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Do small caps generate above average returns in the Brazilian stock market?☆

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Abstract

Some studies suggest that low capitalization stocks have great potential to provide returns above the market average, although some indicate that investment in small caps should be avoided, since they are market anomalies with low liquidity. This article develops a method based on an automated trading system (ATS) applied to the Brazilian stock market, and investigates the relevance of small caps to the investor. The study indicates that, in the case of the Brazilian stock exchange, although there is a possibility of high returns the profitability of technical analysis of small caps is similar to strategies using blue chips.

JEL classification: G11; G15; G17

Keywords: Small caps; Technical analysis; Brazilian stock market; Moving averages

1. Introduction

The Brazilian stock market is very concentrated, with low average liquidity of the traded assets. Only a small number of firms have publicly traded stocks, and a large percentage of the assets is not negotiated frequently. Considering these peculiar characteristics, this study analyses whether trading strategies with low capitalization and reduced liquidity assets in the Brazilian market can generate benefits to the investor, allowing the structuring of higher return portfolios. Although focused on the Brazilian market, the study contributes to evaluating whether emerging market low capitalization assets may be interesting to diversify the portfolios of international investors.

This analysis of small caps in the Brazilian market could suggest opportunities for investors. Small caps are companies with shares traded in the stock market, whose issuers have a low degree of capitalization. Some authors consider that small caps outperform high capitalization assets in emerging countries (Noakes and Rajaratnam, 2014) as well as in developed countries (Shynkevich, 2012). However, the superior performance of low capitalization assets, when compared to medium and high liquidity assets, is not always corroborated by the studies. For example, Sandoval (2015) does not reject the hypothesis that the returns obtained with small caps in emerging markets are equal to the returns obtained with other assets. The author points out that the influence of the level of capitalization on the expected return is only significant for equity markets in developed countries.

Considering the contradictory empirical results in the literature, our work investigates the performance of small caps compared to large caps, that is, companies with a high level of capitalization and that present greater dynamics and liquidity in the market. For the study, we used traditional technical analysis (TA) indicators, due to the high degree of diffusion of these trading mechanisms among investors.

In this context, Nison (1991, p. 10) justifies the importance of understanding TA, since it can be the very reason for the market to move in certain directions, given its enormous degree of use. Moreover, Frankel and Froot (1986) and Shiller (1989) point out that the use of strategies suggested by TA entails an over-

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valuation of asset prices, making the demand for some assets artificially high, without necessarily having a specific real reason.

Nison (1991, p. 9) also emphasizes that the emotions of agents may exert great influence on market dynamics, as highlighted by Keynes (1936). Moreover, the author emphasizes that TA may have advantages over fundamental analysis (FA), which is based on the microeconomic and structural aspects of firms and on macroeconomic variables. More specifically, TA allows one to capture irrational elements of the markets, which may differ from analysis based solely on rational relationships.

The objective of this study is to evaluate the performance of strategies using moving averages, which are extremely widespread indicators among TA practitioners. We investigate trading strategies with small caps assets from the Brazilian stock market. As for the effectiveness of technical indicators for small businesses in the United States, Shynkevich (2012, p. 194) identifies a positive and statistically significant performance using data from 1995 to 2002, even when considering transaction costs. However, with data from 2003 to 2010, the author finds that a static buy and hold strategy was consistently better for portfolios with small caps.

Considering that Brazil is a prominent emerging country in the global context, it is relevant to study small caps in environments with less developed capital markets. Moreover, according to Chang et al. (2004, p. 295), capital inflows to developing countries are relevant, which may represent, for foreign investors, opportunities to generate portfolios with higher returns when compared to investments in developed countries.

The assumption underlying TA is that past prices can be used to anticipate future prices, contrary to the efficient markets hypothesis (EMH). Thus, this study aimed to analyse the performance of TA in an environment that should be less efficient, as it is the case of small cap companies traded in a stock market of an emerging country.

In this paper, we use an automated trading system (ATS), which consists of the automation of negotiations based on historical patterns verified in the data. We specifically take into account the crossovers of moving averages of prices of the traded assets. The study analyses and compares the performance of two sets of portfolios consisting of assets traded on the São Paulo Stock Exchange (BM&FBOVESPA), using data between 2007 and 2016. The sets of portfolios are distinguished by the presence or absence of small caps, since the objective of the article is to study the profitability of these specific stocks.

