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'Legal Regime, Size, and Liquidity Factors in Asset Pricing'

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Legal regime, Size, and Liquidity factors in Asset Pricing

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Abstract

This study contrasts the ability of three liquidity constructs, the price-impact measure of Amihud (2002), the volume based turnover ratio, and the recently developed trading speed measure of Liu (2006) in explaining total trading costs for four large African emerging markets, Egypt, Morocco, Kenya and South Africa, as well as London and Paris. A new legal regime factor is also developed to capture the often substantial differences in returns between markets with either civil or common law origin. The evidence suggests that the Amihud construct outperforms other liquidity measures in Africa while the Amihud and Liu measures are better in London and Paris. Furthermore the incorporation of size, liquidity and legal regime valuation factors within a multifactor CAPM pricing model reveals that size and liquidity factors are significant in capturing the cross-section of returns across the sample universe. The legal regime factor offers improves performance with larger stocks. However, it is significant in capturing the cross section of returns in country portfolios. Costs of equity are found to be lowest for London, Paris and Morocco and highest for Egypt, Kenya and South Africa.

JEL classification: G11, G12, G15, O55

Keywords: Portfolio Choice, Asset pricing, International Financial Markets, Sub-Saharan Africa

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This study contrasts the ability of three liquidity constructs, the price-impact measure of Amihud (2002), the volume based turnover ratio, and the recently developed trading speed measure of Liu (2006) in explaining total trading costs for four large African emerging markets, Egypt, Morocco, Kenya and South Africa, as well as London and Paris. A new legal regime factor is also developed to capture the often substantial differences in returns between markets with either civil or common law origin. The evidence suggests that the Amihud construct outperforms other liquidity measures in Africa while the Amihud and Liu measures are better in London and Paris. Furthermore the incorporation of size, liquidity and legal regime valuation factors within a multifactor CAPM pricing model reveals that size and liquidity factors are significant in capturing the cross-section of returns across the sample universe. The legal regime factor offers improves performance with larger stocks. However, it is significant in capturing the cross section of returns in country portfolios. Costs of equity are found to be lowest for London, Paris and Morocco and highest for Egypt, Kenya and South Africa.

The rapid establishment and institutional enhancement 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 and diversify ownership through a domestic listing (see Lesmond, 2005 and Hearn, and Piesse,. 2009). Additionally, there is evidence that the prevailing legal origin has sizeable influence on the level and depth of regulation and informational transparency surrounding transactions (see La Porta et al, 2008). In our study, we concentrate on African securities markets, which form a particularly interesting region of emerging markets with regard to the prominent role of liquidity in determining levels of portfolio investment, and the continent's regulatory regimes, which are derived from one of two legal families: of civil code and common law. There is a clear division between states with a French civil code legal regime and states with institutions based on English common law (see La Porta et al, 2008), offering a unique opportunity to study the impact of legal origin on the valuation of stocks.

The markets used in this study are the three large regional hub exchanges, Egypt, Kenya and South Africa that are envisaged by current policy to form the centres of regional integration initiatives and the developed Moroccan bourse. The exchanges of London and Paris are also included to facilitate comparison with main European markets. The lack of

consistent data and the small size of the rest of Africa's markets prevents the widening of the scope of the study to include other exchanges.

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 focus 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. 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) and (Lesmond, 2005). Consequently, in the first part of our study we test these two liquidity measures against the quoted bid-ask spread. Our empirical evidence shows a higher association between the Amihud (2002) measure and total trading costs, defined as bid-ask spread plus trading fees. This is particularly important for emerging markets, which usually do not have reliable and consistent data for bid-ask quotes.

While the literature concerning the importance of liquidity has been prominent for over a decade, research on liquidity risk and its applications has been 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). Daniel and Titman (1997) and Liu (2006) find evidence of the limited explanatory power of the Fama and French model. Equally there is evidence of the CAPM not performing well when the assumptions of integrated or efficient markets are violated (Harris et al, 2003) although much of its continued endurance is attributed to the simplicity of application (Jagannathan and Meler, 2002). In emerging markets the size factor should be retained within the pricing model to explain the cross-section of returns because Emerging stock markets are highly skewed with many dominated by a handful of large firms and the rest of the market populated with SMEs. This is supported by Martinez et al (2005) who also find some support for retaining the size factor in the case of the Spanish stock market. Therefore, the second part of the paper tests for the effects of size and liquidity in the pricing model in the African context.[1]

The literature is less clear concerning the inclusion of legal regime factors within pricing and valuation models. Although La Porta et al (2002) found evidence that firms in

[1] We do not include the book-to-market variable as such data are inconsistent for our group of emerging markets.

common law markets have higher valuation and cash flow ownership by the controlling shareholder than in civil code regimes, there is generally very little literature investigating this link. However there is some prominent related work contrasting the differences between civil and common law regimes in terms of different levels of regulation, regulatory enforcement and the nature of innovation of commercial law to take account of changing business environment (La Porta et al, 1997 and 2008). There is considerable evidence that levels of investor protection and patterns in corporate ownership are strongly related to the underlying legal tradition (La Porta et al, 2008). Given the preliminary evidence of the differences in legal regime affecting valuation the formation of a legal regime factor within this study is a new contribution to the existing literature. Furthermore, it is greatly facilitated in the African context for all regulatory regimes having been defined by either civil or common legal codes.

We model aggregate total returns indices using a multifactor 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. Modern portfolio theory indicates that investors should hold mean-variance efficient portfolios, which compares 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 (see Harvey, 1995).

This study finds evidence that the legal regime, liquidity and size factors are all significant in explaining cross section of returns and outperforms the traditional CAPM. This confirms the results of Liu (2006) that the liquidity risk better captures firm distress and associated solvency than the combination of size and book-to-market factors used in Fama and French. 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 shows the superior performance of portfolios that include markets with legal and regulatory regimes based on French civil or English common law, within the African context.

The paper is structured as follows. Section I introduces the liquidity measures and their construction. Section II reports summary statistics for each of the six markets and the

within-country correlation analysis. Section III presents the tests for each liquidity measure and for the differences in returns between the two legal regimes, civil and common law. Section IV details the construction of size, liquidity, and legal regime valuation factors and presents basic summary statistics. Section V contrasts the use of these valuation factors within the multifactor CAPM. Section VI concludes and makes some comments on development policy that follows from the evidence presented in the paper.

I. Liquidity estimation

There is now a considerable menu of liquidity measures available from the literature. The literature in this area has grown rapidly since the work of Stoll (2000) and Amihud (2002). There are principally three classes of liquidity estimator available (Lesmond, 2005). The first concerns the direct measurement of trading costs through the bid-ask spread which utilises price quotes. This is by far the most demonstrable indicator of overall liquidity but its intuitive appeal is somewhat mitigated by the fact that closing prices often differ from quotes as trades are often executed at different prices from, or even outside, the quoted market prices. An additional issue concerning quotes is data availability in the light that at individual stock level these are not always available for consistent and homogeneous time periods across all sample group markets (Lesmond, 2005). As a consequence of the lack of quote information a second class of estimator is constructed from firm level data and involves a price impact measure of liquidity in relating change of prices to trading volumes. This measure, developed by Amihud (2002), is easy to construct and has a considerable following in the literature with applications ranging from East Asia (Shum and Tang, 2006) to European markets (Martinez et al, 2005).

Turnover is the most common measure employed in the literature and has been used in Rouwenhorst (1999) and Bekaert et al (2003) as well as in a wide array of other applications. However, while turnover captures trading frequency it is limited in its appeal as it only focuses on trading volume. Consequently, during times of financial crisis, such as the Tequila crisis or Asian crisis, this measure actually increases (Lesmond, 2005) instead of decreasing to reflect the overall decline in market liquidity (Froot et al, 2001). The appeal of this measure is further mitigated as it is also likely to be non-linear with respect to the bid-ask spread leading to subsequent scaling problems (Lesmond, 2005) although it remains a very easy measure to construct and retains intuitive appeal. Following Lesmond (2005) this measure is hypothesized as being inversely related to the bid-ask spread as larger spreads should reduce the frequency of trading.

The most prominent measure in the second class of estimators is that of Amihud (2002) which attempts to generalize the liquidity measure in making it more adaptable to the nuances of liquidity estimation around the world. This is a price impact measure and is

defined as the ratio of the daily absolute return to the currency denominated trading volume and closely aligned to the idea of prices responding to order flow. The advantage of this estimator is that it can be easily calculated for days when there is no price change, which is a common feature in emerging markets. However, this benefit is mitigated by the necessity of a presence of daily trading volumes and for days where no trading takes place this estimator is rendered as undefined. This is a particular concern in the smaller emerging and frontier markets (Standard & Poors Global Market Factbook, 2006) as these experience considerable lapses between trades (Piesse and Hearn, 2007). This estimator is hypothesized to have a positive relationship with the bid-ask spread as smaller spreads are associated with lower price impact.

