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Review
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TECHNICAL ANALYSIS ACCURACY AT MACEDONIAN STOCK EXCHANGE

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Abstract
The main task of this paper is to determine accuracy of some of widely used technical analysis techniques for MBI-10 stocks price forecast at MSE. We are testing accuracy of several technical analysis techniques: MACD (Moving-Average Convergence/Divergence), RSI (Relative Strength Index), Stochastic Oscillator and ADX (Average Directional Index) on the three most liquid stocks quoted at MSE and included in MBI-10 index. Technical analysis for MPT, ALK and KMB stocks was performed and recommendations were issued in June 2010, based on monthly and weekly data for the stocks' price movements during six years period from 2005 to 2010, as well as on their daily price movements from 2009 to 2010. We find that technical analysis is reliable tool for MSE stocks forecasting. Technical analysis predictions for three MSE stocks were confirmed by actual stock price movements within one year period (June 2010-June 2011). We did not find any notable differences in accuracy of use of technical analysis between stocks at MSE as well as between different technical analysis techniques.

Keywords: stock, return, valuation, regression, volatility.

Jel Classification: G1; G11; G12

INTRODUCTION

Financial literature and practice recognizes two basic approaches for financial markets analyses: fundamental analysis and technical analysis. While the fundamental analysis focuses on the underlying causes of price movements (economic, social, political, geopolitical forces, etc.) that drive supply and demand for the stock, technical analysis focuses on the study of price movements.

Some traders use technical or fundamental analysis exclusively, while others use both to determine trading decisions, which definitely is the most rational approach. Technical

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analysis users are often called technicians or market technicians. Some prefer the term technical market analyst or simply market analyst. In older finance literature often used is term, chartist, but as the discipline has expanded and modernized, the use of the term chartist has become less popular, as it is only one aspect of technical analysis.

Technical analysis argues that prices already reflect all market trends before investors are even aware of them. Determination of those trends is main goal of technical indicators.

One of the most popular definition of technical analysis is that this is study of market action that focus on prices and trading volumes, primarily through the use of charts, for the purpose of forecasting future price trends (Murphy 1999). This technique is based on three premises as following: market action discounts everything, prices move in trends and history repeat itself.

In fact, in order to forecast the direction of future prices movement analysts use historical currency or stock data following the basic idea that all current market information is already reflected in the price of that currency or stock, and that is same as efficient market hypothesis argues. Having in mind that this hypothesis is still dominant in finance literature, we can conclude that the use of technical analysis has solid theoretical background. On the other side, the efficient market hypothesis argues just opposite and does not approve the use of any forecasting techniques. However, traders and investors widely use technical analysis, with idea that analysis of price action is required to make as much as possible accurate forecasting, crucial for trading decisions.

The primary task of the technical analyst is to identify trends and patterns to find profit opportunities. The most basic concept of technical analysis is that financial markets have a tendency to trend (famous traders' proverb is "trend is a friend"). Key element of technical analysis forecasting is possibility to identify trends in their earliest stage of development.

Although technical analysis is widely used among traders and financial professionals in the 1960s and 1970s it was widely criticized by academics. In a recent review, Irwin and Park reported that 56 of 95 modern studies found it produces positive results, but noted that many of the positive results were rendered dubious by issues such as data snooping so that the evidence in support of technical analysis was inconclusive; it is still considered by many academics to be pseudoscience (Irwin and Park 2007).

The main task of our paper is to test accuracy of technical analysis for stock price forecasting at Macedonian Stock Exchange (MSE). In our paper we provide technical analysis of three most liquid stocks traded at MSE and included in the MBI-10 (Macedonian Stock Exchange index of ten most liquid stocks). Technical analysis of MPT, ALK and KMB (Makpetrol, Alkaloid and Komercial Bank) stocks were performed in June 2010, based on analysis of three stocks' monthly and weekly data from 2005 to 2010, as well as their daily price movements from 2009 to 2010. Finally, we compare technical analyses' forecasts for market outlook with actual stock price movements within period of one year after predictions were issued (June 2010–June 2011).