The paper is structured as follows: Section 2 familiarizes the reader with the concepts and results of the research on small caps and briefly discusses the fundamentals of TA; Section 3 discusses the method used in our study and details the algorithm that implements the ATS; Section 4 presents the main results of the paper and draws attention to the importance of these results for the literature.

2. Theoretical background

The level of capitalization of participating companies in a given financial market is heterogeneous. Considering firms financed from the capital markets, there are those with level degrees of capitalization, called blue chips and those with medium capitalization and small caps, which are stocks related to low capitalization firms.

According to Menkveld and Wang (2013, p. 1), small caps usually have low liquidity that, as indicated by Acharya and Pedersen (2005, p. 378), implies a higher cost of capital to attract investors. In addition, Acharya and Pedersen (2005, p. 378) also highlight the risk associated with the difficulty of selling low-capitalization stocks in bearish markets.

Due to the peculiar characteristics of this type of stock, small caps can be associated with anomalies or inefficiencies in the market. However, Guidolin and Nicodano (2008, pp. 1–2) emphasize the high risk premium paid by small caps and the important role played by these assets in the diversification of a portfolio.

Hu and Li (1998) explore whether macroeconomic issues, such as changes in government and in monetary policy, differently affect the movement of assets with different capitalization levels. The results suggest that the size of a firm influences the way its assets are impacted by risk factors. In addition, the movement of small caps can also be explained by the very fact that they have low capitalization. This result is also supported for unemployment shocks, as studied by Hu and Li (1998).

The small caps market can be understood as a subcategory of the whole stock market, but with fewer participants, since these assets generate less interest for the traditional investor. However, as suggested by Guidolin and Nicodano (2008, p. 4), the demand for small caps is expected to be more stable in different regimes or market situations.

Small caps can hinder the market's attempts to achieve efficiency, as described by Malkiel and Fama (1970), since the trading of low capitalization stocks can be seen as an anomaly (Banz, 1981; Menkveld and Wang, 2013; Reinganum, 1981). However, assuming that the number of publicly traded firms in the market is dynamic, it is expected that there will always be small caps. Banz (1981) and Reinganum (1981) suggest that small caps perform better than blue chips for larger time windows between buying and selling an asset.

Ang et al. (2004) obtain a significant negative relation between risk and return, which is counterintuitive. However, Bali and Cakici (2008) attribute this evidence to the fact that in the analysis by Ang et al. (2004) have included small caps.

Switzer (2010) analyses the performance of small caps and blue chips in the US and Canadian stock markets, focusing on the stage of the business cycle of the economy. The author finds that in recessions the evidence on the relationship between risk and return is mixed and inconclusive for both small caps and large caps. In the transition from a valley (local level of lower economic activity) to a peak (local stage of high activity of the economy) low capitalization assets presented a much more satisfactory performance (Switzer, 2010).

Few studies, however, evaluate the performance of TA for portfolios with low capitalization assets, more particularly regarding the generation of buying and selling signals from the crossovers of moving averages. Given that Brazil is an emerging country and that it seems, compared to developed economies,

a less efficient capital market, the trading of small caps may constitute an opportunity for investors to obtain above average profits using ATSs that explore TA strategies.

Recent empirical evidence using South African data suggests that the level of capitalization of traded assets in a country is inversely related to market inefficiency (Noakes and Rajaratnam, 2014). Moreover, the authors suggest that the degree of market efficiency falls during periods of crisis, such as during the financial crisis of 2008.

Costa et al. (2015) analyse the effectiveness of the TA indicators for the Brazilian asset market and identified a low prediction accuracy. However, the use of simple and exponential moving averages and moving average convergence divergence (MACD) indicators may convey strategies that have a high chance of leading to above average returns.

The basic principle underlying TA is associated with the rejection of the EMH. Malkiel and Fama (1970, p. 383) indicate that with the increase in the efficiency of a market, past prices have less explanatory power to forecast future market movements. Thus, taking into account the EMH, consistent profitability of TA could be considered an evidence of market inefficiency.

