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The relationship between conditional stock market volatility and conditional macroeconomic volatility Empirical evidence based on UK data

David Morelli*

Canterbury Business School, The University of Kent, Canterbury, Kent CT2 7PE, UK

Abstract

This paper attempts to determine the relationship between conditional stock market volatility and conditional macroeconomic volatility based upon monthly UK data covering the period January 1967–December 1995. Conditional volatility is estimated using the well-known Autoregressive Conditional Heteroscedastic (ARCH), Generalised ARCH (GARCH) models. The macroeconomic variables used include industrial production, real retail sales, money supply, inflation, and an exchange rate variable, namely the German Deutsche mark/pound.

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1. Introduction

For a number of years, much interest has been shown in the behaviour of stock market volatility (see Baillie & DeGennaro, 1990; French, Schwert, & Stambaugh, 1987; Poon & Taylor, 1992). Ever since the development of the Autoregressive Conditional Heteroscedastic (ARCH) models by Engle (1982), a model exists that allows the conditional variance, which

* Tel.: +44-1227-827467.
E-mail address: d.a.morelli@ukc.ac.uk (D. Morelli).

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is a measure of volatility, to change over time.[1] Given that a model exists to measure this conditional volatility, the question that remains to be answered is that of why does conditional stock market volatility change over time.

Attempts have been made to examine the relationship between conditional stock market volatility and the release of information in the market place.[2] Fraser and Power (1997), examining the UK, US, and a number of Pacific Rim equity markets, found no substantial evidence to support the argument that the magnitude of information arrival in the market place has any impact upon conditional stock market volatility.[3] The use of macroeconomic variables in explaining stock return volatility changes was examined by Schwert (1989) using US data. Using several macroeconomic variables, namely inflation, industrial production, and money, his findings showed weak evidence that macroeconomic volatility can help predict stock return volatility. A study by Liljeblom and Stenius (1997) based on Finnish data found that between one-sixth and more than two-thirds of changes in conditional stock market volatility was related to conditional macroeconomic volatility, namely inflation, industrial production, and money supply.

The objective of this paper is to examine conditional volatility so as to determine whether changes in UK stock market volatility through time, as measured by the conditional variance, can be explained by time-varying conditional volatility in a number of macroeconomic variables.[4] The theoretical explanation for such a relationship comes from recognising that security prices are given by the discounted present value of expected future cashflows (Eq. (1)):

$$E_{t-1}P_t = E_{t-1}\sum_{k=1}^{\infty} D_{t+k}/(1+R_{t+k})^k \tag{1}$$

where D_{t+k} represents the capital gain plus any dividend paid to the shareholder in period $t+1$, and $1/(1+R_{t+k})^k$ is the discount rate for the period $t+k$ based on information available to at time $t-1$. E_{t-1} denotes the conditional expectation. The conditional variance of security prices at time $t-1$, $\mathrm{var}_{t-1}P_t$ will depend upon the conditional variance of expected future cash flows and future discount rates and on the conditional covariances between them. If one was to assume constant discount rates, then the conditional variance of both security prices and expected future cash flows should be proportional to one another. Since the level of corporate equity on the aggregate level should in turn depend on the health of the economy, it

[1] These models have explored the issue of estimating the conditional variance as against the unconditional variance. The latter could be a constant, while the former could be changing over time. Conditional variances are time dependent and are rarely identical to unconditional variances.

[2] Information proxied by trading volume.

[3] For the UK, no significant relationship was found with contemporaneous or lagged information.

[4] The use of macroeconomic variables is nothing new. Macroeconomic variables have been extensively adopted in the past to attempt to explain security returns (see Beenstock & Chan, 1988; Chen et al., 1986; Clare & Thomas, 1994; Poon & Taylor, 1991). The latter three refer to UK studies.