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Mean reversion in international stock markets: An empirical analysis of the 20th century

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This paper analyzes mean reversion in the stock markets of 18 OECD countries during the years 1900–2009. In this period it takes stock prices about 18.5 years, on average, to absorb half of a shock. However, using a rolling-window approach we establish large fluctuations in the speed of mean reversion over time. The highest mean reversion speed is found for the period including the Great Depression and the start of World War II. Furthermore, the early years of the Cold War and the period containing the Oil Crisis of 1973, the Energy Crisis of 1979 and Black Monday in 1987 are also characterized by relatively fast mean reversion. We document half-lives ranging between 2.0 and 22.6 years. Our results suggest that the speed at which stocks revert to their fundamental value is higher in periods of high economic uncertainty, caused by major economic and political events.

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1. Introduction

In early March 2009, many stock markets across the world dropped to their lowest value since the dot-com crisis. In less than two years, U.S. equity market indices lost more than 50% of their value. At the time, a discussion was going on about future stock price movements. Some argued that if stocks

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are down over 50%, an increase must surely follow. And the increase followed indeed. At the end of 2009, stock markets were up more than 30% relative to March 2009. Looking back, it is tempting to think that the increase following the deep drop might have been expected.

The presence or absence of mean reversion has important economic implications. Various studies show that excess returns can be earned by exploiting the mean reversion of stock prices (De Bondt and Thaler, 1985, 1987); Jegadeesh and Titman, 1993; Balvers et al., 2000; Campbell and Shiller, 2001; Gropp, 2004). Furthermore, mean reversion implies that stocks become less risky in the long run, making them more attractive for long-term investors. In a study about pension fund regulation, Vlaar (2005) argues that mean reversion in stock prices would strongly increase the attractiveness of equity investments for pension funds. If stock prices are mean-reverting in the long run, low returns are followed by higher expected future returns, which could stimulate pension funds to invest in equity after a downfall of the stock market.

Do stock prices really exhibit mean-reverting behavior in the long run? For more than two decades the economic literature has attempted to answer this question. Although early studies document significant mean reversion, the general thought on the subject is that convincing evidence has yet to emerge.

The economic literature distinguishes between so-called absolute and relative mean reversion. With absolute mean reversion, stock prices are mean-reverting relative to an unspecified mean value. This results in negative autocorrelation in stock returns. Specifications based on relative mean reversion generally posit a direct relation between stock prices and fundamental indicators, such as dividends and earnings. Fama and French (1988b) and Poterba and Summers (1988) were the first to provide empirical evidence in favor of absolute mean reversion. Fama and French (1988b) document that 25–40% of the variation in 3–5 year stock returns can be attributed to negative serial correlation.

A major problem in analyzing mean reversion over long horizons is the limited amount of available data. Fama and French (1988b) and Poterba and Summers (1988) analyze the time period from 1926 to 1985, using yearly overlapping returns to increase the number of observations. Both studies base their results on long-term returns, with investment horizons between one and ten years. To deal with the issue of dependency, which is inherent in the use of overlapping observations, they apply the method of Hansen and Hodrick (1980). However, this approach suffers from substantial small-sample bias. Richardson and Smith (1991) show that the evidence for long-term mean reversion disappears if the small-sample bias is removed. Moreover, Fama and French (1988b) ignore the seasonal effects in stock price movements. Jegadeesh (1991) shows that mean reversion in stock prices is entirely concentrated in January.

Balvers et al. (2000) take a different approach and focus on relative instead of absolute mean reversion. According to Balvers et al. (2000), the stationary relation between the fundamental value of a stock and a benchmark index permits direct assessment of the speed of mean reversion. Moreover, they use annual instead of monthly data to avoid the problem of seasonality. To estimate the mean-reversion process more accurately, Balvers et al. (2000) adopt a panel data approach. Comparing the real stock price indices of eighteen countries to a world index benchmark during the period 1970–1996, they establish significant mean reversion, with a half-life of approximately 3.5 years. The half-life measures the period it takes stock prices to absorb half of a shock. Balvers et al. (2000) find a 90% confidence interval for the half-life equal to [2.4, 5.9] years.

Several arguments counter the assumption of a constant speed of mean reversion. For example, Kim et al. (1991) conclude that mean reversion is a pre World War II phenomenon only. Poterba and Summers (1988) find that the Great Depression had a significant influence on the speed of mean reversion. Moreover, we may expect the speed of mean reversion to depend on the economic and political environment; see e.g. Kim et al. (1991). Consequently, the speed of mean reversion is expected to fluctuate over time. Additionally, during long sample periods structural breaks in the behavior of stock returns are likely to occur, resulting in model coefficients that change over time (Rapach and Wohar, 2006). To our knowledge all previous studies in the field examine mean reversion in a static framework, thereby ignoring fluctuations in the speed of mean reversion over time. In our study we apply the panel data approach of Balvers et al. (2000) to a long data sample of international stock indices. Our large sample of stock indices in 19 countries, spanning a period of more than a century, allows us to analyze in detail the dynamics of the mean-reversion process. In the 1900–2009 period, it

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