on a global basis. NKY index is a price-weighted average of 225 top-rated Japanese companies listed in the First Section of the Tokyo Stock Exchange. Fast Retailing (FA), FANUC (FN) and Tokyo Electron (TE) are the three largest companies in the NKY index. FA designs, manufactures, and retails its own line of clothing. FN manufactures factory automation systems and robots. TE manufactures and sells industrial electronics products, such as semiconductor manufacturing machines, flat panel display manufacturing machine.

Investing in stock indices is a great opportunity for investors to make a profit, therefore the main purpose of the article is to analyze the profitability and risk of stock indices,

to compare these indices and to forecast the trend of stock price changes. Comparison, systematization, logical grouping, methods for calculating profitability, risk, standard deviation are used in this article. Also, moving averages (short (MA21) and long periods (MA365)) are counted.

Theoretical background and methodology

Stock indices, purchase and sales signals, various traditional and innovative forecasting methods are analyzed in scientific articles. The empirical part and the data of the author of each scientific article are different, but the purpose of all of them is similar - more effective decision-making for investors.

According to the authors Ivanova and Wille (2002) a moving average technique can be used for analysing the stock indices dynamics. The authors say that two moving averages with different time horizons are especially important. Also it is very important to distribute the maximum and minimum in the moving average signal. The dynamics of stock prices is influenced by economic and political factors. Any economic news affects the movement of stock prices. It should be emphasized that any negative economic news affects the fall in stock indices. Especially prices fell during all global economic crises. According to the authors Vamvakaris et al. (2018) have investigated that all of the major economic crises that have taken place over the past twenty years around the world have greatly affected the behaviour of stock price indices. They say that each global economic crisis has affected stock indices differently, however can predict future trends carefully analysing the stock index market using horizontal visibility graph. Analyzing the stock index market it is important to consider systemic risk. According to the authors Li et al. (2018) in high-volatility financial environments systemic risk can be detected using network topology. The authors in their study proposed to apply the minimum spanning tree with the upper tail. Papaioannou et al. (2017) offers a "Buy and Hold" trading strategy for analysing price of stock indices. The strategy is based on the most liquid futures deals from the four major asset classes: equities, bonds, commodities and foreign exchanges. Authors use S&P500 stock index data

and prove that such a strategy can be one of the successful alternatives for predicting future trends. In order to predict stock index price trend can be used the density forecast. According to the authors Hua and Zhang (2008) this forecast is „an estimate of the probability distribution of the possible future values of a random variable” and are increasingly being used. They propose a GARCH model with two-piece normal distribution. Authors Rivera and Arroyo (2012) use histogram time series (HTS) and interval time series (ITS) to analyse S&P500 stock index price trends. However according to the authors Aubert and Grudnitski (2014) „the relationship between the market mispricing of pro forma earnings announcements and the degree to which pro forma earnings are quantitatively reconciled with GAAP (Generally Accepted Accounting Principles) earnings” are more important than other risk factors of market. They proved it using Euro Stoxx index data. Ozturk and Richard (2015) use stochastic volatility leverage models to assess stock indices price trends according S&P500 data. These authors Michaelidess et al. (2016) note that it is very important to analyze stock indices during crises, to anticipate future crises, and to try to forecast share prices through them. They suggest using innovative techniques artificial neural networks. These authors Brida et al. (2016) also examine stock price indices in pre-crisis and post-crisis periods using Euro Stoxx index data. They use „symbolization methods to the raw data to study the behaviour of the market structure in different, normal and critical, situations”. Liu (2009) analyzed the stock index Nikkei 225 and came to the conclusion that „when stocks are added to (deleted from) an index, more (less) information should be generated and incorporated into their prices, leading to higher (lower) pricing efficiency and lower (higher) return predictability for them.” This author has applied runs test. According to the authors Danbolt et al. (2017) stock market index FTSE 100 is different from that of the American or other country’s stock indices as companies may fall into this index according to clear rules that are based on market capitalization. A technical analysis can be used to assess the stock index price trend (Ilalan, 2016). One of the most significant technical analysis indicators is the Elliott wave principle. According to the Ilalan (2016) it is very important to find a linkage between Elliott wave principle and fractional

Brownian motion. This author used the stock index Nikkei 225 and proved that the technical analysis could predict trends of stock prices. For the evaluation of the stock index price trend, it is also possible to use the autoregressive conditional jump intensity (ARJI) model (Lee et al., 2007). These authors used CME-Nikkei 225 and SIMEX-Nikkei 225 data. It is necessary to anticipate market volatility in order to predict the prices of stock indices, and this is rather complicated. Authors Becker et al. (2006) in their study show that the VIX index can be used to assess the volatility of the stock market, but it is not the best option.

