Emerging Markets Group

EMG Working Paper Series

WP-EMG-12-2009

'Modelling Size and Illiquidity in West African Equity Markets'

Bruce Hearn and Jenifer Piesse

April 2009

Emerging Markets Group
Cass Business School
City University
106 Bunhill Row
London
EC1Y 8TZ
UK

www.cass.city.ac.uk/emg/

Modelling size and illiquidity in West African equity markets

Bruce Hearn

Sir John Cass Business School

106 Bunhill Row

London, EC1Y 8TZ, UK, and

King's College London

and

Jenifer Piesse*

School of Social Science and Public Policy

King's College London

150 Stamford St, London SE1 9HN, UK, and

University of Stellenbosch, RSA

Abstract

This paper assesses the effectiveness of traded turnover and Amihud (2002) metrics in measuring illiquidity, as used in a multifactor CAPM. The performance of this model is contrasted with GARCH and simple stochastic drift models on a new sample of five West African equity markets: Cote d'Ivoire, Ghana, Nigeria, Morocco and Tunisia, together with developed markets in London and Paris. Analysis of portfolio characteristics reveals that investment strategies based on Francophone markets outperform those of Anglophone markets in Africa, despite their lower mean returns. There is some evidence of limited benefits to investors from including assets from the small and highly illiquid Cote d'Ivoire and Ghanaian markets.

JEL classification: G11, G12, G15, O55

Keywords: Liquidity, Emerging Financial Markets, Sub-Saharan Africa, West Africa

Running title: Illiquidity and size in an augmented CAPM for West African stock markets

*Corresponding author: Department of Management, King's College London, 150 Stamford St, London SE1 9HN. Tel: 44(0)207 848 4164. Email: jenifer.piesse@kcl.ac.uk

Modelling size and illiquidity in West African equity markets

This paper assesses the effectiveness of traded turnover and Amihud (2002) metrics in measuring illiquidity, as used in a multifactor CAPM. The performance of this model is contrasted with GARCH and simple stochastic drift models on a new sample of five West African equity markets: Cote d'Ivoire, Ghana, Nigeria, Morocco and Tunisia, together with developed markets in London and Paris. Analysis of portfolio characteristics reveals that investment strategies based on Francophone markets outperform those of Anglophone markets, despite their lower mean returns. There is some evidence of limited benefits to investors from including assets from the small and highly illiquid Cote d'Ivoire and Ghanaian markets.

I. INTRODUCTION

The establishment of equity markets in developing economies since 1990 was prompted by a desire to benefit from foreign portfolio investment and provide an attractive venue for companies seeking to raise funds for much needed industrial and development projects. However, extreme illiquidity and high risk premiums are major concerns for both potential investors and firms trying to source cheap capital diversify ownership through a domestic listing (Lesmond, 2005; Hearn et al., 2009). West African securities markets are a particularly interesting sub-region of Sub Saharan Africa. Nigeria has the highest number of listed firms in Africa, with the exception of the developed market in South Africa, and the regional bourse in Cote d'Ivoire is unique as it is the only fully integrated market for member states of the Francophone West African Monetary Union (UMEAO[1]). There is also a clear division between West African states with a French civil code legal regime and those with institutions based on English common law (La Porta et al, 2008), a situation that has caused some regional financial integration initiatives to falter given the considerable differences in accounting standards, regulation and commercial law. For this reason, the West African countries are analysed here in conjunction with two more advanced North African countries, Morocco and Tunisia, which have had

[1] Union Monétaire et Économique de l'Afrique de l'Ouest (UMEAO) countries include Cote d'Ivoire, Benin, Togo, Burkina Faso, Mali, Niger, Senegal and Guinea-Bissau.

considerable influence on the development of the financial markets of Francophone West Africa, including the provision of technical, legal and commercial training programmes.

By its nature, liquidity is a difficult concept to define, largely because of its ability to transcend a number of transactional properties of markets including tightness, depth, resiliency (Lesmond, 2005) and information (O'Hara, 2003). Empirically defined constructs to capture liquidity centre on direct trading costs, measured by the bid-ask spread (quoted or effective) and indirect trading costs, which are often represented by price impact measures. The lack of reliable and consistent bid-ask quotes in many emerging markets leads to market activity proxies to capture liquidity. However, there is little consensus regarding the applicability and efficacy of measures such as turnover and the recently developed price impact variable of Amihud (2002) (Lesmond, 2005). Consequently, the first part of this study tests these two measures against the quoted bid-ask spread to estimate liquidity. Regression provides evidence of the higher association between the Amihud (2002) measure and total trading costs, defined as bid-ask spread plus trading fees.

While the literature concerning the importance of liquidity has been prominent for over a decade research on liquidity risk and its applications is more recent. Pastor and Stambaugh (2003) find evidence that leveraged investors with solvency constraints require higher expected returns for holding assets that are difficult to sell when aggregate liquidity is low. Furthermore, stocks with a higher sensitivity to aggregate liquidity generate higher returns than low-sensitivity stocks, confirming that liquidity is an important state variable for asset pricing. The inability of the traditional CAPM and the three factor augmented CAPM of Fama and French (1993) to capture liquidity represents a serious caveat in asset pricing (Liu, 2006). Liu (2006) and Daniel and Titman (1997) find evidence of the limited explanatory power of the Fama and French model. This is supported by Martinez et al (2005) who also find some support for the retaining the size factor. In addition, there are serious limitations of including the book-to-market variable particularly in the context of emerging markets as such data are inconsistent. Emerging stock markets are highly skewed with many dominated by a handful of large firms and the rest of the market populated with SMEs. Thus, a size factor should be retained within the pricing model to explain the cross section of returns. Therefore, the second part of the paper tests for these effects in the context of West Africa.

Three approaches are used to model aggregate total returns indices: a simple stochastic drift; the generalised autoregressive conditional heteroskedasticity (GARCH) model by Bollerslev (1987); and the size-liquidity augmented CAPM developed in this paper. Following model specification, the one step-ahead forecast of mean and variance-covariance is used within an optimised portfolio framework to assess the potential costs and benefits of diversification for investors. There is a considerable literature that uses GARCH and related market models of GARCH-in-Mean (GARCH-M) models to capture time series effects within equity price series. This was then extended to include GARCH models to capture the dynamics of autoregressive means and volatility processes for valuation in stock options (Ritchken and Trevor, 1999) as well as a variety of applications to equity indices and stock price volatility (Engle, 2001). In addition, this literature has spawned related families of ARCH/GARCH type models such as Exponential GARCH (Nelson, 1991). However, this paper models the conditional means of series through an autoregressive form augmented with simple generalised conditional heteroskedasticity techniques.

Modern portfolio theory indicates that investors should hold mean-variance efficient portfolios, which contrasts the ability to forecast means and covariances in terms of the consequent effects on optimal portfolio asset weights. Harvey (1994) compared the predicted mean and covariance matrix from a simple stochastic drift model, leading to an unconditional asset allocation strategy where managers have no information other than historic returns to predict future values to regression models that include a variety of world and local market variables as conditioning information. Furthermore Harvey (1994) explores the benefits to investors of diversification into emerging markets by the development of efficient frontiers. Chan et al (1999) assess the forecasting ability of a variety of models both in terms of variance tracking performance to a known benchmark and in relative portfolio weights in a minimum variance optimised portfolio setting. The focus is on individual industries within OECD markets, with a further paper that concentrates on market index level analysis Harvey (1995).

This study finds evidence that the liquidity and size factors are significant in explaining cross section of returns and outperforms the traditional CAPM. Following Liu (2006), the state nature of liquidity, and the view that liquidity risk better captures firm distress and associated solvency than the

combination of size and book-to-market factors used in Fama and French, explains the improved performance of the size and liquidity augmented model used here. The success of this multifactor CAPM supports the continued use of the risk-return paradigm in asset valuation in emerging country financial markets. Furthermore, the paper contrasts the performance of portfolios that include markets with legal and regulatory regimes based on French civil or English common law, given both are found in West Africa.

The paper is structured as follows. Section 2 has three distinct parts: the first provides an overview of the institutional features of West Africa's markets; the second introduces the liquidity measures and their construction; and the third discusses the data. Section 3 outlines the three approaches to modelling the total returns series, the simple stochastic drift, GARCH, and the three-factor size and liquidity augmented CAPM. It also briefly describes the application of mean-variance optimisation techniques. Section 4 discusses the empirical results. The final section concludes and makes some comments on development policy that follows from the evidence presented in the paper.

II. WEST AFRICAN EQUITY MARKETS AND LIQUIDITY MEASUREMENT

West Africa's securities markets

The principal characteristics of these markets are summarised below (see Piesse and Hearn, 2005) for an extended discussion of African stock markets).

Cote d'Ivoire/Bourse Regionale des Valeurs Mobilieres: The Bourse Regionale des Valeurs Mobilieres (BRVM) was established in 1973 as the Bourse de Abidjan in Cote d'Ivoire. However, given the economic and monetary union of Francophone West African countries (UMEAO) the local exchange was extended in 1998 to a regional basis and participation was encouraged, both in new listings as well as investment. The trading system is electronic with remote terminals installed in each of the licensed brokers, or Societe de Gestion et d'Intermédiation (SGI). Trading takes place daily and starts with a pre-opening call auction followed by continuous auction from 10-00 to 10-30am. Nine SGIs are based in Abidjan, another three in Dakar, Senegal, where the central bank is located, and another four in Benin. All other UMEAO countries have one SGI, for example, the market in Mali, which has been established jointly between the local finance communities. Technical issues relating

to exchange activities and marketing are handled by a separate Antennae de Bourse located in each country. Settlement is partially G30[2] compliant and there are a small number of well capitalized international custodian banks. Trading activity and market capitalization is highly concentrated with Sonatel, the Senegalese telecommunications company, accounting for 53.95% of traded value and 46.51% of capitalization, see Table 1. Although the microstructure of the regional bourse has been designed to precipitate the maximum order flow possible in one of the poorest regions of the world, it offers institutional investors minimal opportunities for diversification. For example, Table 2 indicates that average annual order flow from Mali accounts for less than 2% of traded value on the regional bourse, which is highly illiquid. Further, this figure is overwhelmingly dominated by a single individual investor who accounts for over 90% of trading in this tiny retail investment community. This adds further support to Lavelle (2001) who states that the BRVM acts to further concentrate wealth in the hands of local elites rather than act as a redistribution mechanism to enforce high governance standards by diversified ownership.

