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# Volatility linkages across three major equity markets: A financial arbitrage approach

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## Abstract

This paper investigates the high frequency behavior of US, British and German stock market exuberance using an index provided by standard portfolio arbitrage relationships. Symmetric and asymmetric multivariate GARCH models are implemented to quantify international volatility linkages between January 1992 and April 2000. A shift in volatility transmission is detected from May 1997 onwards. Empirical analysis suggests that equity markets volatility modeling with exuberance indexes is more accurate than modeling with stock returns. Exuberance volatility comovements across countries are compared with the corresponding return comovements. An interpretation of their discrepancy is provided in terms of bond and stock returns international covariation.

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## 1. Introduction

The recent financial crises have brought about a renewed interest in theoretical and empirical investigations into international links between asset market volatilities. In most cases, however, the origins of turbulence are to be found in the emerging markets, involving financial assets often traded in a context of exchange rate and banking instability. These characteristics are incorporated in the burgeoning literature on asset market volatility “contagion” (see Masson, 1999; Kodres and Pritsker, 2002 among others).

The latter is ill-suited for investigation into the nature of the substantial stock return volatility shifts across large and sophisticated markets of industrialized countries such as the US, Britain and Germany presented in this paper. We introduce a simple model of financial arbitrage which quantifies an index of daily national stock market exuberance, and go on to investigate its behavior over time in an international context, thus encompassing two major aspects of stock market pricing analysis: international interlinkages and over-underreaction to news.

Various interpretations of excess volatility have been given, rational bubbles initially seeming to provide an appropriate explanation. Indeed, a rational bubble is compatible with the forward solution of an expected stock return model whenever the transversality condition is violated (West, 1987, among many others). More recent developments favor an interpretation of excess stock volatility in terms of fads as theoretical and empirical results reduce the plausibility of rational bubble inception. Shiller (1984) and De Bondt and Thaler (1985) point out that economic agents follow irrational trading rules and overreact to news. De Bondt and Thaler show that US stock prices tend to overreact and that extreme movements are followed by subsequent shifts in the opposite direction. Their approach has recently been extended to a multi-market context by Richards (1997) and Schnusenberg and Madura (2000), who assess (national) portfolio volatility relative to a worldwide index.

A major difficulty with over-underreaction analysis lies in the selection of a benchmark with appropriate theoretical and empirical characteristics. It can be provided either by the asset’s own past history or by the (past) behavior of other assets, linked to the former by portfolio theory or arbitrage opportunities. The latter approach is followed here. The paper investigates the behavior of stock market exuberance, tentatively quantified as excess stock market return over expected long-term bond return.<sup>1</sup> Any positive (negative) difference in returns can be interpreted as an over-underreaction of the stock market. Fads and bubbles do not usually affect bond markets, and bond prices are generally believed to reflect economic fundamentals as the use of daily data prevents us from introducing them directly into analysis.<sup>2</sup>

<sup>1</sup> The definition of the exuberance measure used in the analysis is given below. It is related to the “holding period spread” between the rate of return of stocks and bonds used by stock market analysts to derive financial forecasts (Gray, 1993) and to the excess stock return hypothesis investigated by Fama (1981) and Zhou (1996), among others.

<sup>2</sup> Bubbles cannot exist if there is an upper limit on the price of an asset. Finite maturity bonds have a fixed value on the day of expiry and do not admit bubbles (Campbell et al., 1997, page 259).

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