We address the following research questions in our paper: What is the practical use of technical analysis as tool for forecasting stock prices movements at MSE? Are there notable differences in accuracy of use of technical analysis between stocks at MSE? Are there notable differences in accuracy between different technical analysis techniques at MSE?

While we draw our conclusions from the historical data on MSE, we consider this stock market as good representatives of emerging markets. Therefore, we argue that our results are valid for other similar emerging stock markets.

The remainder of the paper is organized as follows. In Section I we give summary of literature overview concerning technical analysis and short presentation of four different techniques of technical analysis (MACD, RSI, Stochastic Oscillator and ADX) used for stock price forecast in our research. In Section II we present technical analysis of three stocks quoted at MSE for the period 2005-2010 as well predictions for future stock price movements for 2011. In Section III we present actual stock price movements for forecasted period (2011), using the historical data from MSE and compare with predictions. At the end of the paper main findings are presented as well as possible directions for future research.

1. LITERATURE OVERVIEW

Technical analysis is widely elaborated in finance literature. Behavioral economics and quantitative analysis also use substantial aspects of technical analysis, although according to the weak-form of efficient-market hypothesis, such forecasting methods are valueless, since prices have random walk, which means that are essentially unpredictable (Kirkpatrick and Dahlquist 2006).

The principles of technical analysis derive from the observation of behavior of financial markets over hundreds of years. The oldest known hints of technical analysis appear in Joseph de la Vega's accounts of the Dutch markets in the 17th century (Lo and Hasanhodzic, 2010). In Asia, the oldest example of technical analysis is thought to be a method developed by Homma Munehisa during early 18th century which evolved into the use of candlestick techniques, which is today one of the main charting tool (Murphy 1999).

In the 1920s and 1930s Richard W. Schabacker published several books which continued the work of Dow and William Peter Hamilton in his books Stock Market Theory and Practice and Technical Market Analysis (Nison 1991). In 1948 Edwards and John Magee published Technical Analysis of Stock Trends which is widely considered to be one of the most important works of the discipline (Nison 1994). It is exclusively concerned with trend analysis and chart patterns and remains in use to the present.

Charles Dow is considered by many technicians as a prominent founder of technical analysis. Other pioneers of technical analysis include Ralph Nelson Elliott, William Delbert Gann and Richard Wyckoff who developed their techniques at the beginning of the 20th century. However, with computer development in recent decades, many more technical tools and theories have been established. John J. Murphy has published his book “Technical Analysis of the Futures Markets” in 1986 and it created strong impact on finance industry. His book has been referred to by many technicians as the “Bible” of technical analysis.

Academics such as Eugene Fama say the evidence for technical analysis is sparse and is inconsistent with the weak form of the efficient-market hypothesis (Paulos 2003). Users hold that even if technical analysis cannot predict the future, it helps to identify trading opportunities (Fama 1970). In the foreign exchange markets, its use may be more widespread than fundamental analysis (Schwager 1999).

Technical analysis employs many techniques to identify price patterns and market trends in financial markets and attempt to exploit those patterns for profit opportunities. However, technicians use various methods and tools beside the study of price charts, like supply/demand indicators used to monitor investors' liquidity, margin levels, etc. (Murphy 1999). Other indicators monitor the sentiment of the market - are investors bullish or bearish? Technicians using charts search for price chart patterns, such as head and shoulders or double top/bottom reversal patterns, study technical indicators, moving averages, and try to identify forms such as lines of support, resistance, channels, and more obscure formations such as flags, pennants, balance days and cup and handle patterns (Murphy 1999). Technical analysts also widely use market indicators like mathematical transformations of price, often including up and down volume, advance/decline data and other inputs.

There are many techniques in technical analysis (for example, candlestick charting, Dow Theory, and Elliott wave theory) but many traders combine elements from more than one technique. Some technical analysts also use subjective judgment to decide which pattern(s) are important at a given time, and what the interpretation of that pattern should be.