Tables 1 and 2

Ghana: The Ghana stock exchange was established in 1989 as part of the transition from socialist central planning under the guidance of the international financial institutions. Trading was originally three days per week but is now daily between 10-00 and 11-00am. This takes place on a trading floor and uses a simple form of continuous auction where bid and ask orders are written manually. However, although the market is partially G30 compliant and information is disseminated through Bloomberg and Reuters, regulation is weak with trades and prices often being agreed informally and the market institutions merely announcing pre-agreed details (Akotey, 2008). The market is highly concentrated with five stocks accounting for 79.08% of traded value and 67.15% of capitalization (see Table 1). Small local financial institutions seeking to diversify their balance sheets in accordance with

[2] G30 relates to the Group of Thirty that encourages standardisation and improvement in global securities administration. The major elements are: i) Brokers match trades on day after deal date (T+1); ii) Trade confirmation on trade day plus 2 days (T+2); iii) a Central Depository; iv) Net basis settlement of cash and stock; v) Settlement takes place as delivery vs. payment or receipt vs. payment; vi) Settlement in same day funds; vii Settlement effected on trade date plus 3 days (T+3) 8; viii) no Securities lending; ix) International securities numbering system (ISIN code).

international best practice are responsible for 64.84% of listed equity. Settlement is undertaken centrally using exchange facilities and there are plans for a central securities depository.

Nigeria: The Nigerian stock exchange was established in 1960 as the Lagos stock exchange with 19 listed firms. The remit of the exchange was extended as part of the governments privatization programme with additional branches opening in major commercial cities around the country including Kaduna (1961) and Abuja (1999) (Nigerian Stock Exchange, 2009). Trading is by an electronic continuous auction daily from 11-00am to 14-00pm and settlement is partially G30 compliant, with a central depository (in 1992) and international custodian banks. The 219 brokers and 234 listed firms ensures it is the largest market in West Africa and although trading activity and capitalization is less concentrated the financial sector accounts for 59.74% of market capitalization (see Table 1). Information dissemination is by stock exchange website, Reuters and local business journals.

Morocco: The Bourse de Casablanca was established in 1929, one of the oldest in North Africa. The exchange has progressed through several phases of development and in 1997 adopted an electronic trading system based on order matching located centrally. The trading system was improved in 2001 to facilitate delocalised trading by local brokers. MAROCLEAR, the central securities depository, was established in 1998 and became fully G30 compliant in 2001 (Bourse de Casablanca website, 2008). Trading is reported electronically to market participants and to international data vendors such as Bloomberg and Reuters, giving the market the opportunity to attract overseas investors. Stock market awareness is high and the exchange is used as a successful route for domestic flotation.

Tunisia: The Bourse de Tunis was established in 1969 and demutualized in 1995 with controlling shareholders being the stakeholders in the market, that is, the 24 local brokers. Trading moved to an electronic system with outlets for all licensed members in 1996 where small and illiquid securities are traded separately from the rest of the market (Bourse de Tunis website, 2009). Trading hours in the continuous market are 9-00am to 14-10pm in the months outside July, August and Ramadan where hours are 8-30am to 12-10pm. Settlement is fully G30 compliant. However, there is little domestic

stock market culture and only an estimated 5% of finance raised by firms in 2007 was through the stock exchange (Zribi, 2008).

Liquidity constructs

The Bid Ask spread and commission cost: The data on the end of month bid and ask quotes were collected from Datastream for London, Paris and Morocco, Bloomberg for Tunisia, and the stock exchange website for BRVM. Data were unavailable for Ghana or Nigeria. There is considerable variation in the length of intraday data London, Paris, Morocco and Tunisia all being available for over 15 years. Intraday data for the BRVM is available since inception in 1998 from the stock exchange website. Because of inconsistencies between the various data sources some was obtained directly from the markets. The bid-ask spread is calculated using the average of the available monthly quotes and incorporates at a minimum a single month's quote for that month. The average bid-ask spread spanning the quarter is used for the estimate of the spread. This procedure minimizes outlier problems and averages out the recording of either highs or lows in quotes resulting from monthly sampling. Following Lesmond (2005) bid-ask spreads that exceed 80% are trimmed as these are potentially errors. The monthly quoted spread is defined as:

$$Quoted\ spread_M = 1/2\left[\left(\frac{(Ask_M - Bid_M)}{(Ask_M + Bid_M)/2}\right) + \left(\frac{(Ask_{M-1} - Bid_{M-1})}{(Ask_{M-1} + Bid_{M-1})/2}\right)\right] \quad (1)$$

In order to estimate the total trading transaction costs, the costs associated with a round trade are added to the quoted spread for each month. Brokerage and Exchange fees are calculated from the fee schedules in Appendix 1. When a percentage commission fee is not provided the maximum fixed cost is applied to the aggregate daily traded value data.

Turnover: Daily trading volume and shares outstanding were obtained from a combination of Bloomberg, Datastream, and the national stock exchanges. There is considerable variation in this measure on an intra-market basis, reflecting the substantial differences in both liquidity and turnover for many companies in these markets. Any turnover statistics that exceed 100% of the shares

outstanding in any month are dropped. The shares-outstanding is determined at the start of the year and remains constant for the 12 months thereafter. The daily turnover measure is defined as:

$$1\Big/ D_M \sum_{t=1}^{M} \left(volume_t / \text{shares - outstanding} \right) \qquad (2)$$

where D_M is the number of days in the month, M.

Amihud (2002) measure: Daily price and volume data are from Bloomberg, Datastream and the national stock exchanges. The daily security prices are scanned for data errors, omissions and delistings. Following Lesmond (2005) the prices are used to calculate daily returns. To control for outliers, a filter eliminates daily prices that are +/- 50% of the prior day's price and that day's price as well as previous day's price are deleted from sample. Also, if zero volume occurs on day t, then that day is deleted from the average. Finally the measure is multiplied by one million as in Amihud (2002) to facilitate comparison. The Amihud measure is defined as:

$$1\Big/ D_M \sum_{t=1}^{M} \left(| R_t | / \text{Pr}\, ice_t \times Volume_t \right) \qquad (3)$$

Data: Sources

Daily stock closing, bid and ask prices, total number of shares outstanding, traded volumes, dividend per share in local currency and converted into sterling were from Datastream for London, Paris and Morocco. These variables were from both Bloomberg and the national stock exchanges for Tunisia, Nigeria, Ghana and BRVM. These data were used to calculate the daily return variance, market capitalization, and the liquidity constructs. The total returns series for each stock were from Datastream for London, Paris and Morocco and were constructed using Standard & Poors methods in assuming reinvestment of dividends and taking account of stock splits and rights issues. Exchange rate and UK - Gilt/Treasury yield data were from Datastream. The one-month UK-Gilt/Treasury Bill yield rate represents the risk free rate although this is adjusted to monthly equivalent values. The total returns series and prices were converted to sterling which assumes long term parity between individual domestic currencies and sterling. In many cases companies were deleted from the sample owing to

either data inconsistencies or the lack of data to compute the total returns. For example, Nigeria has 234 listings yet 60 do not have data and a further 45 firms are missing one critical determinant needed for the total returns indices. Consequently the sample size for Nigeria is 129 firms.

Data: Summary statistics relating to liquidity measures

The skewed nature of West Africa's equity markets in terms of trading activity and capitalization is in Table 3. This contrasts the mean cross section values for daily percentage zero returns, stock prices, traded volumes, market capitalization and bid-ask spreads for the FTSE100 and CAC40 indices as well as the West African markets. The latter are further sub-divided with BRVM, Ghana and Nigeria split into three groups: a total number of firms for which consistent data is available, and then the top 10 and top 5 firms as ranked by market capitalization. Morocco and Tunisia are further sub-divided into two groups: an overall group, dependent on where data is consistently available, and a top 10 grouping based on market capitalization. There is clear evidence of a size effect in all markets, with the mean cross sectional capitalizations of the top 5 and top 10 groupings of firms being several orders of magnitude larger than the overall market. Similarly the bid-ask spread, representing liquidity, decreases as mean cross sectional firm size increases indicating the association between size and liquidity, although this is not the case for BRVM where bid-ask spread increases as firm size increases from value of 0.0592 for cross section of 33 firms to 0.101 for top 5 firms. The percentage of zero daily returns variable, another measure of liquidity, in line with the general trend of bid-ask spreads, also decreases from the aggregate market groupings of firms to the top 10 and top 5 groups of firms. However, the greatest degree of illiquidity consistent across all groupings of firms is in BRVM and Ghana. Ghana has a percentage daily zero returns of over 77% for the overall market that decreases to 72.24% for the top 5 firms, while BRVM is the most illiquid market with 89.65% for the overall market and 80.23% for the top 5 firms, demonstrating the severe price rigidity in these markets.

Table 3

Correlations between the key variables affecting the bid-ask spread and liquidity are in Table 4, and given the different magnitudes the Spearman rank correlation is used. In addition to the bid-ask

spread and the two liquidity measurement constructs, turnover and the Amihud variables, price, daily price return volatility, traded volume, and market capitalization measures are used as control variables following (Stoll, 2000). Traded volume is significantly positively correlated to market capitalization in all markets except BRVM. The BRVM is also unique in having a positive correlation between stock price and market capitalization, that is, large stocks have higher prices as expected. In terms of the liquidity measures, the Amihud construct is highly positively correlated to the bid-ask spread in London and Paris while significantly negatively correlated to both market capitalization and traded volume for London, Paris and Tunisia. This is expected as any trading activity in stocks that are generally less traded and have lower market capitalizations consequently has a higher impact on price. Counter-intuitively, BRVM and Morocco traded volumes have positive correlations with the Amihud measure indicating that more highly traded stocks have greater impacts on price, although this may be an effect of severe illiquidity in these markets. The turnover variable is positively correlated to traded volume in Morocco, Tunisia and BRVM indicating that increased trading volume leads to higher values of turnover in line with the volume-based focus of this liquidity measure.

Table 4

III. EMPIRICAL MODELS

This section considers the following three models:

IID model: Unconditional asset allocation

This strategy is considered unconditional as it implies that there is no other information relevant for forecasting the next period's price other than the previous price. The expected returns are modelled as a rolling window of the mean returns over the previous 12 months. However this method does assume that the best forecast of the equity returns is its past average. This is consistent with the random walk with drift and assumes the time series is weak form efficient. The 12 month rolling window is extended for the calculation of standard deviation, variance, and covariance estimates. This is defined

$$y_t = \mu + \varepsilon_t \ldots\ldots \varepsilon_t \sim N(0, \Sigma), \qquad (4)$$

where μ and Σ are matrices of constant parameters. Recursive rolling window estimation is necessary for μ and Σ to generate vectors of sample means and covariances.

