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Revisiting stock market index correlations

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A B S T R A C T

Comovement of stock market indices increases during volatile periods, and does not come down when the turmoil settles down. This paper explains formation of persistent comovements during high volatility periods with theories from Bayesian learning. My main conclusion is that the correlation that is formed during the high volatility period is persistent because it is learned during the turmoil. The belief that interdependence between markets are high during the volatile period turns into reality by correlated actions of traders in different markets avoiding correlation to fall to its previous level.

1. Introduction

This paper answers the question why the stock market indices in different countries develop a persistently high level of correlation between them during highly volatile periods like crashes.

My main conclusion is that the abnormal price signals shadow the belief of the investors that the correlation between the markets is low. When a strong abnormal signal arrives pointing to a fast movement of the index, investors in other markets reflect that information in their actions depending on the historically lower level of correlations. In turn, investors in the original market will read this (perhaps small) unusual movement in other markets as a private signal of the investors in these other markets. The belief that market movements are loyal to each other will turn into a self-fulfilling prophecy.

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This learned level of correlation has high precision, so there is little doubt that it is at a higher level because of a numerical discrepancy. Traders follow other markets closely before making trading decisions. So the belief that interdependence between markets are high during the crash turns into reality by correlated actions of traders in different markets avoiding correlation to fall to its previous level after the crash, and hence the high correlation becomes persistent.

Chesnay and Jondeau (2001) report that international correlations increase during turbulent periods. Also Ranchand and Susmel (1998) verify this finding with switching-ARCH models.

Longin and Solnik (1995) test the equality of correlation and covariance matrices of seven major stock markets over the period 1960–1990. They partitioned their data into six 5-year sub-periods and tested each period's correlation and covariance matrices against all other periods. Out of a total of 15 such tests with correlation matrices, 9 found to reject the null hypothesis of equal correlation matrices at 10% significance level. Out of a total of 15 tests with covariance matrices, 14 found to reject the null hypothesis of equality at 10% significance level. At a longer time horizon (1870–2000), Goetzmann et al. (2001) find that the period 1919–1939 where the Great Depression took place is characterized by a statistically different correlation coefficient matrix of stock markets of four countries (U.S., UK, Germany, and France) compared to other sub-periods of the period 1870–2000.

Results of non-parametric tests are similar. Longin and Solnik (2001) applied multivariate extreme value analysis to the G-5 countries between 1959 and 1996. They report that the correlation of large negative returns is much higher than what could be expected from a multivariate normal distribution. Hartmann et al. (2001) use a similar non-parametric measure for stock and bond markets in the G-5. Their findings include higher conditional probabilities of having a crash in one market, given a crash also occurred in one another. A more detailed literature review on the existence of contagion among stock markets can be found in Karolyi (2003).

Silvennoinen and Teräsvirta (2005) report that in a portfolio of four stocks, the correlation coefficients between prices of these stocks increase with the degree of market turbulence.

Baele (2005) uses a correlation switching model to find that the shock spillover intensity from the U.S. to the European markets has grown for most European markets under consideration (Austria, Belgium, Germany, France, Ireland, Switzerland) from period 80–85 to 86–90, from a period including the 1987 crash, to a period with no major worldwide crises (Baele, 2005, Table 6). In the same article, Baele also reports that "the U.S. stock spill over dynamics are driven more by cyclical than structural factors." Also, King and Wadhwani (1990) test the correlation between New York stock exchange and London stock exchange when the New York market was closed on some certain days in 1968. They find that volatility in London drops significantly when the New York market is closed and conclude that contagion is driven by price signals rather than by news in the media.

Ang and Bekaert (2002) report existence of a high volatility-high correlation regime which is persistent between U.S.–UK and U.S.–UK–German stock markets. Bekaert et al. (2005) report a similar finding for European, Asian, and Latin American markets.

Dennis et al. (2006) attribute asymmetric volatility (higher volatility when prices are falling) primarily to systematic market-wide factors rather than aggregated firm-level effects.

Lee and Kim (1993) find that average weekly cross market correlations between 12 major stock markets increase from 0.23 before the October 1987 crash in the U.S. markets to 0.39 afterwards. Even one and a half year after the crash, for the period of June 1989 to December 1990 average weekly cross market correlations were 0.41. Forbes and Rigobon (2002) report that during times of high volatility in the series under consideration, correlation coefficient between these series is biased upwards. Through a detailed common factors analysis, Lee and Kim (1993) conclude that "the phenomenon of closer co-movements among stock markets after the crash existed regardless of the extent of the world stock markets' volatility."

Most empirical work in the literature links high correlation with high volatility. The conjecture of persistent high correlation is also supported by empirical findings. The high volatility (which goes together with high correlation) is attributed to cyclical market wide factors rather than structural and firm-level factors. There is also empirical support that volatility is transmitted through price signals rather than other means. This paper explains how a persistent high correlation between stock markets is generated during periods of high volatility by referring to theory of Bayesian learning.