Technicians also look for relationships between price/volume indices and market indicators as Relative strength index (RSI), and MACD, but also very important are sentiment indicators such as Put/Call ratios, bull/bear ratios, short interest and Implied Volatility, etc. (Irwin and Park 2007). Others use a strictly mechanical or systematic approach to pattern identification and interpretation (Brock, Lakonishok, and LeBaron 1992, Nick 2014). Short explanation of four technical analysis techniques used in our research is presented bellow.

1.1. Moving Average Convergence Divergence (MACD)

Moving average convergence divergence (MACD) is a trend-following momentum indicator that shows the relationship between two moving averages of prices, calculated by subtracting the 26-day exponential moving average (EMA) from the 12-day EMA. A nine-day EMA of the MACD, called the "signal line", is then plotted on top of the MACD, functioning as a trigger for buy and sell signals (Murphy 1999). There are three common methods used to interpret the MACD: first, crossovers, second, divergence and third, dramatic rise.

Concerning crossovers, when the MACD falls below the signal line, it is a bearish signal, which indicates that it may be time to sell. Conversely, when the MACD rises above the signal line, the indicator gives a bullish signal, which suggests that the price of the asset is likely to experience upward momentum. Divergence appeared when the security price diverges from the MACD. It signals the end of the current trend. Finally, when the MACD rises dramatically - that is, the shorter moving average pulls away from the longer-term moving average - it is a signal that the security is overbought and will soon return to normal levels (Brock, Lakonishok, and LeBaron 1992).

1.2. Average Directional Index (ADX)

ADX is used to quantify trend strength while its calculations are based on a moving average of price range expansion over a given period of time. ADX is determined as a single line with values ranging from a low of zero to a high of 100. ADX is non-directional and registers trend strength whether price is trending up or down (Brock, Lakonishok and LeBaron 1992).

ADX values help traders to identify the strongest and most profitable trends to trade. Many traders will use ADX readings above 25 to suggest that the trend's strength is strong enough for trend trading strategies. Conversely, when ADX is below 25, many will avoid trend trading strategies.

The best profits opportunities come from trading during the strongest trends, so the ability to quantify trend strength is crucial for traders.

1.3. Relative Strength Index — RSI

The relative strength index (RSI) is a momentum indicator developed by Welles Wilder, that compares the magnitude of recent gains and losses over a specified time period to measure speed and change of price movements of a security (Lo and Hasanhodzic 2010). It is primarily used to identify overbought or oversold conditions in the trading of an asset.

The RSI provides a relative evaluation of the strength of a security's recent price performance. RSI values range from 0 to 100. The default time frame for comparing up periods to down periods is 14, as in 14 trading days. RSI values of 70 or above is a signal that a security is becoming overbought or overvalued, and therefore may be primed for a trend reversal or corrective pullback in price. On the other side of RSI values, an RSI reading of 30 or below is commonly interpreted as indicating an oversold or undervalued condition that may signal a trend change or corrective price reversal to the upside (Brock, Lakonishok, and LeBaron 1992).

Some traders, in an attempt to avoid false signals from the RSI, use more extreme RSI values as buy or sell signals, such as RSI readings above 80 to indicate overbought conditions and RSI readings below 20 to indicate oversold conditions.

1.4. Stochastic Oscillator

The stochastic oscillator is technical analysis techniques created by George Lane and is a momentum metrics for prediction of potential reversals. Instead of measuring price or volume, the stochastic oscillator compares the most recent closing price to the range for a given period, usually for 14 days, though this can be adjusted to meet specific analytical needs. The stochastic oscillator varies between 0 and 100 and is a useful indicator of overbought and oversold conditions. Readings over 80 are considered in the overbought range, and readings under 20 are considered oversold. However, these are not always indicative of impending reversal; very strong trends can maintain overbought or oversold conditions for an extended period. Instead, traders should look to changes in the stochastic oscillator for clues about future trend shifts (Brock, Lakonishok, and LeBaron 1992).