A single stock index was more analyzed in scientific articles. One or two methods have also been applied by scientists. Stock index prices and price trends were the basis. However, the global stock indexes view is composed of stock indexes less analyzed. The methods proposed by researchers can be applied to analyzing several key stock indices in order to make more effective investment decisions.

The average profitability of a market over a period is calculated as a relative change in the index over a certain period Eq. (1), where k_m is average market profitability over the period, I_1 is index at the end of the period, I_0 is index size at the beginning of the period.

$$k_m = \frac{I_1 - I_0}{I_0} \quad (2)$$

The standard deviation reflects the range of the spread of the return on investment. The lower the standard deviation, the lower the risk. The standard deviation is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A low standard deviation indicates that the data points tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values. The formula for the sample standard deviation is Eq. (2), where $x_1 \dots x_N$ are the observed values of the sample items, $\bar{x}$ is the mean value of these observations, and N is the number of observations in the sample.

$$\delta = \frac{\sum_{i=1}^N ((x_i - \bar{x}))^2}{N - 1} \quad (2)$$

In finance, standard deviation is often used as a measure of the risk associated with price-fluctuations of a given asset (stocks, bonds, property), or the risk of a portfolio of assets (actively managed mutual funds, index mutual funds or ETFs). Risk is an important factor in determining how to efficiently manage a portfolio of investments because it determines the variation in returns on the asset and/or portfolio and gives investors a mathematical basis for investment decisions (known as mean-variance optimization). The fundamental concept of risk is that as it increases, the expected return on an investment should increase as well, an increase known as the risk premium. In other words, investors should expect a higher return on an investment when that investment carries a higher level of risk or uncertainty. When evaluating investments, investors should estimate both the expected return and the uncertainty of future returns. Standard deviation provides a quantified estimate of the uncertainty of future returns.