The use of TA is usually supported by the rejection of the random walk of prices hypothesis, as indicated by Lo and MacKinlay (1987, pp. 87–88). Under this condition, the historical trading price of an asset is relevant for making predictions about future behaviour and may therefore reveal opportunities for profit from past observations of financial market movements. In a more economical sense, Jensen (1978, p. 97) considers a market to be efficient when the expected economic profit is zero, when marginal benefit equals the marginal cost of trading based on the publicly available information.

Not all references in the literature consider that TA is a valid strategy, for example, the studies of Allen and Taylor (1990), Frankel and Froot (1986), Jegadeesh (2000), Kuang et al. (2014), and Shiller (1989). For some authors, TA is the essence of data mining, that is, exploration of data in order to draw conclusions from the past behaviours of the variables, without a minimal scientific basis. In addition, Allen and Taylor (1990) highlight the subjective nature of TA. According to Zhu and Zhou (2009), the credibility of the methods of TA is questionable due to the inconclusive results obtained by previous studies about its profitability and the lack of scientific theory to support empirical results.

In TA, prices are assumed to be determined by the balance between supply and demand of the asset, capturing all relevant aspects that could be stressed by FA (Nison, 1991, pp. 8–11). Whereas TA focuses on historical prices to forecast future prices, FA, according to Lui and Mole (1998), turns to microeconomic aspects of firms and macroeconomic fundamentals of a country (Allen and Taylor, 1990) to justify past movements and predict fluctuations.

For TA, any events that focus on the supply and demand of an asset generate a new equilibrium in the market and, consequently, a new price level. Thus, the value of an asset in the stock market is a sufficient variable to understand the structure of the markets. Lo et al. (2000, pp. 1753–1764) suggest that TA benefits from the automation provided by computerized trading systems, especially the identification of visual patterns in the series of historical asset prices.

Ellis and Parbery (2005) suggest that the use of moving averages in the generation of buy and sell signals is based on a mechanism to identify price trends. Whereas the short moving average is more sensitive to price changes, the long moving average captures medium and long term trends. TA is extensively used by investors all over the world and the most commonly used indicators are moving averages, due to their simplicity of understanding and easiness of application (Sobreiro et al., 2016, p. 89).

Sobreiro et al. (2016, p. 89) also present a convenient representation, widely disseminated in the literature, for the computation of moving averages. Let k be the number of periods of the moving averages, p_t the observation of the closing price at time t and $n \geq k$ the period from which the k previous values will used to calculate the averages. A simple moving average (SMA) is defined as:

$$SMA_n := \frac{1}{k} \cdot \sum_{t=n-k+1}^{n} p_t. \tag{1}$$

Using the same notation, the exponential moving average, denoted by EMA, is given by:

$$EMA_n := \left(\frac{2}{k+1}\right) \cdot p_{t-1} + \left(1 + \left(\frac{2}{k+1}\right)\right) \cdot EMA_{n-1}. \tag{2}$$

3. Method and data

In our study, the generation of buy and sell signals from the crossover of two moving averages was derived from historical price series, which aimed to identify high and low trends, as Appel (2005) suggests. Moving averages are TA techniques widely used by analysts. To simulate the trading of assets from the generated signals, an algorithm was structured, and an ATS was programmed in the R language that compared small caps and blue chips. The flowchart of the ATS execution is summarized in the pseudocode below (Algorithm 1):

Algorithm 1 is performed for each class of crossover of moving averages and for thirty small caps portfolios and thirty blue chip portfolios. The input data of the ATS are tables containing the historical closing prices of the assets and the set of parameters, which includes the moving average specification, the range of each moving average and the initial capital to be invested. Following Ellis and Parbery (2005), the buy signal is generated when the short-term moving average becomes larger than the long-term moving average and the sell signal is issued as soon as the short-term moving average becomes smaller than the long-term moving average.

The implementation of the algorithm can be done in a simple way, although the execution of the procedure is more complex. The algorithm detects graphical patterns in the price series (Alexander, 1961; Reitz, 2006) and generates signals to invest an

Table 1
Standard transaction costs from BM&FBovespa.

Trading amount (R$)	Brokerage fee (percentage)	Brokerage fee (additional amount) (R$)
0.00–135.07	0.00%	2.70
135.07–498.62	2.00%	0.00
498.62–1514.69	1.50%	2.49
1514.69–3.029,38	1.00%	10.06
>3029.38	0.50%	25.21

equal amount of capital for each purchase order for each stock. In this case, the investment of US$ 10,000 was standardized in each portfolio comprised of a single asset.