GARCH model: Conditional asset allocation

As discussed in Bollerslev (1987), there is evidence that the change in prices and rates of return are approximately uncorrelated over time, but characterised by tranquil and volatile periods. This study takes the conditional mean as being dependent only on its first order lag and a constant,

$$y_t = \alpha_0 + y_{t-1} + \varepsilon_t \tag{5}$$

with a GARCH (p, q) model for the conditional variance:

$$E\left(\varepsilon_t^2 \mid \psi_{t-1}\right) = h_{t|t-1} \tag{6}$$

$$h_t = \omega_0 + \sum_{i=1}^{p} \delta_i h_{t-i|t-1-i} + \sum_{j=1}^{q} \gamma_j \varepsilon_{t-j}^2 \tag{7}$$

where ω > 0, $\delta \geq 0$, $\gamma \geq 0$. It can be seen in (5) and (6) that there is a tendency for large (small) residuals to be followed by other large (small) residuals but of unpredictable sign. Equation (7) says that the value of h_t depends on past values of shocks (the q moving average terms), which are captured by the lagged squared residual terms, and on past values of itself (the p autoregressive terms) that are captured by lagged h_t terms. Bollerslev (1987) allows assumptions concerning mildly leptokurtic conditionally normal errors to be relaxed, and an adherence to conditionally t-distributed errors. This gives the GARCH model greater flexibility with financial time series with very fat-tailed distributions, which are typical in emerging market time series.

Size and Liquidity Augmented CAPM

Following the three-factor CAPM model of Fama and French (1993) plus the recent work of Martinez et al (2005) and Shum and Tang (2005), this paper modifies the augmented factors to take account of size and liquidity effects by capturing anomalies across the cross section of stock returns that are particularly prevalent in emerging markets. The construction of the market variable is complicated by the lack of appropriate regional benchmarks in the Sub Saharan African region overall and as a

consequence is chosen to be comprised of the universe of all sample group markets. In addition to the market excess returns, the model is augmented by the excess returns attributed to size (SMB), and the excess returns attributed to illiquidity (ILLIQ) and applies this model to a unique sample group of North and West African markets.

The three factors within the three-factor CAPM can be stated as the expected return on a risky portfolio *p*, in excess of the risk free rate $E(R_p) - R_f$ is a function of (i) excess return on the market portfolio, $R_m - R_f$; (ii) the difference between the return on a portfolio of small-size stocks and of large-size stocks, SMB; and (iii) the difference between the return on a portfolio of high illiquidity stocks and of low illiquidity stocks, ILLIQ. Therefore, the expected excess returns on a portfolio *p* of emerging market stocks can be written as

$$E(r_{pt}) - r_{ft} = \beta_p \left[E(r_{mt}) - r_{ft} \right] + s_i E(SMB) + h_i (HML) \tag{8}$$

The equilibrium relation of the Fama and French (1993) three factor model is stated in terms of expected returns. In order to test the model with historical data, it is necessary to transform (8) to the following estimating equation:

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + s_i SMB_t + h_i HML_t + \varepsilon_{it} \tag{9}$$

where the variables are described above and $\varepsilon_{p,t}$ is an iid disturbance term. In all cases, unconditional and conditional, simple mean-variance optimised minimum variance portfolios were formed following the techniques outlined in Harvey (1994) and Jackson and Staunton (2003).

IV. RESULTS

An assessment of the ability of liquidity measures to explain total costs

A more direct measure of association between the liquidity constructs and control variables, as defined in Stoll (2000), is provided through cross sectional panel regressions in Table 5. Interestingly, the control variables, namely price, volatility, traded volume, and capitalization or size, are consistently statistically significant in the London and Paris markets. Thereafter, traded volume is significant only in Morocco and occasionally in Tunisia. Although the turnover liquidity construct was statistically significant in explaining total trading costs for London, Paris and Tunisia it had little impact on the

overall explanatory power of these models compared with the Amihud measure. The coefficients for the Amihud variable also have higher values and a larger and more obvious association. However, while explanatory power was highest in the two European markets, greater than 60%, in Morocco and BRVM it was between 30% and 35% and Tunisian less than 10% indicating that none of the variables have a major impact on Tunisian total trading costs or liquidity.

Table 5

Summary statistics relating to size-liquidity sorted portfolios

Descriptive statistics for all nine size-illiquidity factor sorted portfolios and the zero-cost SMB and ILLIQ portfolios are in Table 6. The average mean returns increase considerably from large to small size stock portfolios. This is also reflected in the measure of volatility, where standard deviations increase dramatically from larger size firm to smaller size firm portfolios. Average returns in small size stock portfolios tend to be more risky than in larger stock portfolios, but also have higher potential returns. However the negative value of the mean of the SMB indicates the likelihood of a reverse size effect from that in Fama and French (1993) where returns steadily decrease as stock size increases. Although there is little difference between the low and high liquidity portfolio means, there is an increase in volatility from low illiquidity to high illiquidity stock portfolios. Even in a less liquid market this result is expected since the impact of sudden erratic order flow on stock prices reflects significant adjustments in value where there is occasional trading activity.

London and Paris stocks dominate the large and medium size sorted portfolios while Nigeria dominates the medium and small size portfolios. Furthermore London stocks tend to be concentrated in the low illiquidity sorted portfolios while Parisian stocks congregate in medium and high illiquidity portfolios. Nigerian small size stocks tend to be low illiquidity while those of medium size are high illiquidity. In contrast, Moroccan and Tunisian stocks tend to be small, with only a few medium size, and concentrated in high illiquidity portfolios.

Table 6

Generally these results are intuitive as London is a highly liquid international market and the stocks are from the FTSE100 index in terms of size and liquidity. Parisian stocks belonging to the CAC40 index, are also large but from a less liquid market than London. Nigeria has a wide range of capitalizations but in contrast to the European markets is smaller and much less liquid, while the firms in the Francophone markets of Morocco and Tunisia tend to raise less capital through stock markets, and hence have lower capitalizations and sizes.

Performance of traditional CAPM against three-factor CAPM

Table 7 reports the results from the grouped pooled regression on all nine size-illiquidity sorted portfolios. The Jensen alpha, α_p, from the one-factor CAPM is significantly different from zero in all cases with the exception of the small size-low illiquidity and medium size-medium illiquidity portfolios. In contrast, the Jensen alpha from the three-factor CAPM is not significantly different from zero in every case except for three portfolios: medium size-medium illiquidity, medium size-high illiquidity, and big size-high illiquidity. This is indicative of an overall improvement in performance of the three-factor model in contrast to the simple CAPM as the non-significant alpha terms infer little segmentation between the portfolios and the aggregate market portfolio. The estimated coefficients on both the market excess return (β_p) and the illiquidity factor (H_p) are large and significant in almost all cases. Those on the size factor-mimicking portfolio (S_p) are smaller in the majority of cases and are only significantly different from zero in the large or small-size company portfolios. The coefficients on the large-size portfolios are negative as well as being highly statistically significant. The negative sign on the large-size portfolio betas indicates that large firms' returns decrease when the size premium increases, which is the opposite for small firms. This behaviour is not expected and is indicative of a reversal of the documented "size effect" that effects the valuation of smaller firms (Martinez et al, 2005). It is also a feature of an extremely heterogeneous universe of stocks, where there are considerable differences between the firms that comprise the FTSE100 and Paris CAC40 indices and those listed on the much smaller and highly illiquid markets emerging markets. This is the opposite of what would be expected and does not provide investors with good hedging opportunities. Thus, as with the results for the small-size portfolios, a different valuation method would be needed to

price very high illiquidity stocks and firms accurately. The estimated coefficients on the illiquidity factor-mimicking portfolios are negative for low and medium-illiquidity portfolios indicating as expected that more liquid firms experience a decrease in expected returns when aggregate market illiquidity increases. In general, the coefficients on the low-illiquidity and medium-illiquidity portfolios are negative, as one would expect, with firms paying lower returns when the illiquidity variable increases. However, the coefficients on the high-illiquidity portfolios are positive indicating that these companies pay higher returns when the illiquidity measure increases. The increased explanatory power of these models illustrates that the augmented CAPM is appropriate for highly illiquid markets.

This is a very important result in the context of emerging markets, as the vast majority of research on the original Sharpe (1964) and Lintner (1965) CAPM is confined to developed markets. In the Table, the first adjusted R^2 [Adj R^2 (1)] is the result from regressing the expected return on risky portfolio *p*, in excess of the risk free rate $E(R_p) - R_f$ as a function of the excess return on the market portfolio, $R_m - R_f$. The second adjusted R^2 [Adj R^2 (3)] is the result from regressing the size and illiquidity augmented three-factor model on excess returns. In all size and illiquidity groups there is substantial improvement, in many cases by more than 100%. This provides further evidence that in a broad, market-wide context that considers stocks from all countries in this sample, the model has a good fit and the size and illiquidity factors are significant across the entire group.

Table 7

Modelling country portfolios and cost of equity estimation

Table 9 reports estimates of the cost of equity calculated from the expected returns from each country regression. It should be noted that the market portfolio used is restricted to a sample of largely small and illiquid African markets, composed of very small and volatile firms and consequently London and Paris are the only markets that are truly liquid and comprised of large firms with a low cost of equity. In contrast, the high cost of equity for the African markets is used as the discount factor and applied to future cash flows in project valuation. The cost of equity is calculated from the annualised

combination of the total risk premium, which is the sum of market, size and illiquidity premiums, with the 1 month UK Treasury rate a proxy for the risk free rate.

Tables 8 and 9

Average Returns in London and Paris: The London and Paris markets are highly developed with internationally recognised standards of corporate governance and regulation. Table 8 shows the explanatory power of the three factor model in both cases is good with adjusted R^2 terms in excess of 90%. Equally the Jensen alpha, α_p terms in both cases are not significant at the 99% confidence level. The cost of equity in Table 9 is lower for London (4.04%) than Paris (9.19%) indicating that listed firms in the former market benefit from higher regulatory standards despite the higher fixed auditing costs from regulatory compliance.

Average Returns in the Moroccan and Tunisian Markets: These two North West African markets have the highest levels of regulation and corporate governance in North Africa. However, despite all coefficients of the three factor model being significant at 99% confidence (Table 8) and the Jensen alpha, α_p, term in each case being not significantly from zero, the explanatory power of the models (0.2907 for Tunisia and 0.4418 for Morocco) are the lowest of the sample countries. The cost of equity shown in Table 9 for Tunisia is 12.53% and 18.62% for Morocco.

Average Returns in the Nigerian Market: The model has high explanatory power for Nigeria, with an adjusted R^2 of 0.8461 and a Jensen alpha coefficient not significantly different from zero. The cost of equity for Nigeria is the highest in the sample at 45.45%. This is largely due to high illiquidity caused by the lack of regulation and poor corporate governance with many firms presenting unaudited financial statements or statement prepared in accordance to Nigerian accounting rather than internationally recognised standards. This is common in a market dominated by smaller firms that have difficulty in affording the high fixed costs of employing independent auditors to perform regular and timely accounting reporting.

