

The structure of interdependence in international stock markets

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Abstract

This study investigates the dynamic structure of nine major stock markets using an error correction model and directed acyclic graphs (DAG). The DAG representation provides a structure of causality among these markets in contemporaneous time. Building on this contemporaneous structure and the estimated error correction model, innovation accounting techniques are applied. The results show that the Japanese market is among the most highly exogenous and the Canadian and French markets among the least exogenous in our nine-market study. The US market is highly influenced by its own historical innovations, but it is also influenced by market innovations from the UK, Switzerland, Hong Kong, France and Germany. The US market is the only market that has a consistently strong impact on price movements in other major stock markets in the longer-run.

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1. Introduction

Interdependence among national stock markets has been widely analyzed. Early studies (e.g., Grubel and Fadner, 1971) have found that interdependence of share price movements is much less pronounced among countries than within a country

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(see also Eun and Shim, 1989).¹ More recent works have paid considerable attention to the structure of interdependence among national stock markets. Two branches of research along this more recent line have emerged. As noted by Kasa (1992) and Francis and Leachman (1998), most empirical work on international stock markets has focused on stock returns and/or returns volatility rather than stock prices. A partial list of such work includes Eun and Shim (1989); Hamao et al. (1990); Campbell and Hamao (1992); Chan et al. (1992); King et al. (1994); Longin and Solnik (1995); Bekaert and Harvey (1995), and Ammer and Mei (1996).

Recognition of the nonstationary property of stock prices has led other researchers to explore possible long-run relations among national stock markets, using the notion of cointegration, as formally defined in Engle and Granger (1987). Taylor and Tonks (1989); Kasa (1992); Malliaris and Urrutia (1992); Arshanapalli and Doukas (1993); Francis and Leachman (1998), among others, found evidence of long run interdependence of major stock market prices. These studies generally fail to address the contemporaneous structure of interdependence (i.e., at the level of stock return innovations) in international stock markets, though the significant contemporaneous correlation among national stock market innovations has been documented in the literature (to be discussed below).²

Our contribution is to combine error correction modeling and directed acyclic graphs to facilitate a more in-depth exploration of the structure of interdependence in international stock markets. Particularly, we explore the direction of causality between innovations across stock markets (i.e., we study the direction of causal flow among residual returns from a vector autoregression (VAR)-type model). The fact that strong contemporaneous correlations exist across stock markets has been well documented in the literature (Eun and Shim, 1989; Koch and Koch, 1991; Hasbrouck, 1995). The existence of such correlation makes the introduction of methods that can handle causal flow without the requirement of time lags (as is required by Granger-type causality) particularly important. Building on recent advances in statistical analysis of directed graphs (Spirtes et al., 1993; Pearl, 1995; Swanson and Granger, 1997), this study proposes application of directed acyclic graphs to examine the causal structure among innovations in various stock markets from an error correction model.

¹ For example, King et al. (1994) argued that international stock markets are not integrated and the perceived increased market integration is only a transitory phenomena caused by the 1987 crash.

² Kasa (1992) used quarterly data and found that during the period of 1974–1990, a single stochastic common trend (four stochastic common trends when using monthly data) drove the stock markets of the US, Japan, UK, Germany, and Canada. The market in Japan was most important and the Canadian market the least important in driving the common trend. Francis and Leachman (1998) used monthly data and found that during the same sample period there were three stochastic common trends (thus one cointegrating vector) among the US, Japan, UK and German markets. Japan was least responsive and the UK most responsive to deviation from the long run equilibrium relation. Francis and Leachman (1998) interpreted this as a reflection of the relative openness. Examining a short period (less than one year) around the 1987 stock market crash, Malliaris and Urrutia (1992) found mixed results of bivariate cointegration among the US, Japan, UK, Hong Kong, Singapore and Australia. Particularly interesting, they found that the UK led Hong Kong and Hong Kong led the other Asia–Pacific markets, including the market in Japan.

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