The third class of estimator, developed in Liu (2006), captures multiple dimensions of liquidity with a specific emphasis on trading speed. Specifically this estimator measures the absence of trading in a particular security through its standardized turnover-adjusted number of zero daily trading volumes over the last period of months. Absence of trading is strongly linked to illiquidity and in extreme form is a measurement of "lock-in" risk, or the danger that assets cannot be sold (Gallmeyer et al, 2004). In addition, this estimator provides a representative measure of trading cost and its effect on liquidity i.e. the more liquid a stock then the less costly it is for investors to trade. This extends the model developed by Lesmond et al (1999) and their LOT measure which measures transactions costs based on the frequency of zero-return days that in turn could be caused by an absence of trades. In the LOT model zero returns occur if transactions costs are high and the information value to trading does not exceed the transaction cost threshold (Liu, 2006). Given the ability of this estimator to capture the multidimensional effects of liquidity it is hypothesized to have a positive relation to the bid-ask spread.

Given the strengths and weaknesses of each of the three liquidity measures, all three are employed in determining the relative efficiency and efficacy of each construct in representing African emerging market liquidity. All liquidity parameters are estimated on a monthly basis to match the frequency of the bid-ask spread data. Firm level data was collected for each constituent member firm of an all share total returns index in that market. The index lists from which the companies were drawn are as follows: All-Share indices for Johannesburg Stock Exchange, Nairobi Stock Exchange, and Egyptian Stock Exchange while the FTSE100 was used for UK and CAC40 for Paris. Although the latter indices are not fully representative of the markets from which they originate they do provide the sample with significant diversity in being representative of internationally recognised regulatory and corporate governance regimes and are the principal destinations for the migration of primary listings out of Africa. Market capitalization is determined on a monthly basis by the end of month closing price and number of shares outstanding at beginning of the year. The local

currency is converted into UK£ (sterling) using beginning of month exchange rate obtained from Datastream in order to facilitate comparison across individual country measures of liquidity.

A. The Bid Ask spread and commission cost

End of month bid and ask quotes were obtained from Datastream for all sample group markets except Morocco where they were sourced from the Casablanca stock exchange. The full sample period is from January 1991 to December 2008 although the availability varies for each country. Data for London, Paris and Morocco are available for the full sample period while South Africa and Egypt are available from January 1996 to the end of the sample period. Kenyan data are only available from January 1995 to December 2005. 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 month 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. Finally, in line with Lesmond (2005) bid-ask spreads that exceed 80% are trimmed as these are deemed to have resulted from coding 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, or opening and subsequently closing a position are added on to the quoted spread for each month. Brokerage and Exchange fees are calculated from the fee schedules detailed in Appendix Table I. When a percentage commission fee is not provided the maximum fixed cost is applied to the aggregate daily traded value data. Table I documents the total transactions costs in accordance with data availability for each individual market. The evidence suggests there is a general decline in transactions costs over the sample period for London and Paris, while despite some considerable degree of variation those for the African markets remain high. Transactions costs are persistently high for the African markets with those for Morocco, South Africa and Kenya increasing from 1996 to 2005. Unsurprisingly Kenya, the least developed and smallest market has the highest costs.

B. Turnover

Daily trading volume data and shares outstanding data were obtained from Datastream. In line with prices, data on volumes and shares outstanding is available for the entire sample period for all markets except Morocco and Egypt where data only starts in 1993 and 1996 respectively. At first glance it is apparent that there is considerable variation in this measure

on an intra-market basis. This reflects the substantial differences in both liquidity and turnover for many of the companies within each market. Although these differences would be expected in an emerging market context with sharp differences between top and bottom performing stocks a prominent outlier in France's data, which are the constituents of the top performing CAC 40 index, is that of Air France – KLM. The inclusion or exclusion of this single stock has a significant impact on the aggregate turnover and liquidity profile of all the other stocks in this market. In this light any turnover statistics that exceed 100% of the shares outstanding in any month are trimmed from the sample. 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:

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

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

C. Amihud (2002) measure

Daily price and volume data are obtained from Datastream. The daily security prices are scanned for data errors, omissions and delistings. Following the procedure outlined in Lesmond (2005) the prices are used calculate daily returns. To control for return outliers, a data error 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 the sample. Equally if zero volume occurs on day t, then that day is deleted from average. Finally, the measure is multiplied by 10^6 as undertaken in Amihud (2002) in order to provide a common representation of measures and facilitate comparison. The Amihud measure is defined as:

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

D. Liu (2006) measure

Daily price and volume data are collected from Datastream. Similar data checks are undertaken to those undertaken in the generation of the Amihud measure. The Liu measure is derived from the recent work of Liu (2006) and is defined as LM_x which is the standardized turnover-adjusted number of zero daily trading volumes over the prior x months (x = 1, 6, 12) i.e.

$$LM_x = \left(\text{Number of daily volumes in prior x - months} \right) + \left(\frac{1/x \ month \ turnover}{Deflator} \right) \times \left(21x / NoTD \right) \tag{4}$$

where x month turnover is the turnover over the prior x months, calculated as the sum of the daily turnover over the prior x months, daily turnover is the ratio of the number of shares traded on a day to the number of shares outstanding at the end of the day, NoTD is the total number of trading days in the market over the prior x months, and Deflator is chosen such that,

$$0 < \frac{1/(x\ month\ turnover)}{Deflator} < 1 \qquad (5)$$

for all sample stocks[2]. Given the turnover adjustment (the second term in brackets in first expression), two stocks with the same integer number of zero daily trading volumes can be distinguished: the one with the larger turnover is more liquid. As such the turnover adjustment acts as a tie-breaker when sorting stocks based on the number of zero daily trading volumes over the prior x months. Because the number of trading days can vary from 15 to 23, multiplication by the factor (21x/ NoTD) standardizes the number of trading days in a month to 21 which makes the liquidity measure comparable over time. LM1 can be interpreted as the turnover-adjusted number of zero daily trading volumes over the prior 21 trading days, which is the approximate average number of trading days in a month. The liquidity measure, LM_x is calculated at the end of each month for each individual stock based on daily data. Daily data is available for all markets across entire sample period except for Morocco and Egypt where data starts from 1993 and 1996 respectively.

II. Summary Statistics

This section first provides a summary of trading and liquidity characteristics for both individual firms and markets across the sample group, namely South Africa, Kenya, Egypt, Morocco, UK and France. It then develops an analysis of the key summary statistics and provides non-statistically parameterized spearman's rank correlations between the various measures.

A. Summary statistics for firm and market characteristics

Analysis of the daily trading characteristics for the firms that make up the individual African emerging markets provides a good fundamental understanding of the key issues. As documented in Table II, the mean percentage daily zero returns are considerable for the African markets. It is over 56.93% for South Africa and 59.06% for Kenya, while for the North African markets of Egypt it is 38.90% and for Morocco 63.13%. These are in direct contrast to the very low values for Paris and London, which are 6.65% and 14.17% respectively. Although the magnitude and difference between these values and markets is

[2] In line with Liu (2006) a deflator of 11,000 is used in constructing estimates for LM1

largely expected from similar results on a wide array of emerging markets in Lesmond (2005), the differences between the African markets and those of Europe is considerable.

The other variables, namely price, volatility, market capitalization and volume are more usually related to trade difficulty through explicit and implicit costs of trading or market quality (Harris, 1994). Although Lesmond (2005) finds that higher volatility, lower stock prices (UK£ equivalent) and lower daily trading volumes are associated with lower liquidity markets there is some ambiguity with this sample. One prominent anomaly is Morocco which has the lowest trading volume and yet is the least volatile and has the highest prices (UK£) of the four African markets. It is also worth noting that all stocks used are the constituents of all-share indices in the national markets with the prominent exception of London and Paris. The constituents of the prestigious CAC 40 index were used in the case of Paris and FTSE 100 index in London. Consequently due to the Parisian index capturing only the very top stocks in the market in contrast to the wider range of stocks falling within the FTSE 100 index for London there are several notable differences between Paris and London evident in Table 2. In line with the above differences between Paris and London the mean market capitalization, or firm size, and prices are considerably higher in the former market than in the latter. Equally the mean proportion of daily zero returns is considerably lower in Paris than in London as the Paris sample is made up of an even smaller and more elite number of stocks than the broader London sample.

Price is often used as a proxy for discreteness (Harris, 1994), risk, and the bid-ask spread (Benston and Hagerman, 1974). Trading volume reflects market depth (Pagano, 1989) and market capitalization has been cited in relation to the bid-ask spread (Stoll and Whaley, 1983). However volatility is the most often cited measure with respect to illiquidity as thin, speculative markets are deemed more volatile than deep ones (Lesmond, 2005). The small, illiquid and volatile nature of the African markets in contrast to London and Paris can also be seen in variance values. Egypt (0.04358) and South Africa (0.03619) are over 100 times more volatile than London (0.00040) although interestingly Morocco (0.00173) and Kenya (0.00595) are lower than Paris (0.00898). However, it is likely that the low value of Kenya is due to the severity of illiquidity across many of the firms in sample causing rigidity in price movements and a lack of measurable

B. Liquidity measure correlation analysis

Table III provides a summary of each liquidity measure for each respective market. Furthermore, as each liquidity measure uses a different scale of measurement and is intrinsically different in the concept of liquidity that is measured a non-parameter related Spearman Rank correlation is employed. Key market descriptive and control variables are included with these being price, volatility, traded volume and market capitalization, which

also have an indirect impact on liquidity through their effects on market traders inventory's, or trading books (Stoll, 2000). There are significant differences in the correlations between variables between the developed European markets and their developing African counterparts. There are generally weak relationships between any of the liquidity measures and the bid-ask spread in London and Paris with the notable exception of a very strong inverse relationship between the Liu measure and turnover as would be intuitively expected from the construction of the Liu measure. Equally there is a strong association in both markets between the Amihud measure and traded volume which is also expected from the construction of the former variable. The measures of correlation between the various measures within the developing African markets demonstrate a very different pattern of association. The correlation between traded volume and the Amihud measure, evident in London and Paris is further extended in the African markets to include high levels of association with the Liu and turnover measures as well. A likely explanation for this wider correlation between traded volume and all the liquidity constructs is that volume has a greater driving impact on markets that have lower levels of activity. Morocco is the sole exception in the African sample in exhibiting few significant correlations between any of the liquidity variables. There is also a large inverse correlation between turnover and Liu in the case of Kenya, and with Liu and Amihud in the case of South Africa and Egypt.

