The Quarterly Review of Economics and Finance 51 (2011) 133–140

Contents lists available at ScienceDirect

The Quarterly Review of Economics and Finance

journal homepage: www.elsevier.com/locate/qref

Return behaviour in Africa's emerging equity markets

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ARTICLE INFO

Article history:
Received 19 October 2008
Received in revised form 12 January 2011
Accepted 26 January 2011
Available online 3 February 2011

JEL classification:
C22
C52
G10

Keywords:
Return predictability
Volatility
Long memory
Nonlinearity
African stock markets

ABSTRACT

This paper provides evidence on return predictability in Africa's emerging equity markets. We concentrate our analysis on the behaviour of the first and second moments of return behaviour, risk return trade off and mean reversion. In a novel contribution to the stock return literature, we establish that individual time varying returns are predictable. Moreover, we find that empirical stylized facts such as volatility clustering, leptokurtosis and leverage effect are present in the African data. Using fractional integration techniques, we find that all African markets in our sample display evidence of long memory: an important indication of less than perfect arbitrage.

1. Introduction

One of the conspicuous examples of globalisation is the ease with which financial capital moves around the world, especially to developing countries. Private capital flows to emerging markets have risen from $25 billion in 1990 to $491 billion by 2005 (see World Bank, 2006). Part of this expansion in financial flows has been brought about by the growth of equity funds dedicated to investing in publicly listed securities in developing countries. Available data from the International Finance Corporation (IFC) indicates that the number of developing countries with actively trading stock markets increased from 31 to 78 between 1989 and 1998. The number of domestic companies listed on emerging market stock indices rose by over 300%, from 8709 to 26,354, and market capitalisation increased by 256% to $1.91 trillion within the same period. By the end of 2002, there were over 80 emerging stock markets and many more are being established each year. Africa has been part of this trend and, at the behest of national governments and, with the assistance of international financial institutions the number of stock markets expanded from less than 10 in the late 1980s to 26 currently.[1]

Stock markets have become an important conduit for raising long-term finance (see Khambata, 2000). Levine and Zervos (1995) argue that the two main channels of financial intermediation—banks and the stock market—should complement each other. Cho (1986) posits that credit markets need to be supplemented by well functioning equity markets, since equity finance does not experience adverse selection and moral hazard problems to the same extent as debt finance does in the presence of asymmetric information. The existence of equity markets would thus enhance capital allocation and diversify investment risk.

The ability of stock markets to fulfil their roles in the pricing and allocation of capital and, in diversifying investment risk depends on their efficiency. Thus, in an efficient market, prices of securities should '*fully reflect*' all available information (Fama, 1965, 1970). At the same time, empirical evidence on the stochastic behaviour of stock returns has produced important stylized facts—the distribution of stock returns appears to be leptokurtic (Fama, 1965;

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[1] In West Africa, the markets are located in Cape Verde, Cameroon, Cote d'Ivoire, Ghana and Nigeria: East Africa has exchanges in Kenya, Rwanda, Tanzania and Uganda. The North African markets are in Algeria, Egypt, Libya, Morocco, Sudan and Tunisia, with Mauritius in the Indian Ocean. Apart from the well established markets of South Africa and Zimbabwe, there are now exchanges in Botswana, Namibia, Malawi, Mozambique, Zambia, and Cameroon. Angola and Gabon are contemplating establishing their own markets. Admittedly, not all these markets are active (e.g., Rwanda has an over the counter exchange for government securities, Cameroon and Sudan are inactive, while the Libyan and Cape Verde exchanges are at their infancy).

1062-9769/$ – see front matter
doi:10.1016/j.qref.2011.01.004

Mandelbrot, 1963; Nelson, 1991). Further, short-term stock returns exhibit volatility clustering. These processes have been modelled successfully by ARCH-type models (Bollerslev, 1986; Engel, 1982). Moreover, changes in stock prices tend to be inversely related to changes in volatility (Bekaert & Wu, 2000; Black, 1976; Christie, 1982). Most of the empirical studies on these stylized facts have focused primarily on developed economies and the emerging markets in Asia and Latin America. Concerning African markets, there are only a few studies on the behaviour of stock returns (see Appiah-Kusi & Menyah, 2003; Mecagni & Sourial, 1999; Omran, 2007; Smith & Jefferis, 2005).

However, interest has been rekindled in African stock markets in recent times on account of their fast growth and relatively low correlation with the more developed markets. For instance, in 1994 African stock markets posted the biggest gains in U.S. dollar terms among all markets world-wide—Kenya (75%), Ghana (70%), Zimbabwe (30%), Egypt (67%). In 1995, African stock exchanges gained about 40% on their indices, with the value of stocks on the Nigerian stock market and Côte d'Ivoire's bourse registering over 100% increases in dollar terms.[2] Average returns on African stocks in 2004 reached 44%. This compares favourably with a 30% return on the Morgan Stanley Capital International (MSCI) global index, 32% in Europe, 26% in the U.S. (Standard & Poor's), and 36% in Japan (Nikkei).[3] Additionally, African stock markets provide benefits of portfolio diversification, as they tend to have zero, and sometimes negative, correlation with developed markets (see Harvey, 1995, for evidence on Nigeria and Zimbabwe). It thus becomes an important research endeavour to examine the evolution of stock returns in Africa's emerging stock markets, since this knowledge would be useful for regulators, academic research and professional fund managers.