Performance of unconditional asset allocation strategy

The unconditional minimum variance portfolio performance results are reported in Table 10 and the recursively optimised portfolio holding weights are in Table 11. There are four potential portfolio combinations considered. The first two are the Anglophone and Francophone portfolios with the former being composed of London, Ghana and Nigeria and the latter of Paris, Morocco, Tunisia and BRVM. These represent the split of markets between the two predominant legal regimes: those of French civil code and English common law. The final two portfolio combinations contrast the difference in performance between an overall portfolio containing all markets with and then without the two highly illiquid markets of Ghana and BRVM. Analysis of investment Sharpe ratios that trade off a portfolios expected return against it's level of risk show that the Francophone portfolio, despite having a lower annual mean return that the Anglophone portfolio (18.38% for the former as opposed to 21.39% for the latter) has a higher Sharpe ratio (0.5366) in contrast to the English common law centred portfolio (0.4813). Interestingly the asset weights, shown in Table 11, are distributed between London and Ghana with Nigeria being minimal for the Anglophone portfolio. The Francophone portfolio tends to hold Parisian, Tunisian and Moroccan assets in approximately equal proportions while commonly maintaining a minimal holding of BRVM of less than 20%. However the portfolio with the highest Sharpe ratio (0.6792) is that of the overall portfolio including the two highly illiquid markets of Ghana and BRVM. This trades off a higher annual mean return (18.38%) with a lower risk (6.14%) against less preferable values (15.62% return and 6.65% risk, or standard deviation) for the overall portfolio not including Ghana and BRVM. Similarly analysis of asset weights in Table 11 shows that in both cases the portfolios are dominated by holdings of London, Morocco and Tunisia. Paris alongside Nigeria is held in minimal proportions. Ghana is held at a level of between 10% and 14% and BRVM is held under 10%. This infers that although Ghana and BRVM assets are held minimally owing to their mean-variance characteristics their inclusion does have beneficial effects on the overall risk-return characteristics of the overall portfolio.

Tables 10 and 11

Performance of conditional asset allocation strategy

The parameters in the GARCH only models in Table 12 that have a simple first order autoregressive term and constant in the mean equation also present problems of acceptable confidence levels. In all cases the constant term is statistically significant at the 90% confidence level. However only in the cases of Nigeria (2, 1), Ghana (3, 1) and BRVM (1, 1) are the autoregressive terms significant at the 90% confidence level. However generally the coefficients on the lagged error and standard deviation terms within the GARCH conditional volatility process are considerably less than unity implying that underlying structural breaks and associated upward bias and inefficiently estimated parameters is not a problem in this case (see an extended discussion on Integrated GARCH models in Mikosch and Starica (2004); Wong and Li (2001); Lanne and Saikkonen (2003)).

Table 12

Table 10 provides evidence of the portfolio performance characteristics for the conditional models using GARCH and three-factor CAPM to model conditional means and variance-covariance matrices. Optimal asset weights are provided in Table 11. The results from the GARCH models are similar to those of the unconditional model with the Francophone portfolio having a higher Sharpe ratio (0.4226) than that of its Anglophone counterpart (0.2504). There is a greater emphasis on holding London and Nigerian assets rather than Ghanaian assets in the unconditional case within the Anglophone portfolio. In the Francophone case all assets are held on an approximately equal basis with notably increased holdings in BRVM in contrast to those of the unconditional model. Similar to the unconditional model the portfolio combination with all markets including BRVM and Ghana has the highest Sharpe ratio (0.4563) while this portfolio has the majority of its asset weight distributed between London, Morocco and Tunisia with Ghana and BRVM generally being held in proportions of under 10%. Owing to the inability of Ghana and BRVM to be modelled effectively using the three-factor CAPM model due to the extreme levels of price rigidity, or illiquidity, the single portfolio constructed using this model contains all markets except these two. Interestingly the Sharpe ratio obtained from using this CAPM conditional modelling technique (1.7249) is considerably higher than those of either the unconditional stochastic drift or conditional GARCH models. In line with this figure the annual mean returns (14.38%) are only slightly lower than those obtained from the other

strategies while levels of risk, or standard deviation, (1.46%) are dramatically lower. The high Sharpe ratios indicate that this conditional model infers the best risk-return related performance.

Further confirmation of the performance characteristics of the various combinations and portfolios can be seen from the loci of the investment frontiers (Figure 1). While the frontiers of the Anglophone portfolio (Figure 1(a)) fit tightly together with little real opportunity for increasing potential returns the Francophone frontiers (Figure 1(b)) have a similar profile of horizontal risk but augmented with a wider vertical distribution inferring greater opportunities to vary returns without increasing levels of risk. Interestingly the frontier loci of the aggregate portfolio excluding Ghana and BRVM (Figure 1(c)) have greater horizontal dispersion and are less spread vertically than fort he portfolio including BRVM and Ghana (Figure 1(d)). This provides further evidence that there are benefits for investment managers from the selective inclusion of BRVM and Ghanaian assets in portfolios. Figure 1(e) provides a contrasting frontier loci derived from having used the three-factor CAPM for the overall portfolio excluding BRVM and Ghana. In comparing the profile of the loci to that of Figure 1(c), that used the GARCH model, the frontier has a far greater vertical spread of potential mean return values while benefitting from a significantly decreased horizontal dispersion of values. This provides further evidence of the benefits of the three-factor CAPM in modelling equity returns.

Figure 1

V. CONCLUSIONS

This study proposes a size and liquidity augmented capital asset pricing model to explain the cross section of expected returns in West Africa, a region which has previously been excluded from empirical research in finance. Three West African and two North African markets are used in addition to London and Paris. The African markets are the large Nigerian stock exchange, the smaller integrated Francophone regional market of BRVM, the small Ghanaian stock exchange and the Moroccan and Tunisian bourses. Illiquidity series were constructed on a time-series cross-section basis and augment the Fama and French (1993) risk-adjusted CAPM. While costs of equity for the markets are estimated from the three-factor CAPM, the potential for portfolio investment

diversification is assessed from contrasting the conditional mean and variance-covariance matrices using GARCH and a stochastic model with drift. Results show that the cost of equity is highest in Nigeria followed by Tunisia and then Morocco and finally by Paris and London. These results shed light on the depth and level of adherence to regulations within these markets and the quality of market institutions. Consequently, firms in Nigeria raising capital domestically to fund industrial expansion are at a distinct disadvantage to those in North Africa or Europe.

Three models are applied to the time series data with considerable differences in the suitability and benefits of each. In practical terms the unconditional iid strategy is questioned as it is only necessity for an investment manager to only be able to predict future trends on the basis of past activity, despite the intuitive appeal of this strategy and the logical results obtained. All modelling strategies show the best trade off between risk and return, as measured by the Sharpe ratio, is for the portfolio containing all market assets in addition to the small and highly illiquid Ghanaian and BRVM assets. This indicates there is some potential for smaller exchanges to attract investment in providing diversification possibilities for overseas investment fund managers. These results merit the extension of the analysis using GARCH in the construction of portfolio efficient frontiers. The frontiers that represent investment opportunities are most diffuse when formed by assets from all markets except Ghana and BRVM. In contrast the frontier for the same aggregate portfolio including assets from the Ghanaian and BRVM markets demonstrates a more vertically flatter profile with little horizontal spread. Thus, any change of asset weights results in increases/decreases in returns with only incremental increase in risk. Finally, the frontier formed from the three-factor CAPM provides the flattest vertical profile and least horizontal inclination supporting the Sharpe ratios where this modelling strategy inferred the best risk-return performance.

This study provides substantial evidence of the benefits of size and liquidity as augmenting factors in the traditional CAPM in explaining stock returns in a new application to West African stock markets. To promote growth of these markets and economic development, it is essential that policy is directed towards improving regulation and its enforcement. In Nigeria, this can reduce the high cost of equity and increase the competitiveness of the stock market and make it a cheaper source of funds than the more established local banking industry. Ghana and the UMEAO countries would also

benefit from improved institutions. This is an important message to international investors as evidence from simple portfolio analysis indicates there are some performance benefits to holding small amount of assets from the Ghanaian and BRVM stock markets, despite their size and illiquidity. There are also clear differences between the markets following French civil code as opposed to English common law. Given the better implementation of the former legal regime within these markets, simple mean variance portfolio analysis reveals advantages for investors in contrast to common law markets in the region. It appears that regulation based on French civil code is easier to implement effectively and thus more suitable for emerging and developing markets.

References

Akotey, A. J. (2007) Interview with Armah Akotey, Vice President of Investments, Databank Brokerage Ltd, Accra, Ghana. 23 December 2008.

Amihud, Y. (2002) Illiquidity and stock returns: cross section and time series effects. *Journal of Financial Markets*, **5**, 31-56.

Bollerslev, T. (1987) A Conditionally Heteroskedastic Time Series Model for Speculative Prices and Rates of Return. The Review of Economics and Statistics, **69**, 542-547

Bourse de Casablanca website (2008) Bourse de Casablanca, Morocco. Available at http://www.casablanca-bourse.com/

Chan, L. K. C., Karceski, J. and Lakonishok, J. (1999) On Portfolio Optimization: Forecasting Covariances and Choosing the Risk Model, *Review of Financial Studies*, **12**, 937-974.

Daniel, K., and Titman, S. (1997) Evidence on the characteristics of cross sectional variation in stock returns. *Journal of Finance*, **52**, 1-33

Engle, R. (2001) GARCH 101: The Use of ARCH/GARCH models in Applied Econometrics, *Journal of Economic Perspectives*, **15**, 157-168

Fama, E. and French, K. (1993) Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics,* **33**, 3-56.

Harvey, C. R. (1994) Conditional Asset Allocation in Emerging Markets, Working Paper: March 1994, Duke University, Durham, NC.

Harvey, C. R. (1995a) The Cross Section of Volatility and Autocorrelation in Emerging Stock Markets, *Finanzmarkt und Portfolio Management*

Harvey, C. R. (1995b) The Risk Exposure of Emerging Equity Markets, *World Bank Economic Review*, **9**, 19-50.

Hearn, B., Piesse, J. and Strange, R. (2009) Market Liquidity and Stock Size Premia in Emerging Financial Markets: The Implications for Foreign Investment. *International Business Review,* **16**, forthcoming

Jackson, M. and Staunton, M. (2003) Advanced modelling in finance using Excel and VBA, Wiley Finance, Chichester, England.

Lanne, M. and Saikkonen, P. (2003) Modeling the U.S. Short Term Interest Rate by Mixture of Autoregressive Processes, *Journal of Financial Econometrics*, **1**, 96-125.

La Porta, R., Lopez-de-Silanes, F., and Shleifer, A. (2008) The Economic Consequences of Legal Origins. *Journal of Economic Literature*, **46**, 285-332

Lavelle, K. (2001) Architecture of Equity Markets: The Abidjan Regional Bourse, *International Organization*, **55**, 717-742.

Lesmond, D. A. (2005) Liquidity of emerging markets. *Journal of Financial Economics*, **77**, 411-452.

Lintner, J. (1965) The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics*, **17**, 13-37.

Liu, W. (2006) A Liquidity-augmented capital asset pricing model. *Journal of Financial Economics*, **82**, 631-671.

Martinez, M. A., Nieto, B., Rubio, G. and Tapia, M. (2005) Asset pricing and systematic liquidity risk: An empirical investigation of the Spanish stock market. *International Review of Economics and Finance*, **14**, 81-103.