III. Comparison between liquidity measures and legal regimes

This section contrasts the liquidity measures and the differences between the civil and common law legal regimes. We use two methods to compare the various liquidity measures. First, using total trading costs as the dependent variable the explanatory power arising from each of the liquidity measures in turn as well as the Stoll (2000) control variables is assessed through cross sectional regressions. This is followed by the application of the Vuong (1989) likelihood ratio test.

Liquidity measures

A. An assessment of liquidity measures ability in explaining total costs

A direct measure of association between the total trading costs and the market control variables, which Stoll (2000) defines as price, traded volume, volatility, and firm size or market capitalization, as well as the various liquidity measures are provided in this section. Following Stoll (2000) price is defined as a proxy for risk, as lower priced stocks tend to be riskier, and controls for the effects of price discreteness. Volume and firm size proxy for order processing and inventory considerations. Increases in volume and firm size increase the probability of locating a trade counter party, which reduces risk. Volatility measures the risk of adverse price changes because of stock put into inventory (see Lesmond, 2005).

For each market in turn three sets of multivariate panel or cross section-regressions were estimated with the dependent variable in each cases being the stock's total trading costs. The employment of panel regression techniques increases the efficiency of the estimators through having large cross sectional dimensions, in terms of the number of individual firms, in addition to the time series dimension of standard regression models. The first set concerns regressing total costs against the Stoll control variables only. The second set concerns regressing total costs against the Stoll control group as well as each of the three individual liquidity measurement variables in turn so as to differentiate between the liquidity variables through any incremental benefits with the inclusion of one as opposed to another. The liquidity variables are the turnover, Liu and Amihud constructs. The third set of regressions concerns the regression of the same dependent variable in the previous two sets of regressions against all the Stoll control variables and liquidity measures. Differentiation can be made through the level of explanatory power, or R^2 terms, and to a lesser extent the statistical significance of variables assessed by confidence levels of t-statistics. In every case price, volume and firm size are natural-log scaled in line with Stoll (2000).

Table IV provides evidence of the significance of various liquidity measures and Stoll market control variables in explaining the total trading costs in each market. There are significant differences between the two developed European markets and the emerging African markets. The explanatory power, or R^2, of the models for London and Paris, which are both in excess of 10%, are much higher than those of African markets, which are generally under 10%, with the sole exception of South Africa with the highest explanatory power of over 24%. The R^2 values of South Africa are between 24% and 25% and are in line with those reported in Lesmond (2005) where similar methods of association were applied to a panel of firm-quarterly data with explanatory power in excess of 30%. However the scope of the study by Lesmond was limited to only South Africa within a wider emerging markets sample. The market control variables are generally statistically significant in all the regression models for the two European markets with the exception of firm size which only becomes significant upon the inclusion of the turnover liquidity construct within the models. This provides some evidence of an association between firm size and the turnover construct. In both markets the coefficients on the Liu and turnover variables are statistically significant although the former has the greatest impact on the models overall explanatory power. Furthermore the sign of the turnover coefficient is negative indicating a negative association between the total trading costs and the turnover construct while a positive association exists between the costs and the Liu measure. The Amihud measure coefficient is also significant in the case of Paris although it has limited effect on explanatory power in contrast to the other measures and is one hundred times smaller in absolute size. The evidence at this stage

suggests that the Liu measure has the greatest level of association with the total trading costs of all the liquidity measures in the two European markets.

In contrast to the two developed European markets the Amihud measure exhibits a greater degree of association with the total trading costs across the emerging African markets. This is especially true in the case of the least developed African markets, those of Egypt and Kenya, where the Amihud construct is the only liquidity measure that is both statistically significant and has an albeit marginal impact on explanatory power. This finding is not surprising given that both markets have similar institutional trading arrangements and levels of regulation and regulatory enforcement despite the differences in legal origins. In contrast, all three liquidity measures are statistically significant in the more developed markets of Morocco and South Africa though the Liu measure has the greatest impact on explanatory power in the former while the explanatory power in the latter is impacted more by the price-impact liquidity construct of Amihud. However the overall explanatory power for the Moroccan models is the lowest of all sample group markets in being under 2%. Interestingly in this case the only Stoll control variables of significance in the majority of models are those of volatility and firm size providing evidence of a size-effect involved in liquidity in Morocco. The evidence from the regressions involving the emerging African markets suggests that the Amihud construct is the most reliable construct with which to use in measuring liquidity. This is broadly in line with Lesmond (2005) which finds evidence that the Amihud construct is an adequate measure although the study finds that an alternative liquidity measure, developed in Lesmond, Ogden and Trzcinka (1999) and based on the occurrence of zero returns, is better performance albeit on a wider selection of non-African emerging markets.

B. Vuong likelihood ratio test

The regression based tests appear to indicate that the Liu and Amihud measures have increased explanatory power over the other market proxies and liquidity estimators for the European and African markets respectively. However while regressions permit a comparison across models given that the dependent variable is always fixed as the total trading costs, or bid-ask spread plus commissions, the simple contrasting of an R^2 statistic does not provide reliable evidence of which of the three liquidity measures, Liu, Amihud or turnover, is more highly associated with the trading costs.

Vuong (1989) provides a likelihood ratio test for model selection without specifying a null hypothesis of either model being true. In contrast, the null states that either model is equally as efficient at explaining the data generating process as the alternative that one model is better. Vuong's likelihood ratio Z-score test statistic provides indication of whether the reference model is better at explaining the comparison model with a one-sided probability. The reference models are either the Amihud estimate or the turnover ratio, and the

comparison models are the Stoll control variables and separately Liu measure. Turnover ratio is a comparison model in the Amihud reference model tests while the Amihud measure is a comparison model in the turnover ratio reference model tests. A positive and significant one-sided probability indicates that the Amihud measure or turnover ratio estimate is more highly associated, or statistically superior to the competing liquidity estimators. In general, a positive sign for the Z-score test statistic indicates the reference model has a higher R^2 regression statistic than the competing models. A more thorough mathematical derivation of the Vuong (1989) likelihood ratio test is given in Appendix 2.

The results summarised in Table V provide clear evidence that regression models explaining the total trading costs including the Amihud liquidity measure are more robust than those with either turnover or other liquidity measures, whether these are Stoll or Liu variables. The Amihud measure outperforms Stoll variables for both Paris and Morocco and additionally in the latter market outperforms turnover and group estimators in its ability to explain liquidity. The results for the other markets of Kenya, South Africa, London and Egypt show that neither Amihud nor Liu measures are preferable in explaining liquidity. These results are in line with the regression based models where all three liquidity measures show a high degree of significance within the equations for total trading costs for the markets of Paris and Morocco. The results for turnover ratio are less clear and demonstrate the inclusion of turnover ratio leads to better performance than the Liu measure for only South Africa. These results are in contrast to the findings of Lesmond (2005) in performing this test across a wide range of emerging markets including South Africa. While quarterly data were used Lesmond found that the Amihud construct outperforms the turnover measure.

Taking into account the panel regression results of the previous subsection where the Amihud measure shows consistent impact on the explanatory power across the four African Markets in contrast to the other liquidity measures, and its robustness in the Vuong likelihood ratio test, we will be using it subsequently to construct the liquidity factor in the valuation model.

C. Legal Regime

The differences in the effect on stock returns by a number of ubiquitous market control variables, based on those of Stoll (2000), between the markets within the sample group with legal systems centred on French civil code as opposed to English common law are assessed through fixed effects cross sectional panel regressions. The legal origin of the national market regulations is provided in Appendix Table 1. One set of regressions contrasts London against Paris while a second set contrasts all of the civil code markets, namely Paris, Morocco and Egypt against their common law counterparts, London, South Africa and Kenya. Unbalanced cross sectional panel regressions employing fixed effects are used to assess the

differences in dependency on a set of explanatory conditioning variables used by Stoll (2000). In this light the independent variables are the natural log of the UK£ adjusted mean of the following three estimates: monthly stock turnover ratio, market capitalisation, and stock price as well as the value of the mean monthly local currency stock price volatility. The time period used per cross sectional unit, or firm, is January 1997 to December 2007.

