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Power arch modelling of the volatility of emerging equity markets

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Abstract

In developed equity markets the APARCH model of Ding, Granger and Engle [Ding, Z., Granger, C. and Engle, R., 1993. A long memory property of stock market returns and a new model. Journal of Empirical Finance 1, 83–106] has proven to be useful in modelling the leverage and asymmetry effects; power transformations and long memory; and non-normal conditional error distributions that characterise the data. Extending the analysis of Jayasuriya, Shambora and Rossiter [Jayasuriya, S., Shambora, W. and Rossiter, R., 2005. Asymmetric volatility in mature and emerging markets, Working Paper, Ohio University.] to a wider set of emerging markets this paper explores the applicability of the model to emerging markets. The key findings are as follows. First, unlike developed markets where a power term of unity and a conditional standard deviation model appears to be appropriate, emerging markets demonstrate a considerably greater range of power values. Second, unlike developed markets where non-normal conditional error distributions appear to fit the data well, there are a set of emerging markets for which estimation problems arise with a conditional *t* distribution, and a conditional normal distribution appears to be the preferred option. Third, the degree of volatility asymmetry appears to vary across the set of emerging markets, with the Middle Eastern and African markets having very different volatility asymmetry characteristics to those of the Latin American markets.

JEL classification: G15

Keywords: Emerging markets; Volatility; GARCH

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1. Introduction

The introduction of the ARCH/GARCH family of models (see Engle, 1982; Bollerslev, 1986) revolutionised the modelling of the volatility of financial time series. Since their introduction many additional features have been added to the base models to capture more complex volatility dynamics. These additional features include leverage and asymmetry effects; power transformations and long memory; and non-normal conditional error distributions. A popular general model that captures all of these features is the asymmetric power ARCH (APARCH) model introduced by Ding, Granger and Engle (1993). Ding, Granger and Engle (1993) and Hentschel (1995) show how the more simple ARCH models are nested within the more general APARCH models, and in addition demonstrate the applicability of the model to US stock market data.

Since that time, the applicability of the model has also been successfully demonstrated for a range of other developed stock markets (UK, Japan, Hong Kong, New Zealand, Germany, France, Singapore, Canada, and Australia) by Brooks, Faff, McKenzie and Mitchell (2000). In a multi-country setting (UK, Japan, Hong Kong, US, Germany, France, Singapore, Canada) Conrad and Karanasos (2003) successfully use a fractionally integrated APARCH model. Giot and Laurent (2003) use a skewed Student-*t* version of the APARCH model to estimate value at risk for three US stocks and three international markets (US, UK, Japan).

The APARCH model has also been successfully applied to a range of European stock markets. Leon and Mora (1999) include the APARCH model as one of the models that they consider in their comparison of a range of GARCH and stochastic volatility models for the Spanish stock market. Angelidis and Benos (2005) use an APARCH model as one of the models in their comparison of calculating value at risk for a number of Europe wide indices. Bohl and Siklos (2004) use the APARCH model to analyse feedback trading in the US and a range of developed and emerging European markets such as, Germany, UK, Czech Republic, Hungary, Poland and Russia. Degiannakis (2004) use a skewed Student-*t* version of the APARCH model to estimate value at risk for three US stocks and three European markets (France, UK, Germany).

The APARCH model has also been successfully applied to a range of Asian stock markets. Chen and Wong (2003) use the APARCH model to examine volatility transmission across the five ASEAN markets (Indonesia, Malaysia, Philippines, Singapore, Thailand) during the Asian crisis. Karansos and Kim (2006) use an APARCH model with non-normal error distributions and in drawing out some of the key theoretical properties of the model successfully apply the model to Korea, Japan, Hong Kong, Taiwan and Singapore. Ane and Ureche-Rangau (2006) extend the APARCH model to allow for regime switching and successfully apply that extended model to Japan, Hong Kong, Singapore and Malaysia. Huang and Lin (2004) use APARCH models to make value at risk calculations for Taiwan, both for the stock index and its associated futures. Ane (2006) uses the APARCH model to make value at risk calculations for Japan.

The above studies have focused on developed or emerging markets in particular regions. Jayasuriya et al. (2005) present a wider analysis of seven developed (Australia, Canada, France, Germany, Japan, UK, US) and fourteen emerging (Argentina, Brazil, Chile, India, Indonesia, Korea, Malaysia, Mexico, Pakistan, Philippines, Taiwan, Thailand, Turkey, Venezuela) markets across a range of regions and find evidence of volatility asymmetry across both developed and emerging markets. The plan of the present paper is to extend the analysis in Jayasuriya et al. (2005) and other papers that have examined particular regions to a wider set of emerging markets, and then compare the results across that wider set of markets.