Mikosch, T. and Starica, C. (2004) Nonstationarities in Financial Time Series, the Long-Range Dependence, and the IGARCH Effects, *Review of Economics and Statistics*, **86**, 378-390

Nelson, D. (1991) Conditional Heteroskedasticity in Asset Returns: A New Approach. *Econometrica*, **59**, 347–70.

Nigerian Stock Exchange (2009) Nigerian Stock Exchange History, Available at http://www.nigerianstockexchange.com/the_exchange.htm

O'Hara, M. (2003) Presidential address: liquidity and price discovery. *Journal of Finance*, **58**, 1335-1354

Pastor, L. and Stambaugh, R. (2003) Liquidity risk and expected stock returns. *Journal of Political Economy*, **111**, 642-685.

Piesse, J. and Hearn, B. (2005) Regional Integration of Equity Markets in Sub-Saharan Africa. *South African Journal of Economics*, **73**, 36-52.

Ritchken, P. and Trevor, R. (1999) Pricing Options under Generalized GARCH and Stochastic Volatility Processes, *Journal of Finance*, **54**, 1521-1555

Sharpe, W. F. (1964) Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance*, **19**, 425-442.

Stoll, H. R. (2000) Friction, *Journal of Finance*, **55**, 1480-1514.

Wong, C. and Li, W. (2001) On a Mixture Autoregressive Conditional Heteroscedastic Model, *Journal of the American Statistical Association*, **96**, 982-995

Zribi, H. (2008) Interview with Hatem Zribi, Market Development, Bourse de Tunis, Tunisia. 18 January 2008.

Table 1. Market Capitalisation and Turnover profiles, 2008

	Morocco	Tunisia	BRVM (Cote d'Ivoire)	Ghana	Nigeria	London FTSE100	Paris CAC40
Total Number of Listed Firms	78	53	39	31	234	102	40
Market Capitalisation							
Top 1 Firm Market Capitalisation to total (%)	27.55	12.51	46.51	22.10	8.40	7.50	10.58
Top 5 Firms Market Capitalisation to total (%)	57.81	43.56	71.49	67.15	27.08	29.96	37.64
Top 10 Firms Market Capitalisation to total (%)	74.29	65.23	84.50	85.03	44.38	45.34	58.96
Top 20 Firms Market Capitalisation to total (%)	88.88	88.20	96.29	98.80	64.33	65.53	81.06
Turnover							
Top 1 Firm Turnover value to total (%)	19.42	9.69	53.95	26.25	9.00	5.72	8.98
Top 5 Firms Turnover value to total (%)	58.92	38.19	89.53	79.08	36.45	23.77	33.63
Top 10 Firms Turnover value to total (%)	78.00	61.98	95.54	93.11	52.66	41.30	51.81
Top 20 Firms Turnover value to total (%)	92.01	86.51	98.70	99.71	69.59	61.10	74.54
Sector Concentration by Market Capitalization							
Financials	42.04%	57.38%	7.13%	64.84%	59.74%	-- --	-- --
Communications	27.55%	0.31%	46.36%	0.02%	1.37%	-- --	-- --
Basic Materials	3.37%	3.89%	0.53%	0.92%	0.53%	-- --	-- --
Consumer cyclical	2.55%	12.16%	2.81%	0.60%	2.81%	-- --	-- --
Consumer non-cyclical	4.35%	8.92%	25.49%	30.23%	17.79%	-- --	-- --
Diversified	7.39%	12.51%	-- --	-- --	1.57%	-- --	-- --
Energy	1.46%	0.38%	3.08%	3.30%	10.41%	-- --	-- --
Industrial	9.93%	4.45%	12.23%	-- --	5.35%	-- --	-- --
Technology	0.14%	-- --	-- --	0.08%	0.02%	-- --	-- --
Utilities	1.23%	-- --	2.37%	-- --	-- --	-- --	-- --

Source: Compiled by authors from Bloomberg

Table 2. Market Microstructure characteristics for BRVM antennae de bourse in Mali

Investor type	Variable	Order Type	2005	2006	2007	2008
Individual	Mean trade size for Equities	Purchase	558 [20]	1,173 [47]	11,263 [18]	5,800 [15]
		Sale	350 [19]	80 [12]	5,342 [30]	24,855 [26]
	Mean trade size for Bonds	Purchase	0 [0]	1,490 [2]	0 [0]	1,000 [1]
		Sale	146 [11]	80 [1]	542 [3]	167 [4]
	Number Individual investors		21	11	12	12
	Proportion of activity by single most active individual		37.58%	93.27%	98.09%	87.51%
Institutions	Mean trade size for Equities	Purchase	0 [0]	69 [2]	2,226 [9]	9,150 [11]
		Sale	0 [0]	0 [0]	260 [2]	22,294 [7]
	Mean trade size for Bonds	Purchase	431 [18]	187 [3]	503 [3]	0 [0]
		Sale	300 [1]	400 [1]	35 [1]	34 [1]
Total Individuals	Number of Certificates		19,428 [50]	59,141 [62]	10,330 [49]	710,030 [45]
Total Institutions	Number of Certificates		8,060 [19]	1,097 [6]	22,102 [15]	256,741 [19]
Total	Total traded Equities	Purchase	11,163 [20]	55,256 [49]	222,765 [27]	187,647 [26]
		Sale	6,655 [19]	962 [12]	5,862 [32]	777,423 [32]
	Total traded Bonds	Purchase	7,760 [18]	3,460 [4]	1,510 [3]	1,000 [1]
		Sale	1,910 [12]	560 [3]	2,745 [6]	701 [5]
	Traded value Equities (Mali) UK£(m)		0.46	0.29	0.41	0.47
	Traded value Equities (BRVM) UK£(m)		16.67	51.03	79.36	150.43
	% of total traded value on BRVM		2.76%	0.56%	0.52%	0.31%

Source: Compiled by authors from Societe de Gestion et d'Intermédiation (SGI), Bamako, Mali

Notes: Square brackets indicate the number of matched trades undertaken on annual basis. Bonds includes both Malian and UMEAO sovereign treasury and corporate instruments. All investors are Malian and are either resident in Mali or France. Traded Value denominated in millions GBP (UK£)

Table 3. Summary Statistics

Country	Start	No. Firms by trading activity	Zero Return (%)	Local market Price	Local market Volume (thousands)	Local market Market Capitalization (millions)	£UK equivalent Price	£UK equivalent Market Capitalization (millions)	Bid-Ask spread (%)
Europe									
London (FTSE 100)	1991	101	12.04 [11.93]	537.89 [539.20]	193,989.62 [141,919.17]	9,275.19 [9,959.53]	537.89 [539.20]	9,275.19 [9,959.53]	0.0085 [0.0089]
Paris (CAC 40)	1991	40	7.13 [6.26]	37.37 [35.52]	635.78 [542.28]	8,793.01 [5,342.61]	25.66 [24.59]	8,817.09 [8,322.69]	0.0042 [0.0039]
Africa									
Morocco	1993	Top 10	43.82 [39.55]	663.27 [636.16]	4,568.47 [1,507.30]	12,228.62 [8,519.74]	42.63 [40.36]	785.21 [528.93]	0.0017 [0.0000]
		40	66.43 [66.67]	616.07 [635.06]	7,071.77 [5,205.65]	4,045.14 [3,077.26]	39.62 [39.75]	263.65 [200.44]	0.0054 [0.0000]
Tunisia	1991	Top 10	51.33 [50.44]	36.42 [33.20]	648.06 [457.64]	187.80 [187.01]	20.21 [17.57]	98.03 [91.49]	0.185 [0.1977]
		37	64.97 [66.04]	34.65 [32.02]	1,084.96 [835.74]	58.59 [48.28]	18.93 [16.02]	103.70 [95.10]	0.5337 [0.6913]
BRVM (Cote d'Ivoire)	1998	Top 5	80.23 [81.91]	21,739.91 [15,113.65]	95.55 [24.94]	141,792.17 [81,624.38]	23.23 [15.52]	151.69 [83.62]	0.101 [0.0939]
		Top 10	83.86 [85.45]	27,191.23 [22,992.42]	110.87 [34.42]	89,600.37 [52,242.39]	28.54 [23.49]	95.42 [54.56]	0.0857 [0.0817]
		33	89.65 [90.47]	21,727.78 [19,088.84]	131.38 [62.19]	35,810.08 [27,313.47]	22.59 [18.93]	37.85 [27.51]	0.0592 [0.0589]
Ghana	2000	Top 5	72.24 [74.66]	2.8144 [2.8816]	945.31 [266.88]	96.77 [104.59]	1.6678 [1.8004]	56.30 [65.95]	-- --
		Top 10	74.43 [79.11]	1.6894 [1.943]	1,784.12 [772.95]	67.92 [77.29]	0.9908 [1.1474]	39.73 [47.99]	-- --
		18	77.22 [83.02]	1.0626 [1.2458]	2,565.28 [1,411.05]	41.90 [51.09]	0.622 [0.7413]	24.57 [30.53]	-- --
Nigeria	2002	Top 10	41.96 [43.18]	12.0450 [7.2429]	1,537,138.03 [920,356.09]	123,079.19 [51,593.87]	0.0518 [0.0297]	540.25 [214.07]	-- --
		Top 20	42.61 [46.47]	23.3492 [18.3349]	1,873,151.36 [1,048,748.96]	89,878.16 [52,539.05]	0.1013 [0.0772]	391.76 [217.99]	-- --
		129	63.67 [66.94]	18.7603 [18.4429]	2,631,207.67 [1,373,235.44]	30,129.70 [25,008.37]	0.0813 [0.0768]	132.49 [102.05]	-- --

Source: Compiled by authors from Bloomberg, Datastream and National stock exchanges

Notes: Square parentheses indicate median values for each variable. Price is the average of daily prices over each month and is stated in domestic currency and converted to £UK using the average exchange rate for each month and country. Volume is the average of the daily trading volume over each month and is stated in thousands. Market capitalization is measured as of 1 January for each country and is equity market value for each firm expressed in millions of local currency or £UK. The monthly average bid-ask spread is taken across all stocks to obtain a market wide measure, for which an annual mean is calculated.

