On the volatility of stock prices: an exercise in quantitative theory

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This paper examines the issues of volatility at the aggregate level. Rather than studying individual securities we focus on volatility utilizing aggregate stock market values and aggregate after-tax net cash flow as a ratio of national income. Our approach is in the tradition of the infinitely-lived classical growth model of Solow, where the behaviour of capital, consumption and investment are studied as shares of output. For the period 1946–1993 both the cash flows to equity and consumption as a share of national income were fairly constant. Yet there was significant movement in the value of the stock market as a share of national income. Our analysis suggests that these large movements cannot be rationalized within the context of the decentralized stochastic growth paradigm.

1. Introduction

The neoclassical growth model and its stochastic variants are a central construct in contemporary finance, public finance and business cycle theory. It has been used extensively by, among others, Abel et al. (1989), Auerbach and Kotlikoff (1987), Barro and Becker (1988), Brock (1979), Cox et al. (1985), Donaldson and Mehra (1984), Kydland and Prescott (1982), Lucas (1988), and Merton (1971). In fact, much of our economic intuition is derived from this model class.

The model has had some remarkable successes when confronted with empirical data, particularly in the stream of macro-economic research referred to as Real Business Cycle Theory, where researchers have found that it broadly replicates the essential macro economic features of the business cycle. See, in particular, Kydland and Prescott (1982). Unfortunately, when confronted with financial market data on stock returns, tests of these models have led, without exception, to their rejection. Perhaps the most striking of these rejections is contained in the paper by Mehra and Prescott (1985). These authors show that for reasonable values of the discount factor and the coefficient of relative risk aversion, the implied equity premium is too low when the model is calibrated to reflect historically observed aggregate consumption growth rates.

A related stream of research has focused on stock price volatility. The majority of studies to date in this area have been micro-studies (a notable exception is Grossman and Shiller 1981). This line of research has its origins in the important early work of Shiller (1981) and LeRoy and Porter (1981), which found evidence of excessive volatility of stock prices relative to the underlying dividend/earnings process. Using data for 100 years, Shiller (1981) in particular reported that, in his model, the volatility of actual stock prices exceeded the theoretical upper bound by a factor of 5.59. These studies use a constant interest rate, an assumption subsequently relaxed by Grossman and Shiller (1981) who addressed the issue of a varying interest rates. They concluded that, although this reduced the excess volatility, Shiller’s conclusion could not be overturned for reasonable values of the coefficient of relative risk aversion.

The conclusions of the above cited studies have been challenged, most notably by Cochrane (1992), Flavin (1983), Kleidon (1986) and Marsh and Merton (1986). These challenges appear to have merit. The interested reader is referred to Cochrane (1991), Gilles and LeRoy (1990) or Shiller (1989) for a detailed overview.

This paper shifts the focus of analysis from the firm to the aggregate level and uses the decentralized version of the representative agent stochastic growth model as a point of departure. Rather than studying individual securities we choose to examine issues of volatility utilizing aggregate stock market values and aggregate after-tax net cashflows as a ratio to National Income. In this tradition, the behaviours of capital, consumption and investment are studied as shares of output, bearing

Accepted 5 March 1998.

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