$$CV_i = \frac{\sigma_i}{\bar{r}_i} \quad (3)$$

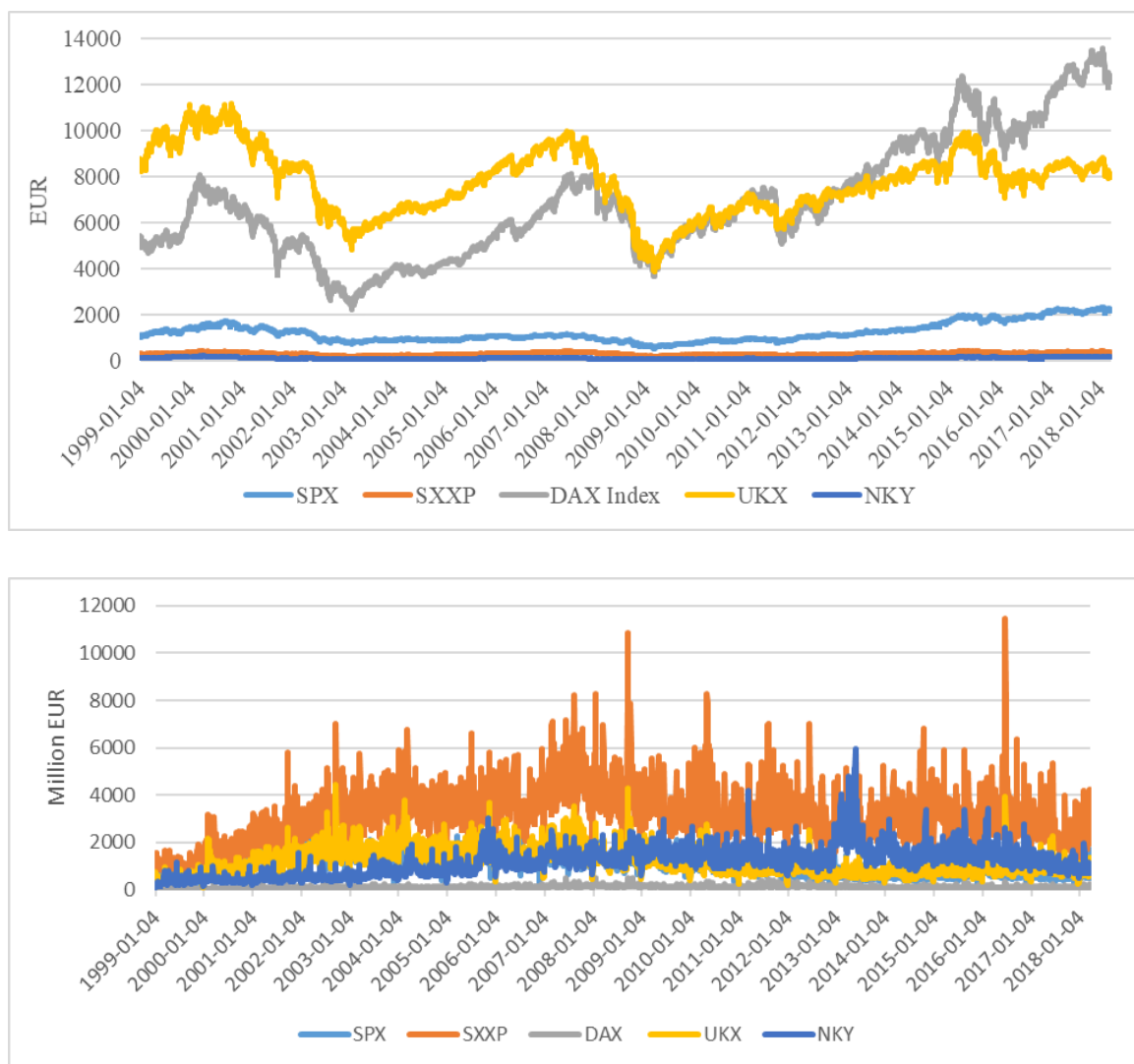
The coefficient of variation represents the risk per unit of profit rate Eq. (3), where σ_i is standard deviation of investment instrument, $\bar{r}_i$ is average return on investment instrument.

The moving average is one of the technical analysis indicators. This indicator is the most popular and most used, it is based on a large number of other indicators. A moving average is the average price over a given period. This is a line that shows the average price after the specified time period, which is expressed in the amount of candles and/or bars. The moving average is very large and different. It could be calculated the moving averages for the short and long periods. It is recommended to use MA21 (the average stock price index for 21 days) for analysis of a short period. MA365 (the average stock price index for 365 days) is recommended for analysis of long periods.

Results and debate

The price trend is analyzed in the stock indexes of different regions of the world: Standard and Poor's 500 Index (SPX, America), STOXX Europe 600 Index (SXXP, Europe), Nikkei-225 Stock Index (NKY, Asia), German Stock Index (DAX, Germany), FTSE 100 Index (UKX, United Kingdom). The price trend and volume are analyzed every day from January 4, 1999 to March 22, 2018, total 4460 days (see Figure 1-2). The most expensive stock index before the global crisis was SPX, but after the crisis, the DAX Index surpassed SPX. On March 22, 2018, the DAX index cost 12100 euros. During the entire analysis period, the average daily price was as follows: SPX 1222 EUR, SXXP 301 EUR, DAX 6894 EUR, UKX 7776 EUR, NKY 108 EUR. All global stock indices were affected not only by the global economic crisis in 2007-2009, but also by the dot com bubble in 2000-2003. The highest price for the SPX index reached 22 January 2018 and was equal to 2314 EUR. The lowest SPX price was on March 9, 2009 and reached 535 euros. The highest price for the SXXP index reached 15 April 2015 and was equal to 414 EUR. The lowest SXXP price was on March 9, 2009 and reached 158 euros. The highest price for the DAX index reached 23 January 2018 and was equal to 13560 EUR. The lowest DAX price was on March 12, 2003 and reached 2203 euros. The highest price for the UKX index reached October 24, 2000 and was equal to 11146 EUR. The lowest UKX price was on March 9, 2009 and reached 3872 euros. The highest price for the NKY index reached March 31, 2000 and was equal to 207 EUR. The lowest NKY price was on March 10, 2009 and reached 56 euros. So, the lowest daily price for all indices was March 9-12, 2009, except for the UKX index. The lowest price for the UKX index was March 12, 2003. The maximum price was different. The highest prices for SPX and DAX indexes were on January 22 and 23, 2018. The UKX and NKY indexes peaked at the highest prices on October 24 and March 31, 2000. The highest price of the SXXP index was on April 15, 2015.