Stochastic oscillator charting generally consists of two lines: one reflecting the actual value of the oscillator for each session, and one reflecting its three-day simple moving average. Because price is thought to follow momentum, intersection of these two lines is considered to be a signal that a reversal may be in the works, as it indicates a large shift in momentum from day to day (Brock, Lakonishok, and LeBaron 1992).

2. TECHNICAL ANALYSIS OF MPT, ALK AND KB STOCKS

We provide technical analysis of three most liquid stocks traded at MSE and included in MBI-10. Technical analysis of MPT, ALK and KMB stocks were performed in June 2010 and analyze monthly and weekly data for the period from 2005 to 2010, as well as daily price movements from 2009 to 2010. The basic idea is to check effectiveness of technical analysis predictions for securities price future movements. In order to do that, we compare technical analyses' forecasts for market outlook with actual stock price movements in period of one year after predictions were issued.

We present complete technical analysis performed with four different technical analysis techniques for one stock (ALK), while for other two securities we give only resume of predictions.

2.1. Technical analyses of ALK stock

Technical analysis of ALK stock was performed using historical data for the period from August 2005 to June 2010.

Weekly chart presented on Figure 1 is showing ALK stock prices for the period from August 2005 to July 2010. We notice that ALK stocks have continuous upward trend from March 2005 to February 2006, with small retracements from July 2006 to December 2006, when bullish trend was formed that continue until December 2007. Than MACD falls below the signal line and confirmed crossovers that pull the prices down. In this moment (June 2010) prices are in similar condition that means after period of short upward movement they have retraced on previous level.

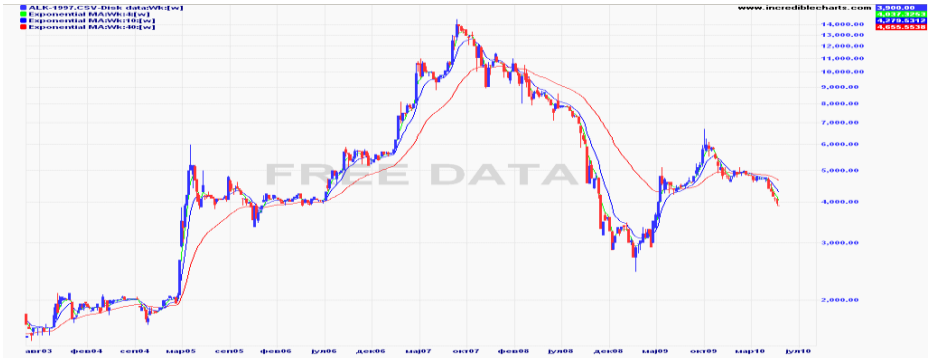

Figure 1. Weekly chart of ALK stock price movements

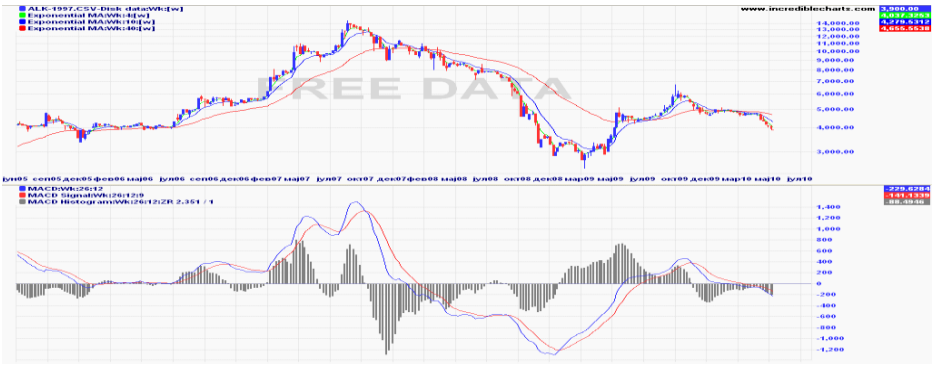

Figure 2. MACD Weekly and MACD Histogram

Using information from MACD weekly chart (Fig.2), we can notice that most characteristic signals of bearish crossovers were formed in period October and December 2007 with aggressive negative divergence, that pull the prices on very low level. During January 2009 bullish crossovers happened and prices experienced upward momentum. Chart data and histogram indicates condition of negative divergence in this moment (June 2010).