The data used in our study are daily closing prices of the Brazilian stock market between 2007 and 2016. From these data, we compared the average profitability obtained from individually trading 30 small caps and 30 blue chips. In other words, the average profitability was calculated for 30 portfolios, each composed of one low capitalization asset. The values obtained in each transaction are reinvested in the portfolio that starts from the initial capital of US$ 10,000. Subsequently, the average profitability was calculated for another 30 portfolios, each composed of on large cap asset.

We analyse three categories of moving average crossovers, according to the definitions in Eq. (1 and 2): SMA-SMA, SMA-EMA, and EMA-EMA. In each category, groups of moving average combinations were used with different time horizons: the short-term moving average window ranges from 10 to 30 days and the long-term moving average window ranges from 100 to 130 days. These windows for the moving averages were selected mainly in order to identify whether, on average, strategies using small caps lead to higher returns in comparison to strategies using stocks of companies with greater levels of capitalization. Additionally, we study how the performance of the portfolios behaves with greater variation of the long-term moving average, which captures longer term trends.

Finally, for each category of combination of moving averages, two simulations were made: the first disregards any transaction costs incurred by the investor and the other considers costs based on Table 1 that represent the transaction costs in the Brazilian stock market. All transaction costs in Brazilian currency (BRL) are translated to dollar amounts.

4. Results and discussion

The final result of Algorithm 1 can be seen in Figs. 1 and 2 that depict the average dollar value obtained with the 30 portfolios following the strategy of crossing a given short-term moving average with another specific long-term moving average. To exemplify the results obtained, 12 graphs were drawn: six for small caps and six for large caps. All graphs are shown in Figs. 1 and 2.

From the analysis of the graphs, we can identify a consistent range that leads to well above average returns for a group of long moving averages in the approximate interval of 100–107 days, regardless of the short-term moving average used, since the yellow band extends over almost the entire axis of short-term moving averages. This result not only indicates that for the Brazilian stock market there is no relevant distinction between the investor applying in low capitalization or high capitalization assets, but also suggests that the strategy of crossing long-term moving averages in the range [100,107] with short-term moving