The results in Table VI indicate that across all samples the turnover variable was highly significant. The firm size, or market capitalization, variable was highly significant in the sample only including the London and Paris markets. In both the European as well as the overall universes the turnover coefficients for the French civil code markets is several times the magnitude of their English common law counterparts. Given that the turnover ratio is a measure of trading activity or liquidity the returns generating process in the French civil code markets is more heavily influenced by the magnitude of this phenomenon than English common law markets. This is further reinforced by the explanatory power of the civil code models being ten times higher than that for the common law markets and also in the considerably lower levels of traded volumes for civil code markets in Table 1. This would fall in line with La Porta et al. (2002) where civil code markets are found to exhibit poorer protection for minority shareholders, or investors, from expropriation by larger block-holding groups than in common law regimes. Consequently levels of transactions costs faced by investors in civil code markets would be higher and the returns generating process would be more strongly influenced by liquidity and turnover than common law markets. However in contrast to La Porta et al. (2002) stock prices are not statistically significant in explaining returns. The evidence would suggest at this stage that there are significant differences in returns generating process between French civil code and English common law markets.

IV. Size, Liquidity and Legal Regime valuation factors

The evidence from the previous sections suggests that the Amihud construct provides the best estimates of liquidity while there are significant differences in the returns generating process between markets with French civil and English common law origins. This section builds on these findings in constructing valuation factors within a multifactor capital asset pricing model (CAPM).

All data are converted into a common base currency, in this case UK£ sterling, which mitigates the effects of inflation through the assumption of long term parity between domestic currencies and that of UK. Consequently exchange rate data was obtained from the Reserve Bank of South Africa for South Africa and Datastream for all other markets. The one-month UK-Gilt/Treasury Bill yield was used to generate excess returns and obtained from Datastream.

The construction of the first factor, associated with firm size, follows Fama and French (1993) and is simply the value of each stock market capitalisation in December of each year, calculated from the product of the number of shares outstanding with the sterling price per share for all countries. All stocks in the sample group of countries are grouped together and then sorted and ranked into three portfolios based on the value of the size variable i.e. small (S), medium and big (B). Sorting is undertaken every December and the size valuation factor is simply the difference between the monthly arithmetic mean of excess returns on ranked stocks within the small (S) and big (B) portfolios, SMB. Stocks ranked and sorted into portfolios each December are held for a further twelve months until portfolio rebalancing the following year.

The second factor is based on liquidity and uses the best performing illiquidity measure from the previous section i.e. that of Amihud (2002) to sort and rank stocks. The method used for the construction of the liquidity valuation factors uses the size factor construction as an initial step. Consequently for each month *t*, each company *j* is ranked by the market value of equity at the end of December. Then, firms are classified into 3 portfolios based on market value, from the smallest to the largest, from which the size valuation factor, SMB, is generated. Furthermore, for each individual size portfolio, stocks are further sorted into 3 separate illiquidity ranked portfolios according to the annualised generated illiquidity factor values, derived from the Amihud measure, in ascending order. Nine size-illiquidity portfolios are constructed and are rebalanced annually. The liquidity valuation factor is constructed from the difference of the mean of the three high illiquidity portfolios (H) and the three low illiquidity portfolios (L), i.e. high minus low or HML. The equally weighted monthly returns on portfolios are computed each month from December to the following December. Repeating this procedure for every year results in 143 equally weighted monthly returns from January 1996 to December 2007.

The third factor is associated with exploiting the differences, outlined in the previous section, between the returns generating process in French civil code and English common law markets. This is formed from the difference between equally weighted aggregate mean returns on all stocks in French civil code and English common law markets. Countries within sample group following French civil code are Paris (France), Morocco and Egypt and those with English common law systems being London (UK), Kenya and South Africa. The legal regime variable is simply termed as "LEGAL" as a reference to its legal and regulatory origins.

Finally, the market premium is generated as the aggregate average returns each month across the universe of stocks. Shum and Tang (2005) form a market returns variable from both an equally weighted and a market capitalisation weighted average but in this paper only the former is employed as the market portfolio. This is because London and the JSE

dominate all of the African equity markets and therefore a market capitalisation weighted portfolio would impose a high level of bias that reflects the characteristics of UK and South African stocks. Equally, other methods commonly used in the literature to determine the market variable, such as a regional investment index proxy, such as the Standard & Poors or MSCI range of indices, are complicated by the lack of benchmarks for Sub Saharan Africa.

The number of stocks from each market contained within each of the nine size-illiquidity sorted portfolios is given in Table VII. This clearly shows that firms from Morocco, Egypt and Kenya dominate the small size portfolios while large size portfolios are almost exclusively contain firms from South Africa, UK and France. A similar trend is shown between high and low illiquidity ranked portfolios with those high illiquidity portfolios being largely filled with firms from Morocco, Egypt and Kenya and low illiquidity portfolios exclusively filled with South Africa, UK and France. This profile of the distribution of firms in accordance to illiquidity can also be seen from the three medium size portfolios which also contain some of the larger firms from Kenya, Egypt and Morocco. In this case there are no UK or France firms in the high illiquidity portfolio and progressively fewer firms from Kenya and North Africa in moving from high illiquidity to low illiquidity portfolios. This reflects that the firms from the UK and France all originate from the domestic blue chip FTSE100 and CAC40 indices.

Further evidence of the characteristics of the stocks contained within the nine size-illiquidity ranked portfolios is given in Table VIII. This demonstrates that in the case of either big or small size portfolios those firms that have high as opposed to low illiquidity have lower mean returns and lower levels of risk, or standard deviation. However, this is reversed for medium size stocks where low illiquidity stocks have higher mean returns and higher standard deviation than their high illiquidity counterparts. The coefficients of variation are found to increase from small size-high/low illiquidity portfolios to big size-high/low illiquidity portfolios. Only in the case of the three medium illiquidity portfolios the value is highest for the medium size portfolio, although in line with the big and small size series of portfolios, the small size-medium illiquidity portfolio had the lowest coefficient value of the three size-illiquidity ranked portfolios. Summary statistics are also given in Table 8 of the equally weighted country indices for each market. Generally the smallest and most illiquid markets, such as Kenya and its component Main board and AIMS market, containing eight very small companies, exhibit the lowest mean returns and the highest standard deviations and coefficients of variation.

Finally, the characteristics and summary statistics for the three valuation factors and the market premium are given in panel B of Table VIII. There is very little correlation between any of the factors with the highest correlation of 40%, or 0.4040, being between the

LEGAL factor and market premium. While there is very little evidence of skewness in the distributions of the valuation factors with all values being close to zero, there is evidence of fat-tailed distribution feature, or kurtosis, in the HML, or illiquidity, factor (2.3869) and market premium (1.6018). The illiquidity factor, HML also has the highest coefficient of variation value too at -14.9448 which in the light of the evidence of skewness and kurtosis is demonstrative that this variable has a skewed and leptokurtic distribution.

V. Multifactor CAPM and estimates of Cost of Equity

This section details the construction and results of the four factor CAPM that utilizes the set of valuation factors constructed in the previous section. Costs of equity for each market are estimated from this model.

A. Four-factor augmented CAPM pricing model

The construction of the multifactor model follows in the spirit of the Fama and French (1993) through the augmentation of the original CAPM model (Sharpe (1964) and Lintner (1965)) with the Fama and French firm size factor followed by the newly constructed liquidity and legal regime factors.

The literature associated with factor construction and performance provides two insights into the relationship between size and illiquidity factors and the underlying firms in sample group. Firstly, an increase in the illiquidity factor should be interpreted as an adverse shock to aggregate liquidity (Martinez et al, 2005). Stocks that tend to pay lower average returns when this measure increases (negative betas relative to this factor) do not provide desirable hedging behaviour for investors and therefore extra compensation is required for holding these stocks. This implies that the premium associated with this liquidity factor in a cross section should be negative. Secondly, Shum and Tang (2005) cite that smaller market value portfolios have been found to produce higher average returns relating to a small firm effect in valuation where excess returns are found to decrease with firm size. This is a counter-intuitive finding and is at odds with the significant and positive relationship, indicated by positive betas, between portfolios containing big size companies and the size premium or factor.

The four-factor augmented CAPM model is constructed with the market premium being augmented with the additional factors associated with size, SMB, illiquidity, HML, and legal regime, LEGAL. This states that 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) the excess return on the market portfolio, $r_m - r_f$, (ii) the difference between the return on a portfolio of small-size stocks and the return on a portfolio of large-size stocks, SMB (small minus big); (iii) the difference between the return on a portfolio of high illiquidity stocks and the return on a portfolio of low illiquidity stocks,

HML, and (iv) the difference between returns of stocks traded in markets with a French civil code regime and those traded in an English common law regime, LEGAL. Therefore, the expected excess returns on a portfolio *p* of emerging market stocks can be written as

$$E(r_{pt}) - r_{ft} = \beta_p \left[E(r_{mt}) - r_{ft}\right] + s_i E(SMB) + h_i (HML) + z_i (LEGAL) \tag{6}$$

The equilibrium relation of 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 (6) to the following estimating equation

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + s_i SMB_t + h_i HML_t + z_i LEGAL_t + \varepsilon_{it} \tag{7}$$

where the variables are described above and $\varepsilon_{p,\,t}$ is an iid disturbance term. The factor sensitivities or loadings, β_p , s_p , h_p , z_p are the slope coefficients in the time series regression.

