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# Heterokedastic behavior of the Latin American emerging stock markets

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## Abstract

Few studies on emerging markets have been devoted to examine the nature of their volatility. This work analyzes the time series characteristics of six major Latin American equity markets: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. Non linear dependency and autoregressive conditional heterokedasticity are studied. The work includes several GARCH(p,q) models, including their exponential and GARCH–in–mean extensions. Weekly data for the 1989–1994 period from the International Financial Corporation is used. Not a single (G)ARCH model was found to depict volatility of these markets. Different models are more appropriate for each country. The best models seem adequate; the models reject autocorrelation, the distribution of the residuals is normal in all cases but one, the series are integrated, and heterokedasticity is rejected. The presence of heterokedasticity and autocorrelation in the major Latin American stock exchanges reflects their thinness and the presence of inefficiencies which reflect in time dependent high volatility. © 2001 Elsevier Science Inc. All rights reserved.

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## 1. Introduction

Sophisticated research on the emerging capital markets has been possible during the last few years due to the impressive growth and internationalization of some of these markets, spurred by financial liberalization and deregulation and structural changes implemented in their economies. Rising interest in these markets has been also made possible due to the

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availability of important data banks. Continuous and reliable time series about emerging markets activity has led to important studies to characterize the characteristic of these markets. Originally, “financial repression” and the lack of information limited the study of emerging capital markets to descriptive studies and policy oriented papers. Important models about financial intermediation and economic growth were also put forth, strongly suggesting financial liberalization to promote the participation of the capital markets in the savings and investments processes of the developing nations.<sup>1</sup>

Structural changes and financial liberalization policies undertaken by many countries during the last decade, along with economic and financial globalization, promoted an accelerated growth of stock exchanges along the world. Some “emerging” markets rose in importance and brought the attention of both practitioners and scholars. This led to an increased interest in determining the opportunities of investing in those markets to enhance portfolio returns.<sup>2</sup> The increased availability of information about these markets soon led to more serious empirical studies, beginning timidly with some inefficiency studies.<sup>3</sup> Currently, the financial literature gives account of studies dealing with co-movements, dynamic linkages, co-integration, seasonal effects, and other phenomena from the emerging markets.<sup>4</sup> Nevertheless, in relative terms, the literature on emerging markets is still scanty. Moreover, there are few studies identifying their stochastic behavior particularly concerning volatility. ARCH, ARCH-M, and GARCH and EGARCH-M models have been used to study these markets by Chiang, Jeon, and Oh (1996), Errunza, Hogan, Kini, and Padmanabhan (1994), Islam and Rodriguez (1997), Koutmos et al. (1993), Liu and Ming-Shiun (1997), Ortiz and Soldevilla (1997), and Thomas (1995). Complementing this research, this work attempts to study the time-series characteristics of six major Latin American stock markets: Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. Nonlinear dependency and autoregressive conditional heteroskedasticity are studied. Traditionally, stock market returns have been carried out assuming homoskedasticity. Following recent advances in the financial literature, this paper examines heteroskedastic behavior of these six Latin American markets. The study includes several GARCH( $p,q$ ) models including their exponential and GARCH-in mean extensions.<sup>5</sup>

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<sup>1</sup> Development financing theory is extensive. A comprehensive treatment on this issue, emphasizing capital markets can be found in Ortiz (1993). That article also has a fine bibliography on this matter.

<sup>2</sup> See Aggarwal and Schirm (1995), Avgustinous, Lonie, Power, and Sinclair (1997), Barry and Rodriguez (1998), Hartmann and Khambata (1993), and Shachmurove (1998). Works on returns and international diversification to emerging stock markets also emphasize exchange rate issues. See, for example, Ghosh and Ortiz (1998), Hauser and Yaari (1994), and Soenen and Schrepferman (1997).

<sup>3</sup> Recent works with this focus are Aggarwal and Leal (1996), Agrawal and Tandon (1994), Arbelaez and Urrutia (1998), Butler and Malaikah (1992), and Leal and Ratner (1994).

<sup>4</sup> See, for instance, the works by Alford and Lustier (1996), Arshanapalli and Doukas (1996), and Shachmurove (1996).

<sup>5</sup> ARCH models were originally developed by Bollerslev (1986), Engle (1982, 1983), Engle and Kraft (1983), and Miljoh (1985). ARCH-M modeling was proposed by Bollerslev (1987) and Engle et al. (1987); the models for Generalized Autoregressive Conditional Heteroskedasticity were introduced by Bollerslev (1986, 1990) and Taylor (1990). The exponential versions of the GARCH models were originally proposed by Nelson (1991).

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