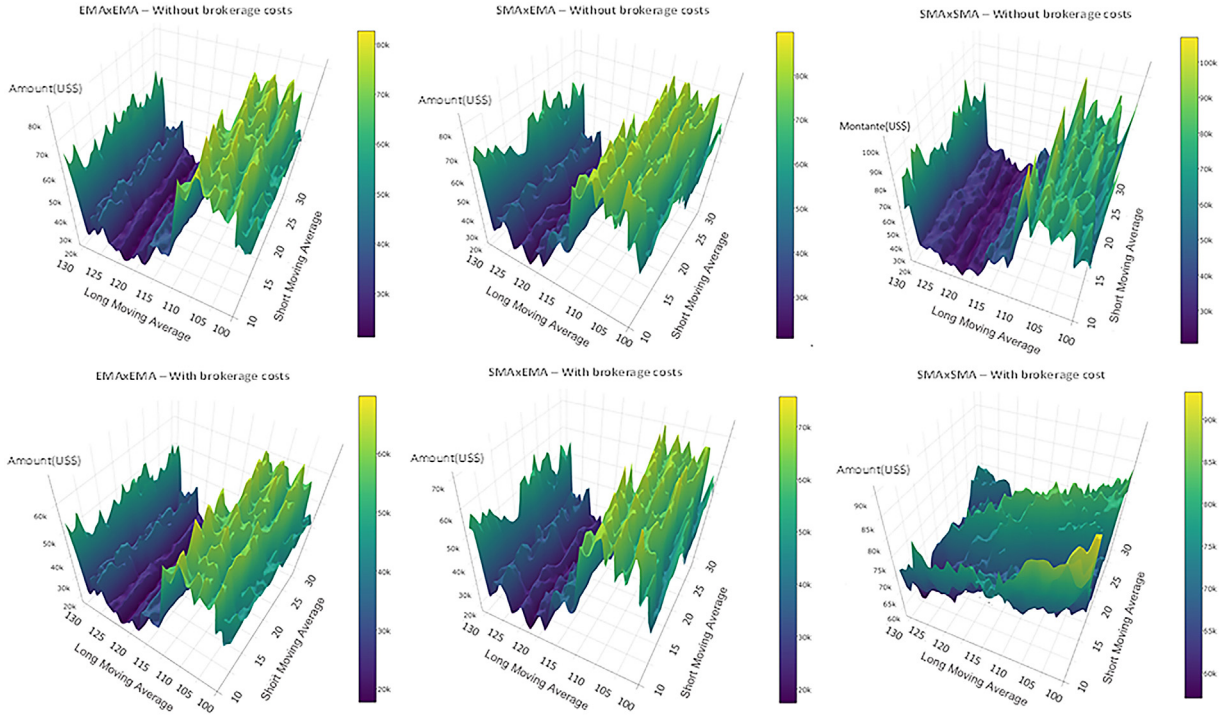

Fig. 1. Tridimensional grids with results for average profitability using large caps.

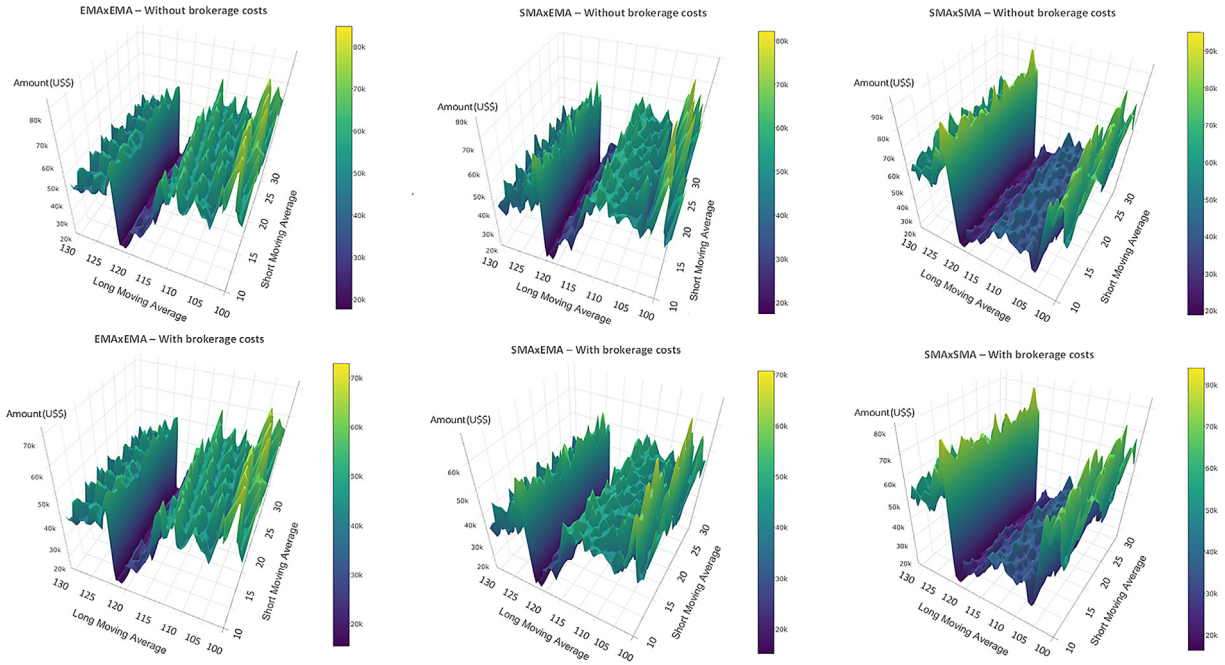

Fig. 2. Tridimensional grids with results for average profitability using small caps.

Table 2
Buy and hold strategy results.

Portfolio	Initial amount (BRL)	Averages buy and hold (BRL)	Buy and hold (USD)
Small caps.	33,728 BRL	79.611.16 BRL	23.603.88 USD
Large caps.	33,728 BRL	575.213.40 BRL	170.544.77 USD

averages in the range [10,30], consistently implies above average profitability, ranging from US$ 70,000.00 to US$ 90,000.00.

A comparative analysis between Figs. 1 and 2 also suggests that for higher capitalization assets, the range of consistently profitable moving averages is expanded, being roughly represented by [100,114]. However, the profitability is very similar to that obtained with small caps.