Prior to estimation, time series diagnostic tests were done to check for autocorrelation and heteroskedasticity, given the sensitivity of the disturbance terms to normality assumptions in the distribution properties of the data. Tests for heteroskedasticity using the White test (White, 1980) and the Durbin-Watson test (Durbin and Watson, 1950 and 1951) for autocorrelation found significant heteroskedasticity and autocorrelation. These test results are not reported here but suggest the t-test in the OLS regressions are unreliable and Newey and West (1987) methods were used and the tests repeated. It should be noted that this adjusts the standard errors and not the regression estimates.

The results in Table IX provide clear evidence of significant improvement in the explanatory power of the four-factor augmented model in contrast to the simple underlying CAPM. However, the improvement in explanatory power, indicated by R^2 terms, is largest only for either small or large size portfolios while medium size portfolios only exhibit a very small and almost negligible increase in explanatory power between models. The direction of the coefficients for the size beta is not as would be expected i.e. being negative for large and medium size sorted portfolios. That infers that when the size factor increases for the market as a whole the returns for large and medium sized companies decrease. The direction of the coefficients of the illiquidity terms are also not as expected as illiquidity betas are negative for low and medium illiquidity portfolios and positive for high illiquidity portfolios. This in turn infers that as aggregate illiquidity increases across the market low and medium illiquidity stocks have decreasing returns and do not act as viable hedges for investors. The direction results for the LEGAL factor are less clear but in terms of contrasting relative size of coefficients are as would be expected. The Legal beta is negative for almost all of the size illiquidity sorted portfolios. However, it is very large and negative for the bigger size sorted portfolios as opposed to the smaller size sorted portfolios. This could reflect that the majority of companies in bigger size sorted portfolios are firms from the English common law markets

of UK and South Africa, while those in smaller size sorted portfolios are from French civil code countries of Egypt, Morocco and only a few from Kenya.

Further evidence concerning the significance and explanatory power of the inclusion of the size, illiquidity and legal regime valuation factors within a multifactor CAPM format is provided on a market by market basis in Table X. The country indices are formed as equally weighted indices aggregating all individual listed stocks, while in the case of Kenya stocks are grouped into three indices: indices representing overall market, main listings board and fledgling AIMS market, containing eight SME firms.

CAPM regressions are run recursively sequentially including each factor in addition to the market premium that represents the standard CAPM until a final regression includes all four factors thereby generating the full four-factor model. Each model is assessed on the merits of significance of t-statistics and the explanatory power, defined by the R^2 terms in each case. The best performing model with a balance of highest explanatory power and significance of each factor is highlighted in bold in each case for each country. In London's case the size, SMB, and illiquidity, HML, factors are of additional benefit in forming a three factor augmented CAPM model in explaining returns for this market. In all other markets the four-factor augmented CAPM, including size, SMB, illiquidity, HML, and LEGAL factors is best performing in explaining returns in each country.

B. Cost of equity estimates and implications for raising capital

Cost of equity estimates derived from the multifactor model for each market are contrasted in Table XI. This is in line with Jagannathan and Meler (2002) who provide evidence for the continued use of the CAPM in decisions regarding capital budgeting and in the assessment of viability of projects through discounting cash flows by the cost of equity, or capital in leveraged firms, and arriving at Net Asset Values, NAV. Morocco has the lowest costs of equity in the sample group at 10.10% reflecting the benefits of a well designed market institutional environment and high level of corporate governance adhering to OECD principles. Morocco[3] also has a sophisticated market microstructure and electronic trading and clearing systems. Its value is in line with that in the prevailing European markets of London and Paris, which have costs of equity of 12.39% and 15.36% respectively. Both the European markets have well established corporate governance and regulatory regimes with high levels of disclosure and transparency.

The markets of Egypt, South Africa and Kenya have a much higher level of costs of equity. Despite the presence of a well established corporate governance and regulatory

[3] See Ghysels and Cherkaoui (2003) for developments in the Casablanca stock exchange.

regime in South Africa which is centred on the King I and II reports[4] the presence of high volatility exerts an influence on the beta estimates in the augmented CAPM regression. This is largely responsible for the high estimates for the cost of equity in this market although there is a significant difference between the overall market, 32.70%, and that of the constituent firms from the prestigious blue chip JSE Top 40 index, 28.04%. In contrast Egypt has an equally high cost of equity which can be largely attributed to a crude electronic floor based system, similar in design to that in Kenya, and poor enforcement of corporate governance and regulatory standards. Kenya also has a high cost of equity, 19.04%, though this is considerably lower than Egypt, 29.51%, which is partly a reflection of the lower volatility and consequent influence of this on the betas of the augmented CAPM. This can in itself be attributed to the higher levels of liquidity in the North African market facilitating the price movements that cause volatility in contrast to the more illiquid Kenyan market where there is considerable evidence of severe price-rigidity, as shown earlier in Table 2. However the market in Kenya does have the highest levels of enforced regulation and corporate governance in the East African region and is taking a central role in the already advanced ongoing regional integration initiatives. In line with expectation the cost of equity for the prestigious Main board, 19.85%, is significantly lower than that for the fledgling AIMS market, 22.73%. This reflects the lower level and less binding nature of regulation and corporate governance legislation in the AIMS market.

C. Implications for investors: portfolio diversification

The implications for foreign portfolio investment from using the augmented CAPM model are explored through the construction of simple mean-variance optimised portfolios. Three asset portfolios are constructed in each case and all time series are denominated in UK£ sterling. Four potential asset combinations are analysed in each case, namely an Anglophone portfolio including, including London, Kenya and South Africa, a Francophone portfolio including Paris, Morocco and Egypt, and then a combination of London, Egypt and Morocco, as well as Paris together with Kenya and South Africa. These combinations give broad pan-African strategies in addition to the inclusion of the international markets of London and Paris. 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).

The evidence from Table XII suggests that the strategy centred on the English common law markets, or Anglophone strategy, outperforms all other combinations. Sharpe

[4] The King Report that regulates corporate governance practices in South Africa is similar, though less stringent in its requirements, to the UK Cadbury Report and the US Sarbanes-Oxley Act.

ratios, providing an indication of the levels of returns in relation to risk for the minimum variance portfolios in each case are highest for the Anglophone (6.5139) followed by the Paris – Kenya – South Africa combination (3.6456). Finally the two strategies heavily focussed on North Africa, i.e. the Francophone and the London – Morocco – Egypt strategies, have the lowest Sharpe ratios at 1.0308 and 0.6677 respectively. The most significant factor driving the higher Sharpe ratios for the strategies dominated by English common law markets is that the high volatility present in all cases is mitigated by equally high mean annual returns. The Anglophone and Paris – Kenya – South Africa strategies have mean annual returns of 29.83% and 32.14% respectively in contrast to the significantly lower values for the Francophone (14.61%) and London – Morocco – Egypt (13.56%) strategies. This provides some evidence that markets adhering to common law regimes are more liquid and hence have higher volatility and returns in contrast to civil law markets. Critically these characteristics would have influence on the mean-variance properties of the aggregate country portfolio returns time series which would be reflected in the portfolio optimisation process.

Further evidence in revealing the relationships between the markets is outlined in the time profiles of the recursively estimated asset weights from the minimum variance portfolios in Table XIII. The inclusion of South Africa in portfolios leads to this asset dominating investment weights. The portfolios containing Morocco and Egypt hold the London and Paris assets in approximately equal proportions to the North African assets with only slight additional emphasis placed on holding London. In all cases holdings of Kenya tend to be low but relatively stable through time indicating some limited benefits for the consideration of this market within investment manager's investment menus. The inclusion of London assets in preference to those of Paris results in improved performance in all cases.

The time-evolution profiles of the three asset portfolio efficient frontiers for each of the four asset combinations are given in Figures 1.1 to 1.4. These provide further evidence of improved asset allocation performance of common law (and London) based portfolios as opposed to civil law (and Paris) based counterparts. This is indicated through the greatest degree of vertical steepness of the frontier loci in each case which infers that any possible change in asset weights that cause incremental increases (or decreases) in portfolio returns are linked to only very small consequential changes in portfolio risk. Consequently the efficient frontiers for Anglophone portfolio, Figure 1.1, and London – Morocco – Egypt portfolio, Figure 1.3, show the optimal risk-return profiles with the Francophone, Figure 1.2, and Paris – Kenya – South Africa, Figure 1.4, portfolios showing the least preferable profiles.

VI. Conclusions

In this paper we assess the strength of three liquidity estimators, namely the ubiquitous turnover ratio, the Amihud price-impact measure, and the recently developed trading speed

measure of Liu, which is more robust in conditions of severe illiquidity, in explaining the total trading cost, itself derived from the bid-ask spread and market transaction fees. Daily data is used to calculate each of the liquidity measures and aggregated into monthly variables that are used alongside market capitalization, as a proxy for size, in the annual sorting of stocks and construction of size and liquidity valuation factors in line with Fama and French. A new legal regime factor is introduced that captures the effects of valuation differences between civil code and common law regulatory jurisdictions. This is constructed from the difference in monthly aggregated returns between component stocks from civil and common law markets.

The evidence suggests that while neither of the liquidity estimators is very strong in explaining the total trading costs the Amihud price-impact measure is more consistent in increasing the meagre explanatory power for these cross section regressions. Furthermore there is some evidence of differences in the modelling of excess returns between the civil and common law countries with returns in the former being influenced more by traded turnover than in the latter. This provides some indication of the difference returns generating process between the two legal regimes.