On the following Figure 3 we can see ALK daily data for the period June 2009 - June 2010. Here we can notice in details what happened with ALK stock prices. Securities prices uptrend were broken as a result of bearish crossovers of moving averages that happened in the middle of October 2009 and stock prices started to move down.

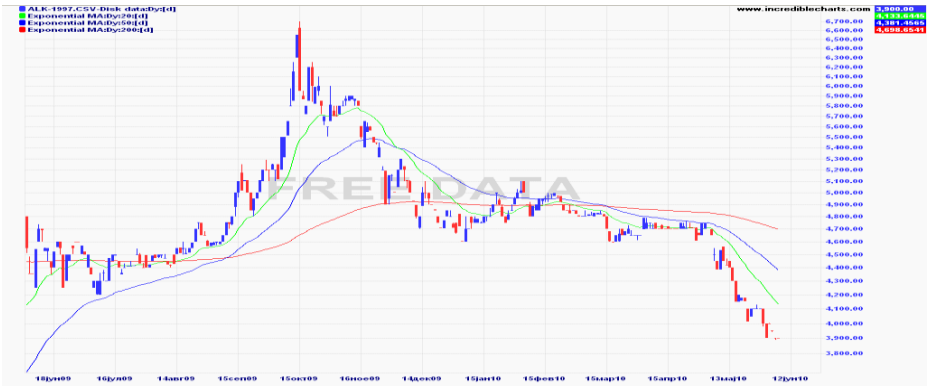

Figure 3. ALK Daily chart

This downtrend continued until the moment of bullish crossovers and ALK stock prices experience upward momentum as it is shown on Figure 4.

Figure 4. MACD (daily) and MACD histogram

MACD chart and histogram indicates that security positively diverges from the MACD, that signals possibility for stock price rise in following months.

Figure 1. RSI

RSI calculation based on daily price movements identified that in October 2009, ALK stocks were overvalued, due to the fact that RSI value was above 70 (level that indicate that stock is becoming overvalued). As already explained, buy signals usually appeared when RSI has value under 70, and after that reverse in previous position (as it was case with ALK stocks). The state of "pure price oversold" was identified in November 2009 and once again in March 2010. It was confirmed, when the peaks of negative divergence happened twice, during March and April 2010.

However, technical analysis with RSI technique identify that RSI momentum indicator is generally in state of bullish divergence and is interpret as buy signal.

In accordance with Stochastic Oscillator that compares the most recent closing price to the range for a given period, as shown on the following Figure 6, we notice that generally Alkaloid stocks were oversold/ undervalued during the period December 2009-Jun 2010.