In particular, this paper contributes to the growing literature on stock return predictability in African markets by employing a battery of time series techniques to uncover the dynamics of the first and second moments of return behaviour. After controlling for nonlinearity, conditional heteroscedasticity and time varying risk premia, we find that individual time varying stock returns are predictable. Using fractional integration methods, we find evidence in favour of long memory: an important indication of less than perfect arbitraging. Our estimates of the risk-return trade off indicate that investors are appropriately compensated for assuming risk, while empirical stylized facts such as leverage effect and leptokurtosis are prevalent in African returns. Previous research such as Brooks, Davidson, and Faff (1997), Appiah-Kusi and Menyah (2003) identified the presence of GARCH effects in some of the markets that we analyse in this paper.

The remainder of this paper proceeds as follows: the next section briefly examines the models employed. Section 3 describes the features of the data. We analyse and discuss the results in Section 4.

2. Modelling technique

Given the nature of the African data, we do not impose any specific data generating mechanism. Thus we first fit an AR(p) to the return series and examine whether the residuals are iid (independently and identically distributed). If we fail to explain the behaviour of the data and there is evidence against iid, we look beyond the linear model to explain the remaining structure of the series. Mills (1996) argues that, once the assumption of linearity is relaxed, a number of possible ways of modelling a time series increases dramatically, covering such classes as chaotic dynamics (Hsieh, 1991) and conditional heteroscedasticity models (Bollerslev, Chou, & Kroner, 1992).

Let $\Delta \log P_t$ be stock returns: the AR(p) model is then

$$\phi_p(L)\,\Delta \log P_t = \varepsilon_t \tag{1}$$

where the AR polynomial in L of order p is $\phi_p(L) = 1 - \phi_1 L - \cdots - \phi_p L^p$ and ε_t satisfies the white noise properties $E[\varepsilon_t] = 0$, $E[{\varepsilon_t}^2] = \sigma^2$ and $E[\varepsilon_t \varepsilon_s] = 0$, $\forall s \neq t$.

However, as Campbell, Lo, and MacKinlay (1997, p. 467) argue,

> "*many aspects of economic behaviour may not be linear. Experimental evidence and casual introspection suggest that investor's attitudes towards risk and expected return are non-linear. And the strategic interactions among market participants, the process by which information is incorporated into security prices, and the dynamics of economy-wide fluctuations are all inherently non-linear. Therefore, a natural frontier for financial econometrics is the modelling of non-linear phenomena*".

Since nonlinearity occurs in many forms, there is no single test that dominates all others. For this reason, we consider five statistical tests—the McLeod and Li (1983) and Engel (1982) test for (G) ARCH, Brock, Dechert, Scheinkman, and LeBaron's (1996) BDS test for randomness, Tsay's (1986) test for threshold effects and the Hinich and Patterson (1995) and Hinich (1996) bicovariance test. All these tests share a common principle—once any linear dependence is removed from the data, the remaining dependence must be due to nonlinearities in the data generating mechanism.

We fit an exponential GARCH-M, where the mean equation is specified as

$$\Delta \log\ P_t = \mu + \sum \phi_i\,\Delta \log P_{t-i} + \delta\sqrt{h_t} + \varepsilon_t, \quad \varepsilon_t \Omega_{t-1} \sim \text{NID}(0, h_t) \tag{2}$$

$\varepsilon_t = z_t\sqrt{h_t}$, where z_t is iid with zero mean and unit variance, and the conditional variance $|h_t|$ takes the form

$$\ln(h_t) = \omega + \sum_{i=1}^{q} \alpha_i g(z_{t-i}) + \sum_{j=1}^{p} \beta_j \ln(h_{t-j}) \tag{3}$$

where $g(z_t) = \theta z_t + \gamma[|z_t| - E|z_t|]$, $z_t = \varepsilon_t/\sqrt{h_t}$. The coefficient of the second term in (3), $g(z_t)$ is set to be 1 ($\gamma = 1$). Note that $E|z_t| = (2/\pi)^{1/2}$ if $z_t \sim N(0, 1)$. The function $g(z_t)$ is linear in z_t with slope coefficient $\theta + 1$ if z_t is positive and $\theta - 1$ if z_t is negative. By expressing the conditional mean in (2) as a function of the conditional variance, we are able to examine the risk premium hypothesis, i.e. whether investors are rewarded with extra return for taking on more risk. And by specifying an EGARCH model we account for asymmetry effects in the volatility process (see Black, 1976; Christie, 1982; Glosten, Jagannathan, & Runkle, 1993; Nelson, 1991). For instance, suppose $\theta = 0$: large innovations increase the conditional variance if $|z_t| - E|z_t| > 0$, and decrease the conditional variance if $|z_t| - E|z_t| < 0$. Alternatively, suppose $\theta < 1$: the innovation in variance, $g(z_t)$, is positive if the innovations z_t are less than $(2/\pi)^{1/2}/(\theta - 1)$. Therefore, negative innovations in returns cause the innovation to the conditional variance to be positive if $\theta < 1$. The natural log formulation ensures positive variances, thus dispensing with the need for parameter restrictions. Further, volatility at time t depends on both the size and sign of the normalized errors (see Nelson, 1991).

In empirical research it is often the case that (3) produces evidence that the conditional volatility process is highly persistent and possibly not covariance-stationary, suggesting that a model in which shocks have a permanent effect on volatility might be more appropriate. We apply fractionally integrated GARCH (FIGARCH)

[2] See the Economist, June 11, 1994: "Stalking Africa's Fledgling Stock Markets."
[3] Databank Group Research, 2004, Accra, Ghana.