The evidence from the cost of equity estimation suggests that Morocco alongside London and Paris has the lowest cost of equity from amongst the principal African markets. This provides some evidence of the benefits of an efficiently run, well organised market with strong institutions and rigorous enforcement of regulatory and corporate governance regime as is the case in Morocco. In contrast Egypt, alongside Kenya, has a much higher cost of equity and while the costs of compliance with listings and corporate governance legislation is lower than in Europe or Morocco this is offset by the imposition of a restrictive burden on domestic firm's ability to finance international expansion and overseas projects. South Africa has a very high cost of equity which reflects the greater liquidity in this market and consequential greater capacity to exhibit volatility. The high cost of equity is largely reflective of this high volatility and has already caused the loss of several blue chip primary listings to the London stock exchange.

Simple mean variance portfolio analysis provides some evidence of improved performance derived from strategies centred on common as opposed to civil law markets. The risk return profiles for strategies based on London, or to a lesser extent Paris, have the most attractive characteristics for investors when held in combination with Kenya and South Africa as opposed to either of the two North African markets. This would infer that development policy in countries with legal systems derived from English common law heritage should shift focus towards the improvement of institutions supporting securities markets in order to facilitate development. In contrast, civil code countries may find a shift in focus to overhauling existing banking systems may provide the most cost effective external source of finance for domestic firm's industrial expansion.

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Table I. Total Costs for UK, France, South Africa, Kenya, Morocco and Egypt

This table presents the total trading costs which are calculated through the addition of the bid-ask spread with the total brokerage commissions and fees applicable in each market for a round-trip or the buy and corresponding sell legs of a trade. Total costs are represented in basis points with annual means being documented. Appendix Table 1 provides a schedule of the fees and commissions in each market. The bid-ask spread is generated through $Quoted\ spread_M = 1/2\left[\left(\frac{(Ask_M - Bid_M)}{(Ask_M + Bid_M)/2}\right) + \left(\frac{(Ask_{M-1} - Bid_{M-1})}{(Ask_{M-1} + Bid_{M-1})/2}\right)\right]$ applied to respective monthly bid and ask prices for individual stocks. The monthly average is taken across all stocks to obtain a market wide measure, for which an annual mean is calculated.

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
London	126.08	104.66	100.93	94.04	95.98	119.72	116.17	142.14	98.73	107.58	84.47	52.52	42.49	34.41	25.84	23.73
Paris	117.81	169.11	165.63	152.45	176.29	109.01	93.33	76.29	92.23	212.55	48.10	37.65	27.98	19.54	13.40	12.45
South Africa	-- --	-- --	-- --	558.73	621.58	775.62	790.14	860.54	931.99	818.23	843.25	789.98	682.26	677.15	585.59	652.10
Egypt	-- --	-- --	-- --	286.76	301.18	336.06	396.68	457.02	359.68	338.68	249.92	228.54	355.03	240.48	225.81	226.11
Morocco	22.16	20.86	45.95	50.96	26.94	26.66	23.93	20.00	620.34	558.53	811.99	715.20	844.75	653.96	600.26	526.81
Kenya	-- --	-- --	724.59	975.82	1,067.24	960.65	1,097.08	893.98	1,167.41	1,065.17	1,034.05	928.44	1,080.64	-- --	-- --	-- --

Table II. Summary Statistics

This table presents summary statistics for the six sample group markets comprising of four major emerging African markets (Egypt, Kenya, Morocco and South Africa) and two developed OECD markets (UK and France). Datastream provides the daily prices, volume and market capitalization information. Start refers to the beginning date of the daily security return data up to the final year 2007. 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 £UK market capitalization is derived using the end of month exchange rate for each country and month. Square parentheses indicate median values for each variable.

			Local market				£UK equivalent	
Country	**Start**	**Zero Return (%)**	**Price**	**Volume (thousands)**	**Volatility (Variance) (%)**	**Market Capitalization (millions)**	**Price**	**Market Capitalization (millions)**
Europe								
London (FTSE 100)	1991	14.17	15.53	1,821,198.54	0.00040	8,802.16	15.53	8,802.16
		[14.57]	[14.82]	[1,666,835.55]	[0.00031]	[10,101.37]	[14.82]	[10,101.37]
Paris (CAC 40)	1991	6.65	97.10	315,366.28	0.00898	12,285.41	68.27	8,234.63
		[6.06]	[91.50]	[192,745.27]	[0.00043]	[11,853.93]	[67.43]	[7,951.88]
Africa								
Egypt	1996	38.90	43.30	19,514.82	0.04358	657.89	6.34	81.27
		[41.62]	[38.51]	[15,709.25]	[0.00059]	[403.71]	[5.63]	[68.21]
Morocco	1993	63.13	569.54	7,821.70	0.00173	3,046.40	36.45	192.80
		[63.71]	[581.46]	[4,580.21]	[0.00031]	[2,671.64]	[35.86]	[167.63]
South Africa	1991	56.93	22.96	214,712.60	0.03619	2,001.54	2.89	460.90
		[53.04]	[21.83]	[235,921.05]	[0.00326]	[1,550.42]	[2.76]	[356.39]
Kenya	1991	59.06	61.30	71,196.98	0.00595	3,114.73	0.62	22.64
		[58.82]	[63.30]	[56,808.98]	[0.00080]	[1,292.76]	[0.57]	[12.96]

Table III. Spearman's Rank Correlations

This table presents the non-parameterized Spearman rank correlation between the Stoll (2000) market control variables and the liquidity measures on a market by market basis. In line with Stoll (2000) the natural logarithms are taken of the variables for price, market capitalisation and volume, while volatility remains untransformed and is the monthly average of daily price variance. Price is the average of daily prices over each month and is stated in local currency units. Volume is the average of the daily trading volume over each month and is stated in thousands. MV or 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 units. Four liquidity measurement variables are presented. Amihud is the liquidity measure of Amihud (2002), which is defined as the daily ratio of the absolute return on a day to the UK£ trading volume for that particular day averaged over the past 1 month and provides a measure of the price impact. Liu is the measure of Liu (2006) and represents a standardized turnover-adjusted number of zero returns over the prior month. Turnover is a ratio of the traded volume of shares in relation to total number of shares outstanding and is scaled by the number of trading days in the month of measurement. It provides a measure of trading frequency. The final measure is the Bid Ask spread which is the average daily relative bid ask spread over the prior 1 month, where daily relative spread is the UK£ denominated spread divided by average of Bid and Ask prices. At the end of each month for the maximum period of data availability for each country cross sectional averages for each variable are calculated over the stocks in each respective market, namely Egypt, Morocco, Kenya, South Africa, London and Paris. Likewise at the end of each month the cross sectional Spearman's rank correlation are computed and the time series average of those correlations are reported.

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

	Price	Volatility	Volume	MV	Amihud	Liu	Turnover	Bid Ask Spread
Price	1.0000							
Volatility	-0.1972	1.0000						
Volume	-0.3179	0.1369	1.0000					
MV	0.4351	-0.0899	**0.5346**	1.0000				
Amihud	0.2512	-0.0139	**-0.9288**	**-0.5727**	1.0000			
Liu	0.3101	-0.1816	-0.3773	0.2696	0.2926	1.0000		
Turnover	-0.3466	0.1944	0.3686	-0.3026	-0.2657	**-0.9630**	1.0000	
Bid Ask Spread	-0.1023	0.0736	-0.1512	-0.2040	0.1736	-0.0047	0.0246	1.0000

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

	Price	Volatility	Volume	MV	Amihud	Liu	Turnover	Bid Ask Spread
Price	1.0000							
Volatility	-0.2447	1.0000						
Volume	0.0956	0.0476	1.0000					
MV	-0.1355	0.0998	0.4827	1.0000				
Amihud	-0.0515	0.2352	**-0.8138**	-0.3512	1.0000			
Liu	-0.4588	0.0937	-0.2763	0.4625	0.3769	1.0000		
Turnover	**0.5325**	-0.0209	0.3907	-0.3627	-0.2996	**-0.8920**	1.0000	
Bid Ask Spread	-0.0632	0.1216	-0.2969	-0.2346	0.3855	0.1292	-0.0920	1.0000