Figure 1-2. Price trend (EUR) and volumn (Million EUR) of stock indices per day from January 4, 1999 to March 22, 2018



Source: Bloomberg Database

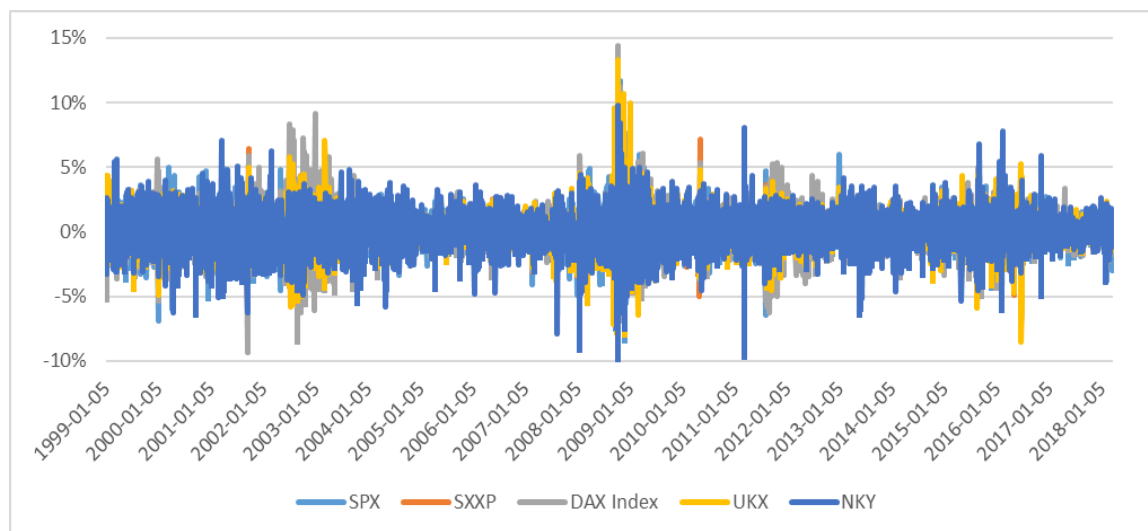
Investors are interested in profitability. Graph 3 shows the profitability of one day over the entire analyzed period from January 1999 to March 2018. The SPX index peaked at one-day profitability of 11.7% and the lowest -8.4%. The SXXP index had a one-day profitability of 13.2% and a low of -7.6%. The DAX index had the highest profitability of one day at 14.4%, and the lowest -9.3%. The UKX index had a one-day profitability of 13.3%, while the lowest -8.8 percent. The NKY index had a one-day

profitability of 9.8% and low of -9.8%. It is very important to analyze the volume of trading in stock indices. The volume of trade in indices for the period 1999-2018 of the SPX index peaked at 11.48 billion, at least 0.6 billion a day. The same volume of the SXXP index peaked at 0.49 billion, at least 6.4 million a day. The DAX index peaked at 4.44 billion, at least 0.08 billion a day. The UKX index peaked at 5.95 billion, at least 0.07 billion dollars a day. The NKY index peaked at 2.95 billion, at least 0.2 billion a day.

Calculating the average profitability of one day can see the following results (see table 1). The highest profitability per day is the SPX index and the DAX index, while the smallest profitability per day is the SXXP index and UKX

index. However, the highest risk is the NKY index and the lowest risk for the SXXP index. It is very interesting that the highest coefficient of variation is for UKX index, and the smallest coefficient of variation is for SPX index.