Table 4. Cross sectional Spearman's rank correlations

Panel A: Results for London (FTSE 100 constituent companies) (1991M01 – 2007M12)

	Price	Volatility	Volume	MV	Amihud	Turnover	Bid Ask Spread
Price	100.00%						
Volatility	-14.45%	100.00%					
Volume	-26.55%	13.49%	100.00%				
MV	40.19%	-9.99%	66.10%	100.00%			
Amihud	-39.31%	17.41%	-69.00%	-92.73%	100.00%		
Turnover	-38.87%	23.00%	33.62%	-17.81%	2.89%	100.00%	
Bid Ask Spread	-46.32%	22.80%	-50.10%	-82.25%	84.37%	8.93%	100.00%

Panel B: Results for Paris (CAC 40 constituent companies) (1992M01 – 2007M12)

	Price	Volatility	Volume	MV	Amihud	Turnover	Bid Ask Spread
Price	100.00%						
Volatility	-9.54%	100.00%					
Volume	22.73%	-4.45%	100.00%				
MV	39.67%	1.75%	66.04%	100.00%			
Amihud	-26.57%	27.12%	-91.69%	-62.36%	100.00%		
Turnover	-23.78%	-3.52%	26.64%	-43.51%	-22.10%	100.00%	
Bid Ask Spread	-18.50%	18.26%	-70.19%	-49.86%	70.76%	-17.12%	100.00%

Panel C: Results for Morocco (1993M08 – 2007M12)

	Price	Volatility	Volume	MV	Amihud	Turnover	Bid Ask Spread
Price	100.00%						
Volatility	-9.09%	100.00%					
Volume	-28.21%	-5.47%	100.00%				
MV	25.13%	-11.47%	54.43%	100.00%			
Amihud	-35.62%	55.65%	-8.75%	-24.72%	100.00%		
Turnover	-33.92%	-4.60%	64.75%	-4.45%	-4.73%	100.00%	
Bid Ask Spread	6.33%	5.93%	-17.23%	-14.34%	3.09%	-13.12%	100.00%

Panel D: Results for Tunisia (1993M08 – 2007M12)

	Price	Volatility	Volume	MV	Amihud	Turnover	Bid Ask Spread
Price	100.00%						
Volatility	-24.37%	100.00%					
Volume	-9.69%	13.82%	100.00%				
MV	47.03%	-18.99%	50.16%	100.00%			
Amihud	-25.36%	38.70%	-52.09%	-53.46%	100.00%		
Turnover	-1.10%	20.58%	81.16%	13.33%	-38.69%	100.00%	
Bid Ask Spread	-6.09%	22.02%	-40.24%	-38.40%	44.27%	-26.42%	100.00%

Panel E: Results for BRVM Cote d'Ivoire (1995M10 – 2005M03)							
	Price	Volatility	Volume	MV	Amihud	Turnover	Bid Ask Spread
Price	100.00%						
Volatility	-8.18%	100.00%					
Volume	2.32%	24.90%	100.00%				
MV	61.39%	3.16%	41.74%	100.00%			
Amihud	-32.45%	67.02%	-8.87%	-25.99%	100.00%		
Turnover	10.06%	20.26%	73.90%	8.59%	-9.34%	100.00%	
Bid Ask Spread	-23.79%	7.57%	1.56%	-13.13%	8.18%	0.57%	100.00%

Table 5. Total costs on liquidity proxies and measures

Market	Intercept	Price	Volatility	Volume	Size	Amihud	Turnover	Adj-R^2
London	0.1420	-0.0086	0.1808	-0.0075	-0.0057			68.15
FTSE100	[16.06]	[-11.66]	[8.54]	[-12.94]	[-7.41]			
	0.1038	-0.0070	0.1356	-0.0047	-0.0045	**4.5977**		74.12
	[16.99]	[-10.19]	[8.0945]	[-10.42]	[-6.88]	**[8.08]**		
	0.1279	-0.0043	0.1634	-0.0024	-0.0109		**-0.0053**	69.12
	[16.27]	[-4.65]	[8.15]	[-3.66]	[-9.21]		**[-10.41]**	
	0.0917	-0.0032	0.1205	-0.0002	-0.0092	**4.5296**	**-0.0047**	74.91
	[17.03]	[-3.51]	[7.62]	[-0.25]	[-8.92]	**[8.12]**	**[-10.29]**	
Paris CAC40	0.0587	0.0106	0.1628	-0.0145	0.0007			63.97
	[13.08]	[7.83]	[9.51]	[-17.35]	[1.49]			
	0.0549	0.0096	0.0778	-0.0132	0.0006	**0.0007**		65.77
	[11.85]	[6.55]	[2.07]	[-14.18]	[1.37]	**[3.21]**		
	0.0405	0.0107	0.1585	-0.0252	0.0112		**0.0106**	64.09
	[5.61]	[7.89]	[9.45]	[-7.12]	[3.32]		**[3.15]**	
	0.0375	0.0096	0.0741	-0.0232	0.0106	**0.0007**	**0.0100**	65.88
	[5.42]	[6.59]	[2.00]	[-6.02]	[3.04]	**[3.17]**	**[2.89]**	
Morocco	0.0375	-0.0030	0.0405	-0.0082	0.0035			32.98
	[6.66]	[-1.15]	[1.22]	[-7.82]	[1.32]			
	0.0424	-0.0041	0.0501	-0.0087	0.0036	**-0.0001**		33.15
	[7.47]	[-1.62]	[1.44]	[-8.09]	[1.37]	**[-5.06]**		
	0.0509	-0.0045	0.0405	-0.0103	0.0054		0.0019	32.98
	[2.47]	[-1.27]	[1.23]	[-3.44]	[1.53]		[0.73]	
	0.0499	-0.0050	0.0499	-0.0099	0.0047	**-0.0001**	0.0011	33.14
	[2.36]	[-1.40]	[1.44]	[-3.21]	[1.29]	**[-4.82]**	[0.39]	
Tunisia	0.0521	-0.0101	0.1249	-0.0023	-0.0011			8.99
	[0.58]	[-0.78]	[1.06]	[-1.53]	[-0.08]			
	0.0428	-0.0117	0.1428	-0.0025	0.0004	-7.13E-07		9.01
	[0.48]	[-0.93]	[1.22]	[-1.67]	[0.04]	[-1.73]		
	0.2670	-0.0736	0.1537	-0.0822	0.0620		**0.0798**	9.26
	[2.67]	[-2.15]	[1.31]	[-2.36]	[1.81]		**[2.31]**	
	0.2747	-0.0822	0.1815	-0.0903	0.0704	**-9.96E-07**	**0.0875**	9.33
	[2.69]	[-2.39]	[1.56]	[-2.54]	[2.05]	**[-2.23]**	**[2.47]**	
BRVM	0.3056	-0.0440	-0.0123	-0.0052	-0.0043			17.66
	[3.21]	[-1.47]	[-0.07]	[-1.27]	[-0.18]			
	0.3143	-0.0455	0.0500	-0.0061	-0.0042	**-0.0103**		17.80
	[3.28]	[-1.53]	[0.29]	[-1.49]	[-0.17]	**[-1.87]**		
	1.1929	-0.1969	-0.0121	-0.1895	0.1486		0.1832	17.93
	[2.35]	[-1.77]	[-0.06]	[-1.78]	[1.42]		[1.71]	
	1.2260	-0.2026	0.0528	-0.1956	0.1528	**-0.0108**	0.1882	18.10
	[2.43]	[-1.83]	[0.31]	[-1.85]	[1.47]	**[-1.95]**	[1.77]	

Notes: White cross-section t-statistics are in parentheses. Bold indicates significance at 95% confidence level

Table 6. Summary statistics for equally weighted monthly excess returns on 9 portfolios formed on size and illiquidity for period 2002 to 2008

Portfolio	S/L	S/M	S/H	M/L	M/M	M/H	B/L	B/M	B/H
Panel A: Summary Statistics for portfolios									
Mean	0.01213	0.02523	0.01862	0.02396	0.01335	0.00297	0.00191	0.00070	0.00066
Standard Deviation	0.03651	0.06455	0.08392	0.04819	0.05546	0.05129	0.07054	0.04735	0.04199
Skewness	0.45651	1.00761	3.55374	0.77642	-1.20288	-0.60386	-0.49401	-1.02858	-1.06101
Excess Kurtosis	3.48194	3.82308	21.00590	5.78562	5.39487	4.03966	5.10357	4.53671	4.27818
Panel 1A: Number stocks by market									
London	0.0000	0.0000	0.0000	25.0119	18.8333	0.1429	27.2024	23.1905	0.0000
Paris	0.0000	0.0000	0.0000	0.0000	3.2857	2.0000	0.0000	5.4286	26.6190
Morocco	2.2024	10.2738	9.2857	1.0000	0.0000	13.4881	0.0000	0.0000	0.5714
Tunisia	5.2857	5.0000	18.1429	0.7143	0.0000	2.8571	0.0000	0.0000	0.0000
Nigeria	16.5952	12.4048	1.2381	0.2619	5.9167	10.0833	0.0000	0.0000	0.0000
Overall Mean	24.083	27.679	28.667	26.988	28.036	28.571	27.202	28.619	27.190

Panel B: Summary Statistics for country portfolios

	London	Paris	Morocco	Tunisia	Nigeria	Ghana	BRVM
Mean	0.00281	0.00319	0.01695	0.00877	0.03153	0.02951	0.02267
Standard Deviation	0.04879	0.06445	0.04056	0.03295	0.09334	0.06524	0.06086
Skewness	-1.00684	-0.53234	0.37558	0.22266	1.49233	1.43855	0.06734
Excess Kurtosis	4.28118	5.14008	3.33823	2.84329	6.40853	5.41699	4.23087

Panel C: Summary Statistics for valuation Factors

	SMB	ILLIQ	MARKET
Mean	0.04907	0.01211	0.01100
Standard Deviation	0.19221	0.09311	0.03853
Skewness	0.85583	-2.03492	-0.68578
Excess Kurtosis	4.29265	14.70336	4.41983

Panel D: Correlations for valuation Factors

	SMB	ILLIQ	MARKET
SMB	1.0000	-- --	-- --
ILLIQ	-0.3791	1.0000	-- --
MARKET	-0.1817	-0.1532	1.0000

Table 7. Time series regressions using equally weighted monthly contemporaneous market excess returns for 9 portfolios formed on size and illiquidity for period: 2002 – 2008, for all sample markets.