Figure 6. Stochastic oscillator

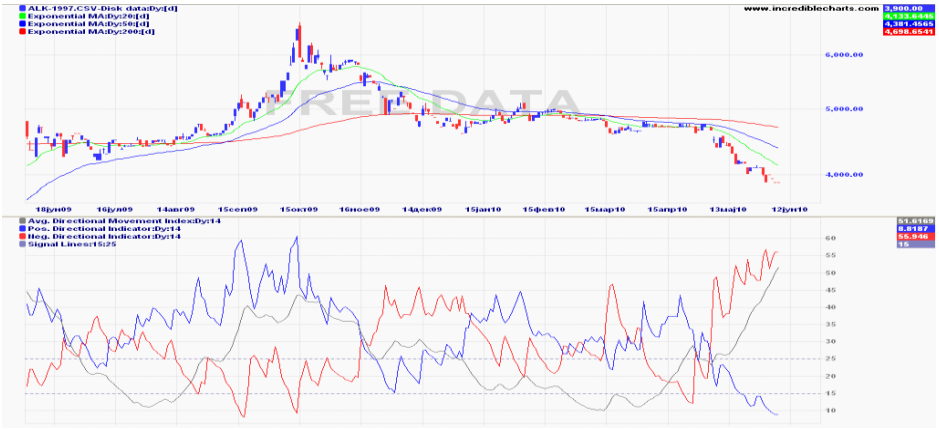

Figure 7.2 ADX

The average directional index (ADX) is indicator that shows trend's strength, and for ALK as it can be seen on Figure 7, it is neutral, or market is without trend, due to the fact that conditions of positive and negative trend were almost equal. In the period of September-October 2009 we notice that market has strong trend, which is confirmed by signal line, but in period November-December 2009 as well May–June 2010 we have reversal trend and signal line indicates that "market has lost its direction".

Resume for ALK stock for period September 2003–July 2010: In accordance with MACD, ALK stock is generally in phase of bullish crossovers, which is positive divergence and indicates possibility for price rise in the future. This conclusion can be drawn both from weekly and daily MACD.

RSI indicates that security is in condition of bullish divergence and confirms forecast for stock upward momentum.

Stochastic oscillator indicates that stock is in condition of oversold while trading volume remains same intensity, and stock price rises can be expected.

ADX signal for ALK stocks is neutral.

In accordance with all information gathered with technical analyses for ALK stocks on date 15.06.2010, recommendation is **BUY**.

2.2. Technical Analysis of MPT stock

Technical analysis of MPT stock was performed using historical data for the period from August 2005 to June 2010. We used MACD weekly and daily, RSI, Stochastic oscillator and ADX and summary of technical analysis predictions and recommendations for MPT security is presented in resume.

Resume for MPT stock for period September 2005–June 2010: In accordance with MACD, MPT stock is generally in phase of bullish crossovers, which is positive divergence and means possibility for price rise in the future. This prediction can be drawn both from weekly and daily MACD.

RSI indicates that stock is in condition of bullish divergence.

Stochastic oscillator indicates that stock is in condition of oversold and trading volume remains same intensity, and stock price rises can be expected.

ADX does not give clear signal, or ADX signal for MPT stock is weak.

In accordance with all information gathered with technical analyses for MPT stock on date 15.06.2010, recommendation for traders is **HOLD**, due to the fact that all technical analysis' indicators indicate possible price rise in future and increased profit opportunities.

2.3. Technical analysis of KB stock

Technical analysis of KMB stock was performed using historical data for the period from April 2005 to June 2010. We used MACD weekly and daily, RSI, Stochastic oscillator and ADX. Compared with previously two analyzed stocks, KB stocks did not have significant fluctuations which could not be considered as negative characteristics.

Technical analysis predictions and recommendations are given as summary in resume.

Resume for KB stock for period September 2005–June 2010: In accordance with MACD, KB stock is generally in phase of bullish (positive) divergence, which means possibility for price rise in the future. This prediction can be drawn both from weekly and daily MACD.

RSI is neutral which means that there is no condition of overbought or oversold.

Stochastic oscillator indicates that stock is in condition of overbought while trading volume remains same intensity, and stock price can experience uptrend.

ADX does not give clear signal that negative divergence can be formed.

In accordance with all information gathered with technical analyses for KB stocks on date 15.06.2010, recommendation for traders is **BUY**, due to the fact that all technical analysis' indicators indicate possible uptrend and increased profit opportunities.

3. TESTING TECHNICAL ANALYSIS ACCURACY AT MSE

The main task of our paper is to test accuracy of technical analysis for future stock price forecasting at MSE, so after providing technical analysis for the three most liquid stocks traded at MSE, we compare technical analyses' forecasts for market outlook with actual stock price movements in period of one year after predictions were issued.

Using daily stock price data for the period June 2010–June 2011 presented on following charts we compare technical analysis prediction with actual price movements.