Figure 3. Profitability of stock indices per day from January 4, 1999 to March 22, 2018



Source: Bloomberg Database

Table 1. Average profitability, standard deviation and coefficient of variation per day for stock indices from January 4, 1999 to March 22, 2018

	SPX	SXXP	DAX	UKX	NKY
Average profitability	0.03%	0.01%	0.03%	0.01%	0.02%
Standard deviation	1.38%	1.29%	1.56%	1.36%	1.57%
Coefficient of variation	53.45	92.85	50.53	160.07	67.20

Table 2. Profitability and probability of stock indices according the normal distributions

SPX		SXXP		DAX		UKX		NKY	
Profit.	Prob.	Profit.	Prob.	Profit.	Prob.	Profit.	Prob.	Profit.	Prob.
-4.11	0.3%	-3.86	0.3%	-4.65	0.3%	-4.07	0.3%	-4.69	0.3%
-3.36	1.4%	-3.16	1.5%	-3.80	1.3%	-3.33	1.4%	-3.83	1.2%
-2.60	4.7%	-2.45	5.0%	-2.95	4.1%	-2.59	4.7%	-2.98	4.1%
SPX		SXXP		DAX		UKX		NKY	

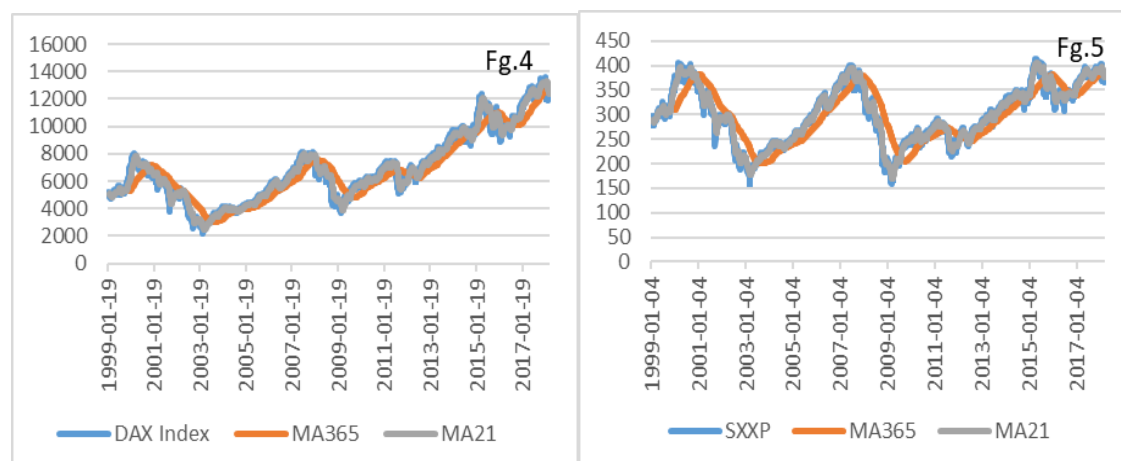
Profit.	Prob.	Profit.	Prob.	Profit.	Prob.	Profit.	Prob.	Profit.	Prob.
-1.85	11.4%	-1.75	12.2%	-2.10	10.1%	-1.84	11.6%	-2.12	10.0%
-1.10	20.7%	-1.05	22.1%	-1.25	18.3%	-1.10	21.0%	-1.26	18.2%
-0.35	27.9%	-0.34	29.8%	-0.40	24.6%	-0.36	28.3%	-0.41	24.5%
0.41	27.9%	0.36	29.8%	0.46	24.6%	0.38	28.3%	0.45	24.5%
1.16	20.7%	1.07	22.1%	1.31	18.3%	1.12	21.0%	1.30	18.2%
1.91	11.4%	1.77	12.2%	2.16	10.1%	1.86	11.6%	2.16	10.0%
2.66	4.7%	2.47	5.0%	3.01	4.1%	2.61	4.7%	3.02	4.1%
3.42	1.4%	3.18	1.5%	3.86	1.3%	3.35	1.4%	3.87	1.2%
4.17	0.3%	3.88	0.3%	4.71	0.3%	4.09	0.3%	4.73	0.3%

