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Drivers of technical trend-following rules' profitability in world stock markets

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ABSTRACT

Testing short-horizon technical trend-following rules, including the first comprehensive evidence on the relatively-neglected MACD rule, on a large panel of world stock market indexes, we investigate the determinants of technical trading rule profitability. The main driver of trend-following rules' profitability is return persistence, which, in turn, is negatively related to market development. Return volatility adds to technical rule profitability. A new result is that the presence of an index futures market lowers profits to short-horizon trend-following rules after controlling for other indicators of market development. This may reflect the role of transaction costs as a friction retarding incorporation of information.

1. Introduction

Since the seminal work of Brock, Lakonishock, and LeBaron (1992), a vast literature has been emerging on Technical Analysis (TA), which had previously been downplayed by academicians despite widespread use by practitioners.[1] While most of these studies replicate the same technical trading rules tested by Brock et al. (1992) on different markets,[2] some papers critically evaluate their findings (Kho, 1996; Bessembinder & Chan, 1998; Sullivan, Timmermann, & White, 1999; Day & Wang, 2002), as the findings of Brock et al. (1992) and its replications pose serious challenge against efficient markets theory. Some papers, on the other hand, show potential improvements in technical rule performance by employing neural networks to exploit nonlinearities (Gençay & Stengos, 1998) or fuzzy logic to reduce erroneous signals (Gradojevic & Gençay, 2013). Some recent work also focuses on testing a variety of other technical rules (Brown, Goetzmann, & Kumar, 1998; Sullivan et al., 1999; Lo, Mamayski, & Wang, 2000; Marshall, Young, & Rose, 2006; Anderson & Faff, 2008) and at different (higher) frequencies (Marshall, Cahan, & Cahan, 2008; Schulmeister, 2009). See Park and Irwin (2007) for a comprehensive review of this rapidly growing literature.

While contrarian trading rules can be (and are in practice) incorporated by technical trading systems, the essence of technical analysis is trend-following. Technicians assume that stock prices move in trends, and Pring (2002) defines TA as the art of identifying a trend at an early stage and riding it until the weight of evidence points to its end. While numerous tools have been designed to accomplish this task, they tend to generate signals in tandem with only timing differences.[3] Therefore, we focus in this study on two most popular trading rules that concisely represent the family of short-horizon trend-following rules: moving average convergence divergence (MACD) and moving average crossover (MA) rules. Our direct communications with professionals indicate that these two rules are among the tools most widely used by traders with a short-horizon, the most intensive users of TA, hence reliably summarize the performance of the family of short-horizon trend-following rules.

MACD is a non-linear trend-following tool designed to detect trend changes at an early stage but also to reduce whipsaw signals. A widespread belief among technicians is that MACD signals provide a balance

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[1] See Taylor and Allen (1992), Lui and Mole (1998), Cheung and Chin (2001), Gehrig and Menkoff (2006) and Menkoff (2010) for surveys on the use of TA by practitioners.

[2] Levich and Thomas (1993) on the foreign exchange market; Hudson, Dempsey, and Keasey (1996) on UK stock index; Lee and Mathur (1996) on European spot cross exchange rates; Szakmary, Davidson, and Schwarz (1999) on Nasdaq stocks; Ratner and Leal (1999) on ten emerging equity markets of Asia and Latin America; Gunasakerage and Power (2001) on South Asian stock markets; Metghalchi, Chang, and Marcucci (2008) on Sweden; among many others.

[3] Schulmeister (2006) shows that "when technical models produce trading signals, almost all signals are on the same side of the market" and "if a persistent trend occurs, it takes between 10 and 20 trading days for almost all models to change their positions".

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between promptness and reliability (noise dampening ability). MACD rules have been relatively neglected in the academic literature, despite their popularity and widespread use among practitioners. We are aware of only few papers which test the performance of MACD rules: Papadamou and Tsopoglou (2001) on USD/DM and USD/GBP exchange rates; Chong and Ng (2008) on UK FTSE index; Park and Irwin (2010) on 17 futures markets, Rosilio, De la Fuente, and Brugos (2013) on Spanish stocks. MA rules are similarly very popular among market participants, yet they have been extensively tested in academic studies following Brock et al. (1992); see footnote 2. Therefore, it is useful to compare the results for the MACD rule to those for the more conventional MA rule.