Panel C: Results for Egypt (1997M01 – 2007M12)								
	Price	Volatility	Volume	MV	Amihud	Liu	Turnover	Bid Ask Spread
Price	1.0000							
Volatility	-0.1872	1.0000						
Volume	-0.0789	0.1453	1.0000					
MV	**0.5217**	-0.1312	0.1213	1.0000				
Amihud	0.0946	0.0590	**-0.8566**	-0.1282	1.0000			
Liu	0.0971	-0.0768	**-0.5012**	0.1690	0.4359	1.0000		
Turnover	-0.1694	0.2060	**0.8262**	-0.2700	**-0.6838**	**-0.6286**	1.0000	
Bid Ask Spread	0.0427	0.0507	-0.3764	-0.1078	0.4275	0.2093	-0.3081	1.0000
Panel D: Results for Morocco (1993M08 – 2007M12)								
	Price	Volatility	Volume	MV	Amihud	Liu	Turnover	Bid Ask Spread
Price	1.0000							
Volatility	-0.1252	1.0000						
Volume	0.3256	-0.0018	1.0000					
MV	0.4055	-0.0531	0.3821	1.0000				
Amihud	-0.2521	0.4646	-0.4150	-0.1915	1.0000			
Liu	0.1623	-0.0092	-0.0368	0.4243	0.1414	1.0000		
Turnover	0.0995	-0.0141	**0.4960**	-0.3119	-0.1867	-0.3421	1.0000	
Bid Ask Spread	0.0278	-0.0081	0.0619	0.0931	-0.0588	0.0530	-0.0201	1.0000
Panel E: Results for Kenya (1995M10 – 2005M03)								
	Price	Volatility	Volume	MV	Amihud	Liu	Turnover	Bid Ask Spread
Price	1.0000							
Volatility	-0.2588	1.0000						
Volume	0.0191	0.1827	1.0000					
MV	0.2437	-0.0828	0.0953	1.0000				
Amihud	0.0659	0.2109	**-0.5268**	0.0722	1.0000			
Liu	-0.1651	-0.1053	**-0.7333**	0.3362	0.4408	1.0000		
Turnover	0.1480	0.0915	**0.5627**	-0.3258	-0.3953	**-0.7116**	1.0000	
Bid Ask Spread	-0.1002	0.1586	-0.1206	-0.0750	0.1893	0.1038	-0.0823	1.0000
Panel F: Results for South Africa (1996M04 – 2007M12)								
	Price	Volatility	Volume	MV	Amihud	Liu	Turnover	Bid Ask Spread
Price	1.0000							
Volatility	-0.4900	1.0000						
Volume	0.2125	-0.0564	1.0000					
MV	**0.6981**	-0.3183	0.4011	1.0000				
Amihud	-0.1695	0.2220	**-0.6593**	-0.2753	1.0000			
Liu	-0.2206	0.1001	**-0.7411**	-0.0742	**0.5950**	1.0000		
Turnover	0.2188	-0.0683	**0.8206**	0.0704	**-0.5097**	**-0.8984**	1.0000	
Bid Ask Spread	-0.3979	0.2160	-0.3763	**-0.4944**	0.3397	0.1857	-0.1872	1.0000

Table IV. Total costs on liquidity proxies and measures

This table presents the panel cross section regression results on a firm-monthly basis using total trading costs as the dependent variable. Three liquidity measurement variables are presented. Amihud is the liquidity measure of Amihud (2002), which is defined as the daily ratio of the absolute return on a day to the UK£ trading volume for that particular day averaged over the past 1 month and provides a measure of the price impact. Liu is the measure of Liu (2006) and represents a standardized turnover-adjusted number of zero returns over the prior month. Turnover is a ratio of the traded volume of shares in relation to total number of shares outstanding and is scaled by the number of trading days in the month of measurement. It provides a measure of trading frequency. The final measure is the Bid Ask spread which is the average daily relative bid ask spread over the prior 1 month, where daily relative spread is the UK£ denominated spread divided by average of Bid and Ask prices. Firm size is determined from the first day of each month. Volatility is the average daily stock return variance and price and volume measure the average price (local currency units) and trading volume over an annual trading period. Turnover, price, volume, and market capitalisation are all log scaled in line with Stoll (2000). The White (1980) t-statistics are in parentheses.

Market	Intercept	Price	Volatility	Volume	Size	Amihud	Liu	Turnover	Adj-R^2
London FTSE100	0.0417	-0.0067	1.7049	-0.0039	0.00016				10.91
	[22.18]	[-11.68]	[4.51]	[-7.99]	[0.31]				
	0.03960	-0.0066	1.6344	-0.0037	0.00022	0.0049			11.22
	[19.92]	[-12.05]	[4.30]	[-7.71]	[0.45]	[1.57]			
	0.0355	-0.0056	1.6196	-0.0034	0.00033		**0.0049**		14.63
	[26.05]	[-9.97]	[4.32]	[-7.47]	[0.75]		**[10.38]**		
	0.0521	-0.0025	1.7926	0.0004	-0.0044			**-0.0068**	12.26
	[23.38]	[-3.50]	[4.79]	[0.73]	[-6.37]			**[-8.47]**	
	0.0434	-0.0023	1.6661	0.0002	-0.0034	0.0022	**0.0046**	**-0.0056**	15.66
	[25.50]	[-3.14]	[4.49]	[0.36]	[-5.07]	[1.37]	**[9.74]**	**[-6.99]**	
Paris CAC40	0.1546	-0.0105	-1.51E-05	-0.0193	0.0014				8.27
	[12.62]	[-2.31]	[-0.67]	[-5.38]	[0.70]				
	0.1277	-0.0106	3.84E-05	-0.0116	-0.0016	**0.00014**			12.63
	[11.47]	[-2.35]	[1.95]	[-3.15]	[-0.74]	**[4.06]**			
	0.11115	-0.0111	7.08E-05	-0.0066	-0.0035		**0.0425**		14.24
	[13.28]	[-2.46]	[4.06]	[-1.83]	[-1.61]		**[6.20]**		
	0.13217	0.0173	0.00039	0.0252	-0.0307			**-0.0596**	11.40
	[12.67]	[3.17]	[10.72]	[6.25]	[-8.88]			**[-8.17]**	
	0.1021	0.0014	0.00025	0.0127	-0.0177	**7.48E-05**	**0.0280**	**-0.0265**	15.82
	[13.19]	[0.22]	[7.35]	[4.10]	[-6.68]	**[2.17]**	**[3.87]**	**[-3.88]**	
Egypt	0.1140	0.0032	-0.0137	-0.0085	-0.0057				6.59
	[13.34]	[2.88]	[-2.46]	[-12.05]	[-6.25]				
	0.0930	0.0035	-0.0140	-0.0055	-0.0055	**0.0001**			7.65
	[10.71]	[3.20]	[-2.96]	[-5.67]	[-6.10]	**[5.26]**			
	0.11409	0.0032	-0.0137	-0.0085	-0.0057		-9.86E-06		6.57
	[13.11]	[2.86]	[-2.45]	[-12.09]	[-6.26]		[-0.01]		
	0.1120	0.0048	-0.0142	-0.0060	-0.0076			-0.0031	6.63
	[12.79]	[2.04]	[-2.43]	[-1.68]	[-2.69]			[-0.76]	
	0.0928	0.0037	-0.0141	-0.0051	-0.0058	**0.0001**	-2.80E-05	-0.0005	7.61
	[10.19]	[1.57]	[-2.85]	[-1.36]	[-2.04]	**[5.66]**	[-0.05]	[-0.12]	
Morocco	-0.0859	-0.0081	-0.0358	-0.0025	0.01998				1.03
	[-3.89]	[-1.14]	[-4.07]	[-0.65]	[4.72]				
	-0.1113	-0.0077	-0.0947	0.00209	0.02026	**6.04E-05**			1.24
	[-4.65]	[-1.10]	[-3.26]	[0.46]	[4.78]	**[2.38]**			
	-0.0749	-0.0122	-0.0304	-0.0015	0.01882		**0.00426**		1.30
	[-3.39]	[-1.63]	[-3.45]	[-0.38]	[4.54]		**[2.48]**		
	-0.0829	0.02205	-0.0295	0.03448	-0.01338			**-0.0409**	1.22
	[-3.78]	[2.42]	[-3.53]	[2.86]	[-1.43]			**[-3.27]**	
	-0.0944	0.01780	-0.0774	0.03945	-0.01403	**5.50E-05**	**0.00455**	**-0.0404**	1.70
	[-4.09]	[1.96]	[-2.79]	[3.14]	[-1.46]	**[2.20]**	**[2.60]**	**[-3.13]**	

Market	Intercept	Price	Volatility	Volume	Size	Amihud	Liu	Turnover	Adj-R^2
Kenya	0.2788	-0.0362	0.1422	-0.0093	-0.0147				5.57
	[10.11]	[-5.54]	[7.71]	[-3.56]	[-5.22]				
	0.2399	-0.0368	0.1385	-0.0039	-0.0138	**0.0002**			8.37
	[9.15]	[-5.83]	[7.68]	[-1.72]	[-4.87]	**[5.59]**			
	0.2787	-0.0361	0.1334	-0.0092	-0.0148		0.0105		5.56
	[10.09]	[-5.54]	[6.21]	[-3.57]	[-5.25]		[0.55]		
	0.2706	-0.0311	0.1427	-0.0037	-0.0199			-0.0089	5.59
	[9.70]	[-4.88]	[8.05]	[-1.43]	[-5.99]			[-2.57]	
	0.2337	-0.0320	0.1333	0.00126	-0.01888	**0.00021**	0.00667	-0.0085	8.32
	[8.80]	[-5.13]	[6.77]	[0.52]	[-5.60]	**[5.44]**	[0.41]	[-2.40]	
South Africa	0.3922	-0.0418	0.0005	-0.0124	-0.0260				24.34
	[43.28]	[-20.69]	[1.58]	[-16.78]	[-18.12]				
	0.3808	-0.0405	0.0005	-0.0105	-0.0263	**0.0001**			24.92
	[42.38]	[-20.31]	[1.58]	[-12.88]	[-18.34]	**[3.73]**			
	0.3918	-0.0415	0.0005	-0.0120	-0.0262		**0.0052**		24.36
	[42.89]	[-20.82]	[1.58]	[-16.08]	[-18.46]		**[2.89]**		
	0.3935	-0.0439	0.0005	-0.0148	-0.0239			**0.0039**	24.37
	[43.37]	[-19.58]	[1.57]	[-10.35]	[-13.51]			**[2.36]**	
	0.3823	-0.0436	0.0005	-0.0143	-0.0230	**0.0001**	0.0033	**0.0066**	25.01
	[42.59]	[-20.02]	[1.57]	[-10.15]	[-13.11]	**[3.73]**	[1.64]	**[3.67]**	