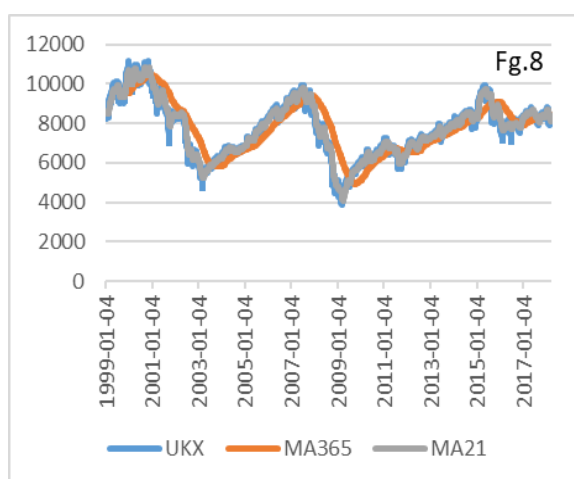
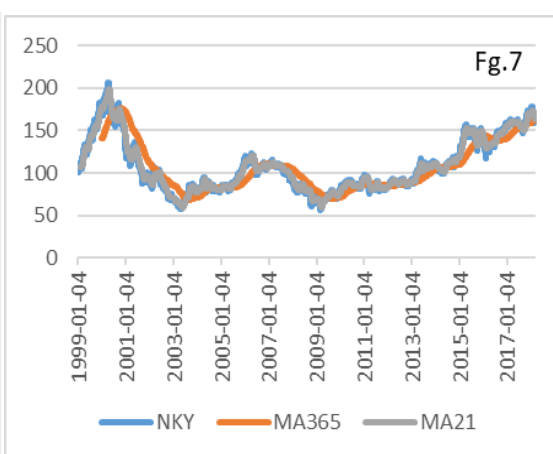
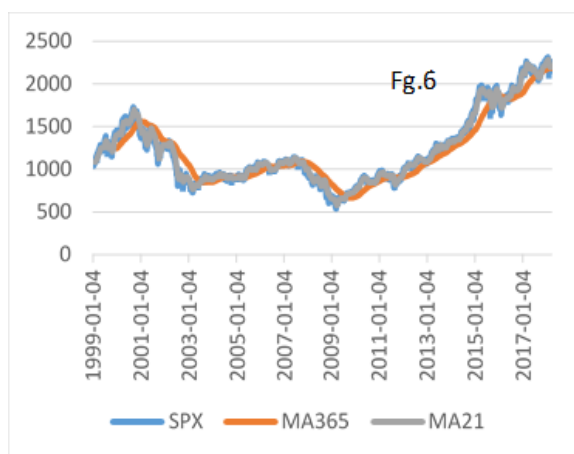
Table 2 presents the normal distributions of these stock indices: SPX, SXXP, DAX, UKX, NKY. There is a 0.3% probability getting such profitability per day from stock indices: SPX (4.17%), SXXP (3.88%), DAX (4.71%), UKX (4.09%), NKY (4.73%). However, there is also a 0.3% probability per day getting the same loss of these stock indices. Interestingly, the 30% probability per day is to get such profitability or loss from these stock indices: SPX (0.41%), SXXP (0.36%), DAX (0.46%), UKX (0.38%), NKY (0.45%). The results show that with the same probability, the highest profitability is possible by investing in the NKY stock index. However, making a profit is most likely to be invested in the SXXP equity index.

Floating averages can help determine the trend of stock price indices. Looking at long-term

data, it is necessary to study the moving averages for a shorter and longer period. Selected 21-day and 365-day moving averages. When the short-term moving average crosses the long-term floating midsole from the bottom up, it shows a long position. According to Figure 4-8, it can be seen that the short-term moving average crossed the bottom of the long-term moving average in 2003 and 2009, when the stock price indices started to rise. Moving Average Method in 2018 in the first quarter showed different signals for stock indices. The stock indexes SXXP, DAX, UKX short period moving average crossed the long period moving average from top to bottom. It showed a short position for investors. For the stock indices, SPX and NKY moving averages did not cross each other, so there were no bigger signals.

Figure 4-8. Trend of stock indices price and moving averages (MA21 and MA365) per day from January 4, 1999 to March 22, 2018





Conclusions

After analyzing the stock index price trend in 1999-2018, it can be concluded that all stock indices (SPX, SXXP, DAX, UKX, NKY) were strongly affected by the dot com bubble and the global economic crisis. The dot com bubble was the strongest hit by the DAX index price (almost four times). The lowest price for SXXP index fell (almost twice). During the global economic crisis,

the price of the SPX index fell the most. The lowest price for the NKY index fell. During the period of 1999-2018, the highest upward trend was the SPX and DAX indexes. The UKX Index did not have a long-run trend. The highest average daily yield was the DAX index. The highest risk was the NKY index. The 2018 stock price index does not show optimistic expectations.

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