The current paper tests the MACD rule and the 22-day simple MA rule on 44 national stock market indexes including both developed and emerging/frontier markets. Later, we include other technical rules (56-day and 200-day MA, and trading range break-out) to see whether our main results are sensitive to the choice of specific technical rules. Using national indexes, we are able to concisely compare country-market characteristics affecting technical rule performance. This analysis makes four contributions to the literature: First, presenting comprehensive evidence on the performance of trend-following rules in a large cross-section of national stock market indexes, including developed, emerging and frontier markets.[4] This offers an out-of-sample test on a recent sample period, robust to the survivorship bias to which in-sample tests (i.e., tests on sample periods during which these rules became popular) are vulnerable. Second, providing a comprehensive test of the MACD rule, which has been widely used by market participants but relatively neglected in academic studies. Evidence on the performance of MACD rule in world stock markets is currently a gap in the literature. Third, investigating the drivers of the profitability of the trend-following rules.[5] This is the main objective and the major contribution of the study, made possible by our comprehensive panel. Fourth, we investigate the role of an index futures market in driving technical trading rule profitability. The presence of an index futures market results in a dramatic reduction in transaction costs, and gives rise to the emergence of a short-horizon trader population. We find that the presence of an active index futures market significantly reduces the profitability (before transaction costs) of the short-horizon technical trend-following rules after controlling for other indicators of market development. The presence of a futures market is also negatively correlated with return persistence. This implies that transaction costs are a significant driver of technical trading rules' statistical (before-transaction-costs) profitability, and of market behavior in incorporating new information. This finding adds to a specific strand of literature which focuses on the impact of derivatives on the behavior of the underlying spot price, led by Cox (1976),[6] and provides insight into the nature and market efficiency implications of the statistical profitability of TA. The negative effect of the presence of index futures on the short-horizon trend-following type of technical rule profits can be consistent with either or both of the following hypotheses: first, market frictions such as transaction costs impede market efficiency by deterring informed traders so that incorporation of information in the absence of a futures market is slower giving rise to TA profitability; second, TA helps speed up incorporation of information and the absence of technical traders in the absence futures markets leaves some profitable opportunities unexploited.

The literature empirically assessing potential explanations for TA's potential predictive ability is fairly limited. Our investigation is closely related to an assessment of the implications of Hong and Stein's (1999) model. In this model, a key feature is gradual diffusion of private information. This can be due either to the strategic behavior of monopolistically informed trader (Kyle, 1985) or insufficient activity of risk averse informed arbitrageurs, the so-called newswatchers (Hong & Stein, 1999). Gradual diffusion of information implies that momentum traders can profit from trend-following over the information assimilation phase. Hong, Lim, and Stein (2000) focus on analyst coverage as the driver of the speed of information diffusion in individual stocks. Our setup to investigate the impact of index futures on TA profitability controlling for market development, on the other hand, focuses on the role of transaction costs in incorporating information. We hypothesize that an active index futures market gives rise to a population of technical traders which survive on potential profits to be earned by further incorporating the information not fully exploited by newswatchers. These technical traders are unable to distinguish noise from information signals, thus some proportion of their trades result in losses due to whipsaw signals. Such short-term strategies are designed to exploit recurring information assimilation process and their performance is sensitive to transaction costs, hence technical traders of marketwide information nest in markets where index futures are active.

Another implication of Hong and Stein's (1999) model is that the intensity of fundamental news arrivals should increase the profitability of short-horizon trend-following strategies. Thus, our technical rules should perform better when the volatility of fundamental news arrivals is high. In our assessment of the drivers of technical rule profitability, we investigate this using appropriate proxies.

The information assimilation phase should be relatively short in case of marketwide information. Therefore, in our study with stock indexes, we mainly focus on short-horizon trend following rules. By doing so, we characterize the information assimilation phase. The profitability of longer horizon rules such as 200-day moving average may be linked to the presence of big trends during the sample period, which in turn may be related to big shifts in fundamentals, i.e., contingencies of new information, and not necessarily the characteristics of the information assimilation process. Furthermore, our investigation on the impact of index futures on TA profitability requires us to employ short horizon rules that require frequent trading such that transaction costs should be significant enough to shape trader behavior.

In Section 2, we discuss issues in evaluating technical trading rules' profitability and its economic implications. Section 3 describes the data and the technical trading rules. Section 4 presents results on the performance of technical rules tested. Potential drivers of the cross-sectional and time variation in the profitability of technical rules are investigated employing panel regressions in Section 5. Section 6 summarizes the conclusions.

2. Issues in testing technical trading rules

When translating results of *ex-post* academic tests of technical trading rules into economic conclusions a number of important issues have to be considered: accounting for transaction costs, possible deviations of the execution price from the signal price, distributional assumption in assessing statistical significance, spurious positive portfolio autocorrelation in stock index returns, time-varying risks and data snooping. These issues concern not only academicians interpreting the implications of the tests of TA on market efficiency, but also practitioners trying

[4] Previous studies that test technical trading rules on large cross-sections of stock markets are quite limited: Ratner and Leal (1999) replicate Brock et al.'s (1992) tests on ten emerging equity markets of Asia and Latin America. Fifield et al. (2005) test two trading rules on eleven European stock markets. Metghalchi et al. (2012) test three moving average rules on 16 European stock markets.

[5] The first paper with a similar goal of identifying the drivers of technical trading rule profitability is Irwin and Brorsen (1987). We are aware of only two more recent studies with a similar goal: Owen and Palmer (2012) investigate the factors driving the performance of a very simple momentum rule, which is not likely to be widely used by real-life practitioners, on nine currencies. Cialenco and Protopapadakis (2011) test drivers of the returns to a moving-average-based filter rule and a double-moving average on 14 currencies. A related path of literature attempts to identify the drivers of the cross-section of weak-form of efficiency of emerging stock markets: Lagoarde-Segot and Lucey (2008) on seven MENA stock markets, Lim, Brooks, and Hinich (2008) on ten Asian emerging stock markets.

[6] Recent contributions include Antoniou, Koutmos, and Pericli (2005) and Chau, Holmes, and Paudyal (2008) for futures, and Badreddine, Galariotis, and Holmes (2012) for options.