Portfolio	S/L	S/M	S/H	M/L	M/M	M/H	B/L	B/M	B/H
Panel A: CAPM-adjusted performance									
$\hat{\alpha}(\%)$	0.0057	0.0154	0.0073	-0.0089	-0.0006	0.0150	-0.0089	-0.0105	-0.0146
	(0.81)	(2.65)	(2.19)	(-2.65)	(-0.20)	(5.71)	(-3.06)	(-3.78)	(-4.01)
$\hat{\beta}$	1.1708	0.8904	0.4374	1.0845	1.2710	0.8126	0.8694	1.0238	1.5082
	(2.40)	(4.01)	(4.78)	(7.55)	(12.02)	(9.04)	(8.15)	(7.73)	(7.48)
Adj R^2 (1)	0.2802	0.2737	0.2034	0.6594	0.7769	0.4150	0.6320	0.6904	0.6746
Panel B: Three-factor CAPM performance									
$\hat{\alpha}$	-0.0039	1.17E-05	-0.0007	0.0008	0.0054	0.0067	-0.0002	-0.0022	-0.0058
	(-1.61)	(0.01)	(-0.27)	(0.48)	(2.13)	(2.46)	(-0.17)	(-1.61)	(-2.42)
$\hat{\beta}$	1.2812	1.1329	0.5886	0.9252	1.1656	0.9672	0.7265	0.8913	1.3810
	(13.42)	(12.64)	(9.37)	(15.95)	(14.40)	(10.04)	(35.08)	(34.61)	(23.20)
$\hat{s}$	0.2525	0.2488	0.0733	-0.1450	-0.0772	0.0761	-0.1262	-0.1317	-0.1677
	(13.51)	(13.58)	(5.14)	(-11.94)	(-4.13)	(5.27)	(-19.10)	(-16.72)	(-9.09)
$\hat{h}$	-0.3202	0.0456	0.2289	-0.0749	-0.0956	0.2311	-0.0768	-0.0351	0.0671
	(-6.711)	(0.89)	(5.41)	(-5.50)	(-2.22)	(3.68)	(-5.21)	(-2.35)	(1.84)
Adj R^2 (4)	0.8997	0.7693	0.4880	0.9038	0.8331	0.5804	0.9042	0.9434	0.9181

Table 8 Pooled cross-section regression for equally weighted monthly excess returns on country portfolios with size and illiquidity for 2002 to 2008

Explanatory Variables	$\hat{\alpha}$	$\hat{\beta}$	$\hat{s}$	$\hat{h}$	Adj R^2
Panel A: London (FTSE100 constituents)					
Excess Market alone	-0.0088 (-2.94)	1.0685 (8.67)			0.7172
Excess Market and SMB	-0.0016 (-1.50)	0.9577 (30.95)	-0.1222 (-14.19)		0.9464
Excess Market and ILLIQ	-0.0095 (-2.83)	1.0832 (11.13)		0.0397 (0.84)	0.7195
*All Three Factors	0.0005 (0.51)	0.9136 (32.40)	-0.1384 (-17.05)	-0.0793 (-7.98)	0.9651
Panel B: Paris (CAC40 constituents)					
Excess Market alone	-0.0120 (-3.52)	1.3602 (7.12)			0.6643
Excess Market and SMB	-0.0020 (-0.96)	1.2065 (20.71)	-0.1695 (-10.70)		0.9161
Excess Market and ILLIQ	-0.0150 (-4.25)	1.4298 (11.74)		0.1878 (4.74)	0.7346
*All Three Factors	-0.0034 (-1.67)	1.2348 (20.49)	-0.1591 (-9.40)	0.0509 (1.81)	0.9196
Panel C: Morocco					
Excess Market alone	0.0107 (2.97)	0.5362 (5.96)			0.2523
Excess Market and SMB	0.0090 (2.34)	0.5626 (6.66)	0.0291 (1.99)		0.2620
Excess Market and ILLIQ	0.0083 (2.45)	0.5900 (5.53)		0.1452 (2.36)	0.3551
*All Three Factors	0.0032 (1.08)	0.6772 (7.56)	0.0712 (3.97)	0.2065 (4.99)	0.4418
Panel D: Tunisia					
Excess Market alone	0.0054 (1.72)	0.2851 (3.27)			0.1014
Excess Market and SMB	0.0045 (1.30)	0.2989 (2.81)	0.0153 (0.65)		0.0982
Excess Market and ILLIQ	0.0033 (1.13)	0.3333 (5.03)		0.1303 (3.98)	0.2273
*All Three Factors	-0.0003 (-0.13)	0.3955 (6.32)	0.0507 (3.11)	0.1739 (4.67)	0.2907
Panel E: Nigeria					
Excess Market alone	0.0158 (1.98)	1.4060 (3.46)			0.3322
Excess Market and SMB	-0.0046 (-0.95)	1.7189 (15.47)	0.3433 (18.58)		0.8249
Excess Market and ILLIQ	0.0233 (3.13)	1.2397 (5.78)		-0.4379 (-5.24)	0.5153
*All Three Factors	0.0003 (0.08)	1.6236 (14.51)	0.3088 (14.32)	-0.1681 (-2.55)	0.8461

Notes: * indicates models selected from which Cost of Equity are estimated. Newey-West HAC covariance adjusted t-statistics in parentheses.

Table 9. Cost of Equity estimates derived from multi-factor regression

	Cost of Equity (Annualized)
London (FTSE100)	4.04%
Paris (CAC40)	9.19%
Tunisia	12.53%
Morocco	18.62%
Nigeria	45.45%

Notes: The UK Gilt/ Treasury rate is used in each case for risk free rate

Table 10. Portfolio performance of un/conditional strategies

Universe	Mean return	Standard Deviation	Maximum	Minimum	Sharpe Ratio
Strategy: IID					
Anglophone	21.39%	9.24%	72.95%	2.78%	0.4813
Francophone	18.38%	7.80%	44.62%	-12.31%	0.5366
Overall (incl. Ghana/ BRVM)	18.38%	6.14%	44.98%	-12.71%	0.6792
Overall (excl. Ghana/ BRVM)	15.62%	6.65%	46.84%	-13.15%	0.5035
Strategy: GARCH					
Anglophone	13.12%	9.38%	14.82%	10.52%	0.2504
Francophone	20.58%	10.13%	27.01%	17.26%	0.4226
Overall (incl. Ghana/ BRVM)	16.67%	7.17%	19.89%	14.50%	0.4563
Overall (excl. Ghana/ BRVM)	13.87%	7.69%	17.21%	9.43%	0.3312
Strategy: Conditional (Multifactor CAPM)					
Overall (excl. Ghana/ BRVM)	14.38%	1.46%	41.13%	-19.35%	1.7249

Notes: All statistics are represented in their annualised forms. The annualised average Sharpe ratios are defined as the mean return in excess of the UK Gilt 3 Month rate, divided by the standard deviation. The Sharpe ratios highlighted in bold are the largest for each respective portfolio combination across all models used to construct the sample means. Anglophone portfolio indicates inclusion of markets following English Common law, i.e. London, Nigeria, and Ghana. Francophone indicates those with French civil code i.e. Paris, Morocco, Tunisia, and Cote d'Ivoire (BRVM).

Table 11. Minimum variance asset weights for portfolio unconditional and conditional strategies

	2003	2004	2005	2006	2007	2008
Panel A: IID						
Panel 1: Anglophone Portfolio						
London	22.75%	85.82%	77.18%	53.20%	62.28%	41.51%
Ghana	40.94%	8.77%	7.13%	26.93%	36.51%	48.95%
Nigeria	36.31%	5.40%	15.70%	19.87%	1.21%	9.54%
Panel 2: Francophone Portfolio						
Paris	2.91%	28.95%	27.68%	7.95%	34.09%	3.65%
Morocco	10.63%	33.77%	27.37%	28.56%	6.63%	39.78%
Tunisia	68.88%	28.42%	37.97%	38.05%	40.49%	42.90%
Cote d'Ivoire (BRVM)	17.58%	8.86%	6.98%	25.43%	18.79%	13.67%
Panel 3: Overall (incl. Ghana/ BRVM) Portfolio						
London	0.76%	25.54%	46.18%	13.12%	34.58%	12.42%
Ghana	1.63%	1.33%	2.09%	12.95%	6.77%	3.00%
Nigeria	25.92%	10.58%	13.62%	18.31%	0.49%	0.70%
Paris	1.85%	0.00%	0.00%	0.06%	4.97%	0.00%
Morocco	0.61%	23.43%	14.28%	23.88%	3.76%	40.09%
Tunisia	56.01%	29.65%	17.95%	17.93%	34.36%	33.51%
Cote d'Ivoire (BRVM)	13.23%	9.47%	5.87%	13.75%	15.07%	10.29%
Panel 4: Overall (excl. Ghana/ BRVM) Portfolio						
London	0.21%	29.18%	47.92%	30.63%	53.54%	19.44%
Paris	1.73%	0.00%	0.00%	0.00%	7.26%	0.00%
Morocco	2.01%	28.56%	16.12%	18.05%	4.19%	47.69%
Tunisia	68.15%	32.21%	22.12%	29.06%	34.09%	32.75%
Nigeria	27.91%	10.06%	13.84%	22.26%	0.91%	0.13%
Panel A: GARCH						
Panel 1: Anglophone Portfolio						
London	1.59%	2.37%	19.79%	19.70%	32.47%	18.23%
Ghana	24.74%	30.40%	30.44%	24.87%	17.50%	31.52%
Nigeria	73.67%	67.23%	49.76%	55.43%	50.03%	50.24%
Panel 2: Francophone Portfolio						
Paris	1.96%	6.54%	30.55%	25.48%	27.65%	18.09%
Morocco	50.11%	50.70%	39.52%	31.71%	24.72%	39.86%
Tunisia	21.97%	19.30%	13.31%	16.10%	20.75%	19.79%
Cote d'Ivoire (BRVM)	25.95%	23.46%	16.62%	26.71%	26.88%	22.26%

Panel 3: Overall (incl. Ghana/ BRVM) Portfolio						
London	0.00%	1.84%	29.92%	32.62%	27.72%	21.16%
Ghana	13.20%	0.84%	0.00%	7.34%	20.22%	9.82%
Nigeria	28.02%	22.47%	12.41%	16.13%	1.32%	0.00%
Paris	0.04%	0.01%	0.00%	0.00%	0.00%	0.00%
Morocco	0.92%	4.83%	16.65%	14.40%	12.73%	22.80%
Tunisia	47.75%	55.34%	31.19%	21.94%	28.70%	37.42%
Cote d'Ivoire (BRVM)	10.08%	14.67%	9.83%	7.57%	9.31%	8.80%
Panel 4: Overall (excl. Ghana/ BRVM) Portfolio						
London	0.47%	7.92%	49.93%	49.62%	58.12%	45.97%
Paris	0.00%	0.00%	0.00%	0.00%	1.87%	1.70%
Morocco	11.12%	10.36%	10.17%	11.07%	0.99%	2.42%
Tunisia	43.84%	38.97%	20.38%	13.06%	20.23%	27.87%
Nigeria	44.58%	42.74%	19.53%	26.24%	18.79%	22.03%
Panel A: Linear Multifactor CAPM						
Panel 1: Overall (excl. Ghana/ BRVM) Portfolio						
London	65.75%	64.12%	66.02%	63.73%	63.45%	64.45%
Paris	26.38%	23.45%	19.94%	22.93%	24.94%	27.07%
Morocco	1.90%	3.71%	4.55%	4.11%	3.26%	2.46%
Tunisia	0.21%	0.60%	0.89%	0.61%	0.31%	0.15%
Nigeria	5.76%	8.12%	8.60%	8.62%	8.04%	5.86%