In addition, when transaction costs are considered in the analysis, the average profitability is not considerably diminished. The shape of the charts does not change dramatically and only the magnitude of profitability is reduced by about $ 10,000, with the addition of transaction costs.

Regarding the analysis of the results of the ATS compared to the static strategy of buy and hold, Tables 2 and 3 show interesting results. First, according to Tab. 2, there is a huge discrepancy between the average profitability obtained with small caps and large caps when the static buy and hold strategy is used. However, through Figs. 1 and 2, the ATS, based on crossover of moving averages, generated very similar results for both groups of assets. In Table 3, it can be observed that no asset considered blue chip was able to surpass the average profitability of buy and hold.

The static buy and hold strategy was outperformed by 16.67% of the small cap assets for the crossing of SMA with SMA. It is not possible, however, to explain why only the SMA versus SMA combination was able to overcome the buy and hold performance, since the same assets for the combinations SMA versus EMA and EMA versus EMA had an average performance lower than the buy and hold strategy result.

Table 3
Percentage of results that generate profits higher than the average profitability of the buy and hold strategy.

Portfolio	SMA *vs* SMA	EMA *vs* EMA	SMA *vs* EMA
Small caps.	16.67%	0.00%	0.00%
Large caps.	0.00%	0.00%	0.08%

5. Final comments

This paper investigates the profitability of TA in the Brazilian stock market with a special focus on a group of assets called small caps, which are shares associated with low capitalization companies. We intended to analyse whether small caps provide investors with above average profits, since emerging markets may be less efficient (Banz, 1981; Menkveld and Wang, 2013; Reinganum, 1981).

The results indicated that the ATS developed in this study generates a very similar average profitability for low level capitalization assets and for high level capitalization assets. Results suggest that in the Brazilian stock market the level of capitalization of the assets is not related to the degree of market

inefficiency, as suggested by Noakes and Rajaratnam (2014). The use of TA presented similar profit opportunities for the two groups of assets. For emerging countries, more specifically Brazil, small caps, compared to blue chips, do not significantly contribute to generate higher returns due to diversification, as Guidolin and Nicodano (2008) suggest, since the average profitability of small caps is very similar to that of large caps.

The conclusions of our study are closer to those obtained by Sandoval (2015), who found that small caps do not present above average market returns in stock markets of emerging countries. The results of the study suggest that there is no statistically significant difference between average returns with assets of different levels of capitalization, although in terms of portfolio performance, there is a possibility of substantial gains using trading strategies based on moving averages.

The results also highlight a group of long-term moving averages, ranging from 100 to 107 days, which, with short-term moving averages in the interval of [10,30] days, have been consistently profitable for all the simulations carried out, regardless of taking into account small caps or blue chips. These results are robust whether or not one considers transaction costs.

The study also indicated that, on average, TA can lead to an interesting trading strategy based on moving averages. With some assets, the performance obtained was very good, covering the losses related to low performing assets. It should be noted that the buy and hold strategy has consistently outperformed ATS for both sets of assets. Our study, as in Zapranis and Tsinaslanidis (2012) and Bisoi and Dash (2014), does not take into account risk-adjusted profitability.

Our study cannot convey explanations related to why a select group of long- term moving averages leads to well above average profitability. One of the main reasons for TA to be criticized is that, although there may be a systematic relevant set of indicators for establishing trading signals, the computational procedure does not provide a direct explanation for the results. The analysis of the phenomenon of profitability, especially on potential reasons for the performance of trading strategies, may be a topic for future studies. Microeconomic aspects of publicly traded companies in Brazil may provide some explanation, suggesting that there may be some complementarity between TA and FA.

Algorithm 1. Automated trading system

Data: List containing closing prices for $stock_i$, i = 1,...,30.

Result: Table with gross and net results and statistics related to performance of trading strategy.

1 **for** $stock_i$ *in* $[1, 30]$ **do**
2 Calculate long-term and short-term moving averages for each category of crossover;
3 Generate buy and sell signals from the interaction of small and medium moving averages;
4 Apply TA trading strategy with re-investments and with or without transaction costs; and
5 Generate a table with gross and net products and relevant statistics of each trade.
6 **end**
7 Consolidate results and statistics for all thirty stocks;
8 Calculate average of total value of portfolio for each asset; Build a graph for a given combination of short-term and long-term moving averages.

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