Int. Fin. Markets, Inst. and Money 20 (2010) 389–403

Contents lists available at ScienceDirect

Journal of International Financial Markets, Institutions & Money

journal homepage: www.elsevier.com/locate/intfin

Long-run relations among equity indices under different market conditions: Implications on the implementation of statistical arbitrage strategies

Christos Alexakis*

Department of Economics, University of Piraeus, 80 Karaoli and Dimitriou str, 185 33 Piraeus, Greece

ARTICLE INFO

Article history:
Received 5 January 2010
Accepted 16 May 2010
Available online 26 May 2010

JEL classification:
C32
G15

Keywords:
Cointegration
International stock markets
Statistical arbitrage

ABSTRACT

Compared with previous research, the present work extends existing literature by considering long-run relations among major international stock market indices, under different market conditions, and the implications of these relations on the implementation of statistical arbitrage strategies. The examined data contain two bust phases interrupted by a mild bullish period. Employing cointegration analysis, reported results initially indicate that changes in market performance affect the stability of long-run relations, therefore suggesting that arbitrageurs should perform rebalancing among the examined indices when a change in a market trend is evident. Furthermore, extreme market performance harms the mean-reverting properties of a potential long-run relation while moderate market performance points to cointegration between a pair of indices. However, the absence of a stationary spread does not suggest the potential of abnormal returns realization, in the short-run, through exploitation of deviations from its mean value. The applicability of our results may be of importance to market participants since the cointegration approach has recently received considerable attention by hedge funds adopting statistical arbitrage strategies.

1. Introduction and literature review

The present study examines long-run relations among stock market indices, under different market conditions, and the implications of these relations on the implementation of Statistical Arbitrage (SA)

* Tel.: +30 2104142300.
E-mail address: calexakis@tutors.eap.gr.

1042-4431/$ – see front matter © 2010 Elsevier B.V. All rights reserved.
doi:10.1016/j.intfin.2010.05.003

strategies. There is considerable literature in financial economics concerning the validity of various forms of the Efficient Market Hypothesis (EMH), Cuthbertson (1996) provides a thorough review. EMH implies that in liquid markets, where asset prices will be the result of unconstrained demand and supply equilibria, the current price should accurately reflect all the information that is available to the players in the market. In other words, the price of an asset at time t is equal to the price of the asset at time $t-1$ plus a random term which reflects the impact of new unpredictable information. This is why the model that is most commonly assumed for stock price movement is a log-normal process; that is, the logarithm of the stock price is assumed to exhibit a random walk. However, because the random walk is a martingale, the mean value of the predicted increment is zero. Therefore, knowing the past history of a random walk is not much help in predicting forward-looking increments. The condition is very different for stationary processes. Armed with the knowledge that stationary processes are mean reverting, one can predict the increment to be greater than or equal to the difference between the current value and the mean. The prediction is guaranteed to hold true at some point in the future realizations of the time series.

Given that stock price predictability may lead to abnormal returns, testing mean reversion has been the objective of many researchers since 1960. While initial studies (Fama, 1965; Samuelson, 1965; Working, 1960) could not reject the random walk hypothesis, later findings are mixed. Some studies suggest stock prices are either mean reverting (Chaudhuri and Wu, 2004, 2003; Balvers et al., 2000; Grieb and Reyes, 1999; Urrutia, 1995; Fama and French, 1988; Lo and MacKinlay, 1988; Poterba and Summers, 1988) or random walk (unit root) processes (Narayan and Narayan, 2007; Narayan and Smyth, 2007, 2004; Kawakatsu and Morey, 1999; Zhu, 1998; Choudhry, 1997; Huber, 1997; Liu et al., 1997).

Since there is no consensus as to whether stock prices are mean reverting or unit root processes, assuming that the joint hypothesis of risk neutrality and market efficiency holds (and thus lack of stock price mean-reversion property), we cannot apply trading strategies that rely upon unconditional variance in order to realize excess returns. However, previous research suggests the existence of stationary linear relations among log data of either share prices or stock indices. Based on this result, prior literature suggests the construction of SA strategies exploiting the mean-reverting properties of linear relations among financial data (Jacobsen, 2008; Canjels et al., 2004; Hogan et al., 2004; Bondarenko, 2003; Laopodis and Sawhney, 2002; Tatom, 2002; Harasty and Roulet, 2000; Forbes et al., 1999; Wang and Yau, 1994).

Reviewing relevant literature, Gori (2009), Gatev et al. (2006) and Vidyamurthy (2004) mention that SA is attributed to Nunzio Tartaglia, a Wall Street quant who was at Morgan Stanley in the mid 1980s. Tartaglia's group of former academics employed statistical methods to develop trading programs, executable through automated trading systems, which replaced traders' intuition and skills with disciplined, consistent filter rules. SA techniques are widely used by hedge funds, Wall Street companies, and even sophisticated independent investors trying to profit from temporary deviations of equity prices from their fundamental value. In academic literature, SA is opposed to arbitrage (deterministic). In deterministic arbitrage a sure profit can be obtained from being long in some securities and short in others. In SA there is a statistical mispricing of one or more assets based on the expected value of these assets. In other words, SA conjectures statistical mispricings or price relationships that are true in expectation, in the long run, when repeating a trading strategy. One of the most popular trading strategies is Pairs Trading (PT). PT is a relatively simple technique: "Find two stocks whose prices have historically moved together, when the spread between the two widens, short the winner and buy the loser; if history repeats itself, prices will converge and the arbitrageur will profit" (Pole, 2007). PT is a trading strategy that aims to exploit temporal deviations from an equilibrium price relationship between two securities. This is given by a long position in one security and a short position in another security in such a way that the resulting portfolio is market neutral (which typically translates in having a beta equal to zero). This portfolio is often called a spread. According to Gori (2009), in the framework of spread modelling, among the more recent techniques we find that cointegration is probably the most popular approach in quantitative trading strategies adopted by hedge funds and a reasonable amount of literature has been published on it.

The main objective of this study is to examine cointegrating relations among equity indices with the implementation of SA strategies exploiting the mean-reversion property of the implied long-run rela-