Table 12. GARCH model parameters for period January 2002 to December 2008

	London (3,2)	Paris (1,3)	Morocco (1,1)	Tunisia (1,2)	Nigeria (2,1)	Ghana (3,1)	BRVM (1,1)
	Mean Equation						
α	0.0067 (1.68)	0.0086 (1.50)	0.0149 (2.59)	0.0078 (2.81)	0.0120 (1.27)	0.0171 (2.35)	0.0182 (2.11)
β	0.0534 (0.46)	0.0652 (0.52)	0.0912 (0.64)	-0.0037 (-0.06)	0.2981 (2.22)	0.2678 (1.66)	0.3055 (2.44)
	GARCH representation for Residuals						
ω_0	0.0003 (0.81)	0.0004 (1.34)	0.0009 (0.26)	0.0008 (2.22)	0.0001 (1.29)	0.0008 (1.19)	0.0035 (1.89)
$\delta 1$	0.2604 (2.08)	0.3647 (2.26)	0.0415 (0.24)	-0.2096 (-3.96)	0.2351 (44.48)	0.3453 (0.96)	0.2204 (1.61)
$\delta 2$	0.0505 (0.37)				-0.2693 (-14.06)	-0.2138 (-0.54)	
$\delta 3$	0.4519 (1.79)					-0.0683 (-0.43)	
$\delta 4$							
$\delta 5$							
$\gamma 1$	-0.1645 (-0.92)	0.9787 (4.06)	0.3884 (0.16)	0.2477 (0.54)	1.0274 (64.53)	0.6942 (2.27)	-0.2232 (-0.48)
$\gamma 2$	0.3526 (1.40)	-0.8380 (-2.44)		0.1511 (0.44)			
$\gamma 3$		0.4335 (1.86)					

Notes: GARCH lag order chosen *via* Schwartz-Bayesian Criterion informational criterion (SBC). Z-statistics are in parentheses and significance levels are as follows: 60% confidence is 0.84; 70% confidence is 1.04; 80% confidence is 1.28; 90% confidence is 1.65; 95% confidence is 1.96; 99% confidence is 2.58.

Figure 1. Efficient Frontiers for portfolio using conditional multi-factor CAPM (Excl. Ghana and BRVM) for 2002M12 to 2008M12

Figure 1(a) GARCH Anglophone portfolio

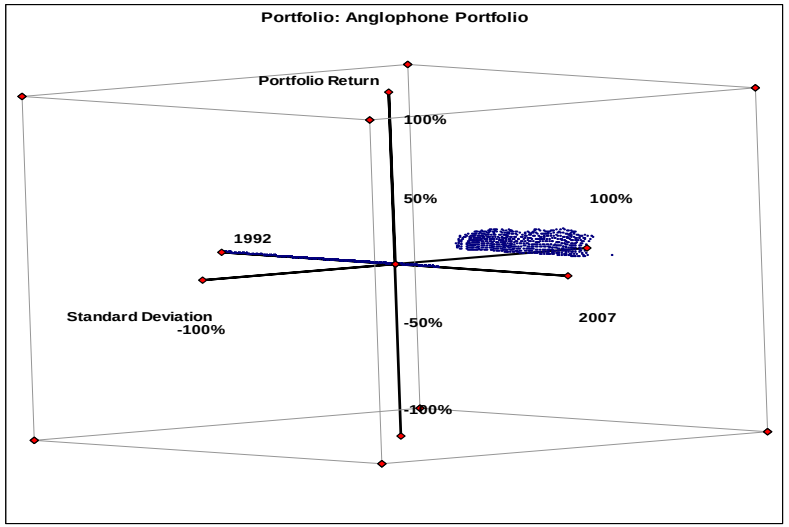


Figure 1(b) GARCH Francophone portfolio

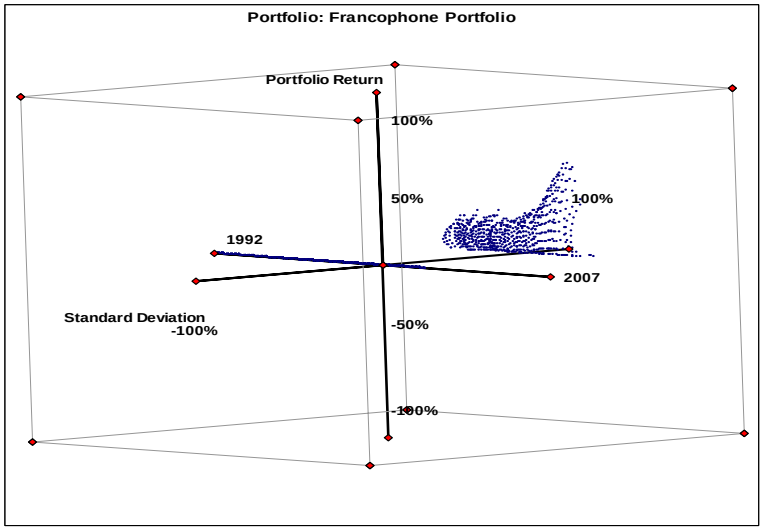


Figure 1(c) GARCH Overall (Ex. Ghana/ BRVM) portfolio

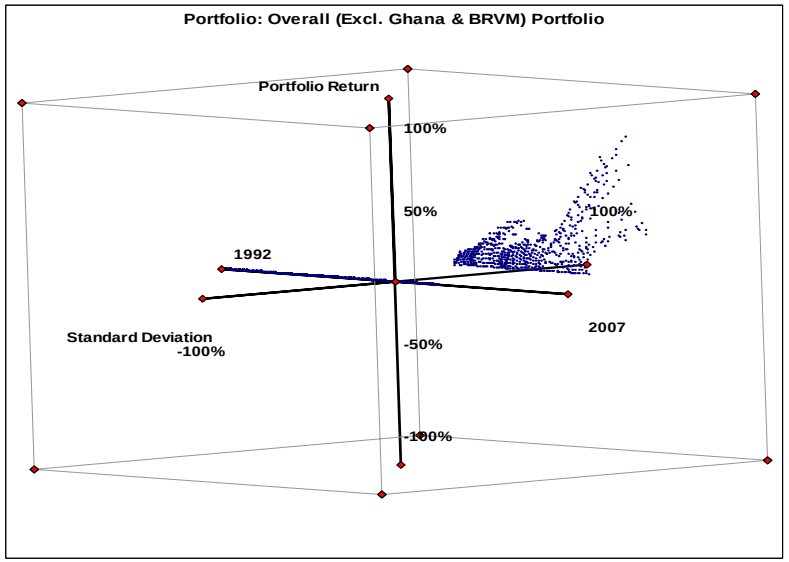


Figure 1(d) GARCH conditional (Incl. Ghana/ BRVM) portfolio

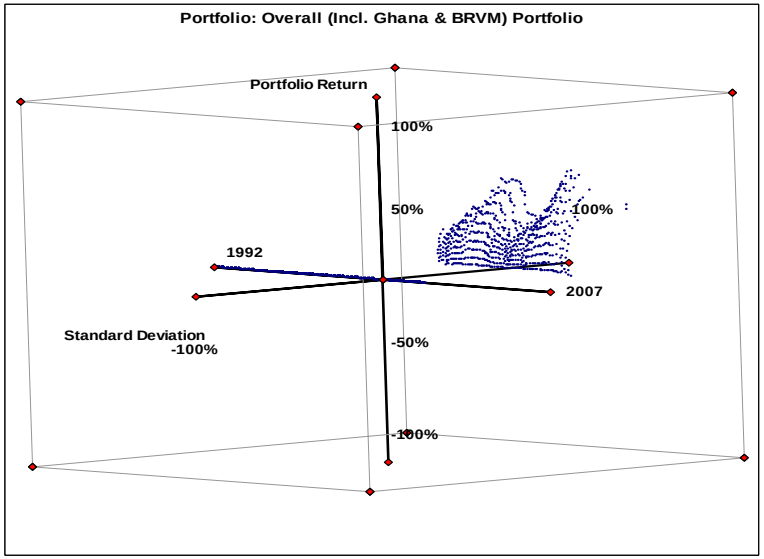
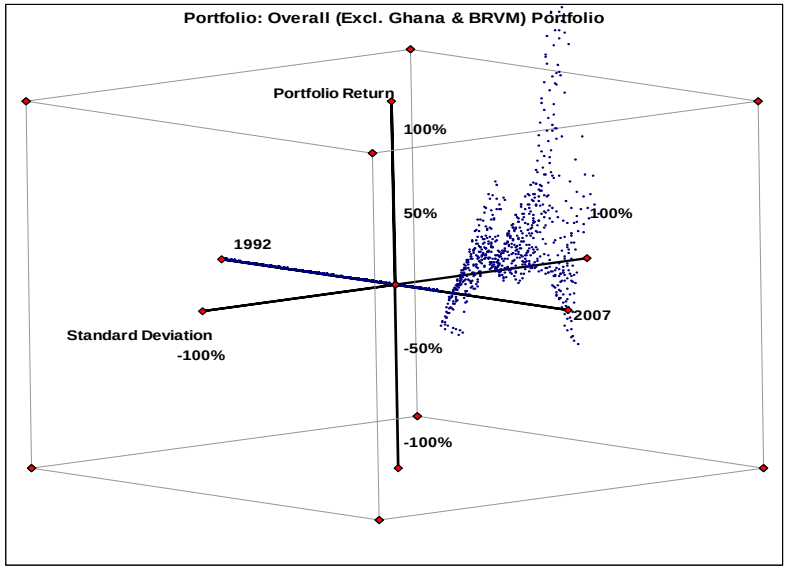


Figure 1(e) Multifactor CAPM Overall (Ex. Ghana/ BRVM) portfolio



Appendix 1 Summary of Secondary Market regulations and fees for selected countries

	Morocco	Tunisia	BRVM (Cote d'Ivoire)	Ghana	Nigeria (Lagos)
Commercial Law	French civil code			English common law	
No. Brokers	15	24	9 in Cote d'Ivoire; 4 in Benin; 3 in Senegal; 1 in all other UMEAO countries	16	219
Capital Gains Tax	Exempt	Exempt	Exempt	Exempt	10%
Other Taxes and Fees	VAT applied to the amount of commissions is 10%. No other tax/ fees.	None	None	10% withholding tax	Stamp Duty of 0.07%. SEC fee of 1%. VAT levied as % of commission fee. Withholding tax on dividend and interest is 10%; corporate income tax, 35%
Commission	Standard fee of 0.1% of trade value in Moroccan Dirhams (MAD) levied against buyers and sellers engaging in securities transfer or dealing. This fee, Negotiation des Titres, is applied to both buy and sell legs of trade.	Two fees: First is fee of 0.20% on transactions less than 50,000TDN and 0.10% on those above. Second fee is sliding schedule depending on value traded and ranges from 0.25% <0.5m TDN to 0.05% for >3m TDN.	Discretion of individual local brokerage firms (SGIs)	Sliding scale of fees from 2.5% for transactions less than 5m ¢ to 1% for those over 500m ¢	Sliding scale of fees from 1% to 2.75% down to 1.00% of consideration Depository settlement fee: 0.30%

Source: Compiled by authors from national stock exchange websites