



Full length article

## Trading System based on the use of technical analysis: A computational experiment<sup>☆</sup>



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### ABSTRACT

Previous studies highlight the influence of methods of technical analysis in the search for exceptional gains in the context of the financial market. Based on this scenario, the main objective of this paper is to analyze the performance of the Simple Moving Average, Exponential Moving Average, MACD and Triple Screen techniques in an actual trading system that included 198 stocks traded in the Brazilian. This paper studies the power of predictability of such methods using various combinations of periods, brokerage fees and a policy of Stop-Loss and compares these with the buy-and-hold strategy. The results indicate that while the studied techniques lead to a high probability of obtaining a return that exceeds the investment value, they have little power of predictability in the Brazilian market. In relation to the passive buy strategy, only the smallest part of the obtained returns outweighs the results of the buy-and-hold strategy.

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### 1. Introduction

Technical Analysis (TA) involves an attempt to predict the movement of future asset prices based on an analysis of past prices using qualitative methods, such as graphic analysis, quantitative methods, such as Moving Averages (MA), or a combination of both (Menkhoff and Taylor, 2007; Gençay, 1998, p. 937, p. 347). To measure the presence of the TA in the market, Taylor and Allen (1992) conducted a survey in British agencies and concluded that at least 90% of the respondents benefit from TA tools when making decisions related to their portfolios. Studies such as those of Fabozzi et al. (2007), Menkhoff and Taylor (2007), Marshall et al. (2008), Hsu et al. (2010),

and Menkhoff (2010) also found that TA has a large influence in the financial market. However, there are few studies regarding indicators related to TA in the academic arena (Teixeira and Oliveira, 2010, p. 6886).

Although the importance of TA in the current scenario is clear, according to Ming-Ming and Siok-Hwa (2006, p. 145), there is no consensus regarding the effectiveness of TA tools. Furthermore, few studies have attempted to investigate the results of these techniques or systems in emerging markets such as Brazil, even though, according to Chang et al. (2004, p. 295), such a market can be considered as a good alternative for investors who seek to diversify their portfolios.

From a practical perspective, autonomous asset trading programs are transforming the major stock markets in electronic financial markets (Creamer and Freund, 2010, p. 401). Thus, it is important to note that, according to Austin et al. (2004, p. 37), with the development of new computational techniques and newly available data, the construction and use of the Trading System (TS) has become increasingly more plausible. A TS can be briefly

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defined as a set of rules that define necessary conditions to start or exit a negotiation (Chande, 2001, p. 3).

Within this context, the main objective of this paper is to analyze the performance of a TS based on Simple Moving Average techniques (SMA), Exponential Moving Average (EMA), Moving Average Convergence Divergence (MACD) and Triple Screen in 198 stocks traded in the Brazilian stock market from January 2000 to February 2014, noting various combinations of periods, brokerage fees and a Stop-Loss mechanism. More specifically, this paper aims to study the following aspects:

1. Which TA tool performs best?
2. What is the influence of brokerage fees on the performance of TA methods?
3. What is the impact of the Stop-Loss mechanism on operations?
4. Upon observing a wide range of results, which of the TA methods are capable of overcoming the buy-and-hold strategy?

We posit that the main results of this work contribute to or advance the discussions about the effectiveness of TA tools and about the automated systems with respect to the predictability of the behavior of prices or returns, which according to Campbell et al. (1997, p. 27), is one of the main issues in financial econometrics:

*'ONE OF THE EARLIEST and most enduring questions of financial econometrics is whether financial asset prices are forecastable. Perhaps because of the obvious analogy between financial investments and games of chance, mathematical models of asset prices have an unusually rich history that predates virtually every other aspect of economic analysis. The fact that many prominent mathematicians and scientists have applied their considerable skills to forecasting financial securities prices is a testament to the fascination and the challenges of this problem.'*

Campbell et al. (1997, p. 27).

This paper is structured as follows. The second section presents a brief description regarding the concepts of TA and a brief historical contextualization of the topic. The third section is devoted to the presentation of the methods and the computational model used in the experiment, while the fourth section presents the results. The fifth section highlights the main conclusions of the study.

## 2. Theoretical reference

The technical analyst uses past prices and other statistics when making investment decisions, believing that past data contain important information about future stock market behavior (Zhu and Zhou, 2009, p. 519). Accordingly, Murphy (1999, p. 3) defines the three assumptions underlying the precepts of TA described below:

1. Prices reflect market events;
2. Changes in the prices move in trends; and
3. Historical prices tend to repeat.

On a historical scope, although the TA has gained prominence with the work of Charles Dow in 1884 and William Peter Hamilton in 1900 and in the Wall Street Journal (Vanstone and Finnie, 2009, p. 6671), Cowles (1933) is considered one of the first empirical studies in the area of TA published in a specialized scientific journal. In this article, the result of an analysis of effort prediction of 45 professional agencies in selecting specific stocks that could provide higher than average market return results is presented. The results show that the average income of agency forecasts was 4% below the overall market average.

Important studies have discussed the power of predictability of the market. Papers such as Alexander (1961), Fama and Blume (1966) and Levy (1967) demonstrate the presence of the random walk in the markets analyzed in their respective articles. In short, the random walk is an assumption that involves the Efficient Market Hypothesis (EMH). In this context, Fama (1991) states that the EMH assumes that asset prices reflect all available market information and follow a random behavior. Adding to the discussion, Fama and Blume (1966, p. 226) claim that successive price changes are independent, that is, follow the theory of random walk. This independence implies that the historical series of changes in the price of an asset may not be used to predict future movements in the value of the asset in any path in a significant way.

After the publication of these studies, the EMH was considered the theory that governs the movement of stock prices (Zhu and Zhou, 2009, p. 521). However, later influential studies gave greater value to TA in the academic arena. Rejecting the theory of random walk with the use of weekly stock returns based on a simple test of volatility specified, the study of Lo and MacKinlay (1988) is considered one of the major works in the area of TA. Thus, to investigate the predictive capacity of the market, the article of Brock et al. (1992), one of the influential studies, used the popular strategies of TA, specifically, Moving Averages (MA) and the Trading-Range Breaks techniques, on the Dow Jones Industrial Average from 1897 to 1986. Excessive returns and the evident power of predictability of the method used in relation to the market studied by the authors have resulted in increased credibility of the TA.

Proof of the great influence of the study of Brock et al. (1992) is the wide replication of his method by several researchers, such as, Parisi and Vasquez (2000), Kwon and Kish (2002) and Chang et al. (2004) in different markets. Among these replications is the study of Hudson et al. (1996), which used as a sample the British stock market for the period 1935 to 1994. Such research, whose method used resulted in excessive returns in relation to the considered market, is widespread in academic studies of price behavior, thus contributing to the acceptance of TA in the study of financial markets.

The purpose of MAs, techniques that are based on the works of Brock et al. (1992) and Hudson et al. (1996), is to identify or signal that a new trend has started or an old one has finished (Murphy, 1999, p. 197). Regarding this issue, Zhu and Zhou (2009, p. 521) contend that these are the most popular and simple existing techniques. Therefore, the MMs were applied in the context of emerging markets in prominent studies, such as Gunasekarage and Power

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