Technical analyses recommendation for ALK stock issued at 15.06.2010 was BUY. We can notice that ALK security experienced strong upward momentum and reach even 22% of price increase compared with opening price at the start of analyzed period (maximum ALK price of 4.553 MKD) as presented on following Figure 8:

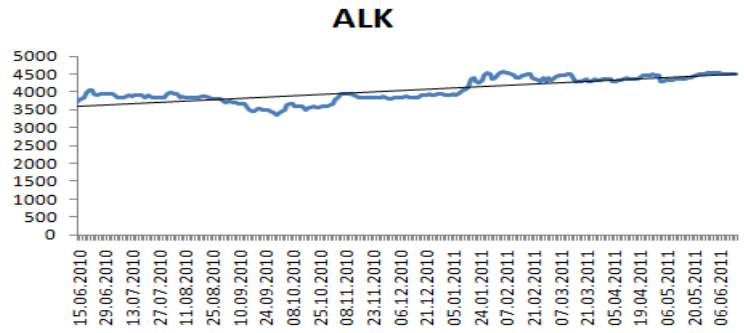

Figure 8.3 ALK daily stock prices June 2010–June 2011

Short analysis of ALK security price movements is presented on Table 1 as follows:

Table 1. Data for ALK stock for 52 weeks (10.06.2010–09.06.2011) in MKD

Price	Values
Opening price 10.06.2010	3.726
Closing price 09.06.2011	4.497
Minimal price	3.337
Maximum price	4.553
Average price	4.048

We can notice that ALK security has strong uptrend with limited retracements experienced during September-October 2010. This confirms technical analysis accuracy and forecasting capacity for ALK stock for analyzed period.

We proceed with our analysis with MPT stock and present daily stock price movements for 52 weeks on following Figure 9.

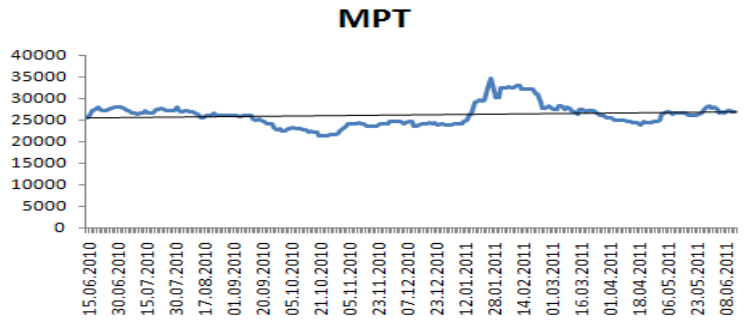

Figure 9. MPT daily stock prices June 2010–June 2011

Technical analyses recommendation for MPT stock issued at 15.06.2010 was **HOLD**, due to the fact that all technical analysis' indicators indicate possible price rise in future and increased profit opportunities.

We can notice from the previous chart that MPT security experienced generally moderate uptrend with positive peaks during January and February 2011, when MPT price reached over 34.000 MKD and small retracement below the trend line from September 2010 to November 2010, when minimal price was around 21.000 MKD. We present summary for MPT data on following Table2.

Table 2. Data for MPT stock for 52 weeks (10.06.2010–09.06.2011) in MKD

Prices	Values
Opening price 10.06.2010	26.200
Closing price 09.06.2011	27.000
Minimal price	21.151
Maximum price	34.655
Average price	26.052

This confirms technical analysis accuracy and forecasting capacity for MPT stock for analyzed period.

Technical analyses for KB stocks at 15.06.2010 recommended to BUY, due to the fact that all technical analysis' indicators indicate possible uptrend and increased profit opportunities.

