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# Non-linear dynamics in international stock market returns

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**Abstract**

Recent empirical finance research has reported non-linear dynamics within asset returns. However, much of this extant research has focussed upon asset markets within the US and UK. This paper examines whether such dynamics are also present in a series of six international equity index returns. Using empirical models which are consistent that the theoretical behavioural finance noise trader motivation of non-linearity, whereby market dynamics differ between small and large returns, our results suggest these models improve the in-sample fit and out-of-sample forecast over linear alternatives. Further, the point of regime transition differs between positive and negative returns indicating that noise traders are more likely to engage in trend-chasing behaviour in up markets and anchoring behaviour in down markets. Finally, the forecast gain in the Asia-Pacific markets is greater than in the European markets suggestive that limits to arbitrage are greater perhaps as fundamental traders knowledge of market dynamics and noise trader behaviour is still evolving.


*JEL classification:* C22; G12
*Keywords:* Stock market returns; Smooth-transition model; Non-linear; Behavioural finance

## 1. Introduction

The testing for and estimation of non-linear dynamics in asset returns has become a growing area of empirical finance research. This research has been conducted across a range of financial asset, including interest rate dynamics, for which major examples include Balke and Fomby (1997), Enders

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and Granger (1998) and Enders and Siklos (2001); exchange rate dynamics, Krägler and Krugler (1993), Obstfeld and Taylor (1997), and Coakley and Fuertes (2001); and equity returns, Martens, Kofman and Vorst (1998), Perez-Quiros and Timmermann (2000), McMillan (2001, 2003) and Maasoumi and Racine (2002).

Whilst several rationales exist for the presence of such non-linear dynamics within asset returns, perhaps the most promising theoretical developments concern the interaction between heterogenous agents, namely noise traders and fundamental, or arbitrage traders, and the presence of transactions costs and other markets frictions.[1] The existence of noise trading means that profitable opportunities will inevitably arise for privately informed and arbitrage traders.[2] In an early development of this line of research, Cootner (1962) argued that the activities of noise traders will cause prices to hit upper or lower 'reflecting barriers' around an equilibrium, which would subsequently trigger arbitrage activities by informed traders who push prices back to equilibrium. Cootner argued further that the position of such barriers is likely to depend upon the size of market frictions and other transactions costs, including the bid-ask spread, short-selling and borrowing constraints, giving rise to a band of price movements around the equilibrium price. Thus, informed traders only actively trade when deviations from equilibrium are sufficiently large to make arbitrage trade profitable (He & Modest, 1995). Similarly, models of international goods market arbitrage examined by Dumas (1992, 1994) and Sercu, Uppal and Van Hulle (1995) have suggested that the presence of transactions cost which result in small imbalances being left uncorrected may impart non-linear adjustment to equilibrium due to non-linear factors affecting the costs of arbitrage, such that the speed of reversion to equilibrium increases with the size of the deviation.

Furthermore, the recent 'behavioural finance' literature with its focus upon the attendant risks associated in interacting with noise traders has developed models of non-linear behaviour which do not require the presence of transactions costs. This literature has focussed upon deviations from fundamental value due to investor cognitive biases and subsequent limits to arbitrage.[3] More specifically, arbitrageurs actions may be limited until returns, of either sign, become sufficiently extreme to allow arbitrageurs to engage in profitable reversion trading strategies. This line of enquiry suggests that noise traders typically engage in momentum trading (or trend-chasing) which leads, in the short-run, to a market over-reaction following the arrival of news, such that changes in returns will exceed that required by the news, but with the result that, in the long-run, there will be a subsequent

[1] Alternative explanations include irrational investor behaviour which may be exploited in trading strategies (e.g. Cutler, Poterba, & Summers, 1989), so-called conditional asset pricing models attempt to explain asset returns using available information, for example, Ferson and Harvey (1991) show that such asset returns predictability does not arise due to market inefficiency but from predictability in the variables which form the information set, and time-variation in required rates of return (Cochrane, 1999, 2001).

[2] The rationale generally offered for noise trading is that it allows privately informed traders to profitably exploit their informational advantage, without which market efficiency would not be assured (e.g. Kyle, 1985). That rationale does not, however, explain the reasons for noise trading, on which there are differing views. Noise trading may be regarded as, either, rational agents trading for liquidity and hedging purposes, consistent with a fully rational efficient-markets perspective (Diamond & Verrecchia, 1981; Biasis & Hillion, 1994; Dow, 1995; Dow & Gorton, 1994, 1997), or, irrational (or not fully rational) agents trading on beliefs and sentiments that are not justified by news concerning underlying fundamentals (Black, 1986; DeLong, Shleifer, Summers, & Waldmann, 1990; Shleifer & Summers, 1990). An interesting alternative interpretation recently offered by Dow and Gorton (1997) suggests that delegated portfolio managers may engage in noise trading in order to appease clients or managers who are unable to distinguish purposeful inaction from non-purposeful inaction, as a result of which the amount of noise trading can be large compared to the amount of hedging volume, and Pareto improving.

[3] For recent surveys of the behavioural finance literature, see Hirshleifer (2001), Barberis and Thaler (2003) and Ritter (2003).