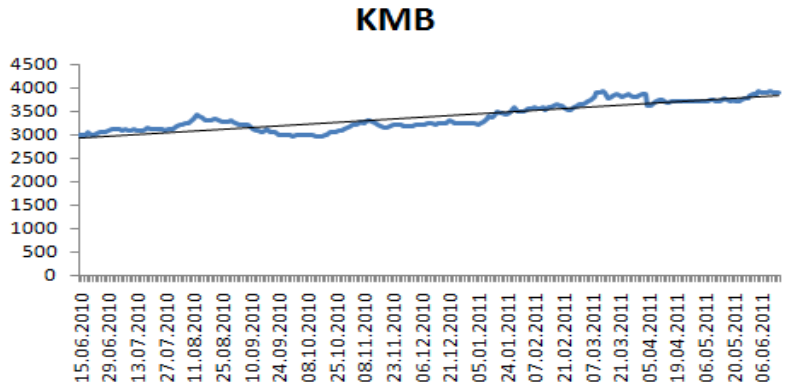

Figure 10. KMB daily stock prices June 2010**–**June 2011

We can notice that KMB security experienced strong upward trend and continuous price rise during analyzed 52 weeks. KMB average price in that period is 12% higher than opening price at the beginning of analyzed period, while maximum price reach even 31% increase.

Short analysis of KMB historical data are presented on following Table 3.

Table 1. Data for KMB stock for 52 weeks (10.06.2010–09.06.2011) in MKD

Prices	Values
Opening price 10.06.2010	2.994
Closing price 09.06.2011	3.900
Minimal price	2.942
Maximum price	3.931
Average price	3.379

This confirms technical analysis accuracy and forecasting capacity for KMB stock for analyzed period.

Based on results of our analysis we argue that technical analysis is reliable tool for MSE stock forecasting. Technical analysis predictions for three MSE securities were confirmed within analyzed one year period. This finding confirms reliability and accuracy for practical use of technical analysis as tool for forecasting stock prices movements at MSE. We did not find any notable differences in accuracy of use of technical analysis between stocks at MSE as well as notable differences in accuracy between different technical analysis techniques at MSE.

CONCLUSION

Technical analysis is widely used tool among traders and financial professionals but it was widely not very popular and accepted by academics. Although modern studies found it reliable and accurate, many of the results were treated dubious so that the evidence in support of technical analysis was inconclusive.

Technical analysis has been studied mainly with respect to the developed stock markets in industrial countries. On the other side, there is limited number of studies for emerging markets. MSE was not previously considered in the technical analysis literature.

On the other side, our information indicate that security dealers and analysts at MSE prefer more fundamental analysis, due to the fact that fundamental parameters allow comprehensively to determine operative and financial capacities of the firms and hence to determine trend.

Situation is different at the foreign exchange markets, where technical analysis use is more widespread than fundamental analysis. This due on its relatively easy use and possibility to provide fast recommendation, which is necessary on the market where trends have to be determined in limited time framework and where trading multitude is high. This does not mean technical analysis is more applicable to foreign exchange markets, but that technical analysis is more recognized there as to its efficacy there than elsewhere (Taylor and Allen 1992).

The main task of our paper is to test effectiveness of technical analysis for future stock price forecasting at Macedonian Stock Exchange (MSE) in order to fill the gap in the literature and provide evidences that can encourage security dealers to use it regularly. We have tested accuracy of technical analysis of three most liquid stocks traded at MSE and included in MBI-10. Technical analysis for MPT, ALK and KMB securities was performed and its recommendation were issued in June 2010, based on monthly and weekly data for the six years period from 2005 to 2010, as well as daily

price movements from 2009 to 2010. Finally, we compare technical analyses' forecasts for market outlook with actual stock price movements in period of one year after predictions were issued, from June 2010 to June 2011.

We find that technical analysis is reliable tool for MSE stock forecasting. Technical analysis predictions for three MSE securities were confirmed by actual stock price movements within one year period (June 2010–June 2011). This finding confirms reliability and accuracy for practical use of technical analysis as tool for forecasting stock prices movements at MSE. We did not find any notable differences in accuracy of use of technical analysis between stocks at MSE as well as notable differences in accuracy between different technical analysis techniques at MSE. Finally, we can conclude that if technical analysis cannot always predict the future, it helps to identify trading opportunities. So, it confirms its effectiveness of its use on MSE.

This study outlines directions for future researches that could be investigated to improve the forecasting of price movements for the Macedonian stock market securities. Due to the fact that we use limited data and time series of stock prices (2005−2010) and compare with actual securities movements for one year, longer time series would allow estimation with greater precision.

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