Table V. Likelihood ratio tests

This table presents the results of the Vuong (1989) likelihood ratio test for non-nested model selection for each market. The models compared are based on the regressions of the bid-ask spread and Amihud measure, defined in Amihud (2002), Turnover, defined as a ratio of the traded volume of shares in relation to total number of shares outstanding and is scaled by the number of trading days in the month of measurement, Liu measure of liquidity, of Liu (2006) representing a standardized turnover-adjusted number of zero returns over the prior month. Natural logarithms are taken of Traded Volume, price, and market capitalisation variables which in addition to the volatility measure, defined as monthly average of daily stock returns, represent the underlying set of explanatory variables in Stoll (2000). A Z-statistic, using a one sided probability, is the basis of determining if the Amihud estimate or Turnover (the reference model) is better at explaining the true bid-ask spread data generating process than alternative liquidity proxies, or the comparison models tested either singularly or as a group. The group contains all the competing liquidity measures excluding the reference estimate. A positive and significant Z-statistic indicates that the comparison models are rejected in favour of the reference model. These cases are in bold type. N is sample size

Country	**Amihud versus**				**Turnover versus**		
	Stoll	**Turnover**	**Liu**	**Group**	**Stoll**	**Liu**	**Group**
London	-2.5709*	-1.1423	-1.2041	-1.4425	-2.5045**	-0.5938	-0.7400
Paris	**3.2289***	1.1310	-0.3587	0.2839	-0.6706	-2.1099**	-2.9819*
Egypt	-0.39106	0.5986	0.9965	0.5944	-0.7794	0.8681	-0.6052
Morocco	**2.2984****	**2.3099****	0.1791	**7.4693***	-0.4000	-2.2048**	-2.3175**
Kenya	0.6726	0.8188	0.8130	0.7974	-0.2674	-0.2517	-0.8360
South Africa	-6.4243*	-0.8232	0.7090	-0.9088	-7.2291*	**2.5099****	0.6879

* denotes significance at the 0.01 level

** denotes significance at the 0.05 level

Table VI. Contrast of Stock Returns generating processes between French civil code and English common law legal regimes

This table presents the results from the cross sectional unbalanced panel regression with fixed effects designated in the following model:

$$r_{Stock\,t} - r_{risk\ free\,t} = \alpha_{it} + \beta_{1it}(\log MV) + \beta_{2it}(\log P) + \beta_{3it}(\log TO) + \beta_{4it}(Volatility) + \varepsilon_{it}$$

with the UK£ adjusted natural logarithm converted market capitalization (MV), stock price (P) and turnover ratio (TO) as well as mean monthly volatility, which is calculated from local currency stock prices, as explanatory variables in line with Stoll (2000). All stocks within universe were initially split into two groups based on the underlying legal regime i.e. French civil code or English common law. The markets of Paris, Morocco and Egypt were classified as the former and London, South Africa and Kenya as the latter. The choice of fixed effects as opposed to random effects in panel regression was made using the Hausman (1978) test. The risk free rate used to generate excess returns is the 3-month UK Gilt/ Treasury rate. T-statistics are given in parentheses. White cross-section standard errors and covariance (degrees of freedom corrected)

	Europe and Africa		**Africa only**	
	English common law	**French civil code**	**English common law**	**French civil code**
α	-0.0021	-0.0362	-0.0325	-0.0791
	(-0.0456)	(-0.6828)	(-0.7366)	(-1.4993)
β_1	**-0.0131**	**-0.0182**	-0.0088	-0.0114
	(-2.3577)	**(-3.3860)**	(-1.4343)	(-1.5592)
β_2	0.0058	0.0015	-0.0021	-0.0138
	(0.7923)	(0.1433)	(-0.2718)	(-1.2114)
β_3	**0.0173**	**0.0319**	**0.0179**	**0.0363**
	(5.6635)	**(6.6269)**	**(5.8948)**	**(7.5261)**
β_4	-7.53E-05	-0.0003	-4.72E-05	0.2738
	(-0.5906)	(-0.6632)	(-0.3742)	(1.0333)
Adjusted R^2	0.002473	0.019331	0.001887	0.032727

Table VII. Summary statistics for equally weighted monthly excess returns on 9 portfolios formed on size and illiquidity for period 1996 to 2007

This table presents the summary statistics for each of the nine size-illiquidity sorted portfolios. For each year, t, every stock is ranked by its market capitalisation of equity and the end of December in year t. Stocks are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, stocks are further sorted into 3 Illiquidity portfolios based on individual stocks Illiquidity ranking in ascending order. Nine size-illiquidity are so formed and rebalanced annually. The equally weighted monthly returns on portfolios are computed each month from January to the following December. Repeating this procedure for every year results in an overall sample set of 143 equally weighted monthly returns from January 1996 to December 2007. The terms B, M, S delineate Big, Medium and Small size and H, M, L delineate High, Medium and Low illiquidity terms. Additionally for each sample time period three zero cost portfolios, SMB (HML) representing long small size (high illiquidity) portfolios and short large size (low illiquidity) portfolios and LEGAL representing differences in value depending on whether stock is traded in a civil or common code legal regulatory regime. The Kenya Main and AIMS markets are subsets of the overall Kenya market portfolio. The AIMS market is for local SME companies (mostly Tea and Coffee exporting companies) and has a persistent 8 listings for the duration of sample period. Annual rebalancing takes place annually every December.

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 during sample period: 01/1996 – 12/2007									
Mean	0.0176	0.0225	0.0187	0.0174	0.0138	0.0084	0.0075	0.0123	0.0099
Standard Deviation (SD)	0.0590	0.0630	0.0601	0.0617	0.0674	0.0456	0.0429	0.0440	0.0617
Coefficient of Variation (CV)	3.3523	2.8057	3.2130	3.5482	4.8727	5.4031	5.6984	3.5704	6.2278
Panel B: Average number of stocks in each of the 9 size-illiquidity portfolios sorted by nationality by year in period: 1996-2007									
France	0.0000	0.0000	0.0000	2.2000	6.0000	0.0000	5.8182	19.5833	7.7500
UK	0.0000	0.0000	0.0000	4.6667	1.0000	0.0000	48.5833	31.5000	6.8333
SA	33.3333	35.8333	24.5000	37.8333	41.4167	22.3333	3.9167	7.8333	36.5455
Kenya	15.3333	14.1667	14.2500	4.0909	5.2500	5.7500	0.0000	0.0000	1.0000
Egypt	4.2500	7.5833	10.9167	5.8333	11.3636	11.3333	0.0000	0.0000	2.8000
Morocco	5.0833	3.8333	7.1667	5.6667	1.6667	18.2500	1.6000	1.0000	7.2500
Panel C: Summary Statistics for countries during sample period: 01/1996 – 12/2007									
	UK	**France**	**South Africa**	**South Africa JSE Top 40**	**Egypt**	**Morocco**	**Kenya**	**Kenya Main**	**Kenya AIMS**
Mean	0.0119	0.0149	0.0172	0.0145	0.0134	0.0087	0.0147	0.0158	0.0087
Standard Deviation (SD)	0.0382	0.0577	0.0732	0.0811	0.0783	0.0403	0.0607	0.0654	0.0930
Coefficient of Variation (CV)	3.1958	3.8799	4.2608	-- --	5.8601	4.6423	4.1346	4.1440	10.6334

Table VIII. Summary statistics for equally weighted monthly excess returns on 9 portfolios formed on size and illiquidity for period 1996 to 2007

This table presents the summary descriptive statistics and correlations between the market, size, liquidity and legal regime valuation factors. For each year, t, every company is ranked by its market capitalisation of equity and the end of December in year t. Stocks are then classified into 3 portfolios based on market value, from the smallest to the largest. For each size portfolio, stocks are further sorted into 3 Illiquidity portfolios based on individual stocks Illiquidity ranking in ascending order. Nine size-illiquidity are so formed and rebalanced annually. The equally weighted monthly returns on portfolios are computed each month from January to the following December. Repeating this procedure for every year results in an overall sample set of 143 equally weighted monthly returns from January 1996 to December 2007.

	SMB	HML	LEGAL	MARKET
Panel A: Summary statistics for zero cost portfolio factors				
Mean	0.0290	-0.0055	0.0054	0.0147
Standard Deviation	0.1243	0.0815	0.0491	0.0468
Coefficient of Variation (CV)	4.2838	-14.9448	9.1563	3.1713
Skewness	0.2064	0.6336	-0.0639	-0.4401
Excess Kurtosis	-0.1639	2.3869	0.5140	1.6018
Panel B: Correlation Coefficients				
SMB	1.0000	-- --	-- --	-- --
HML	0.2725	1.0000	-- --	-- --
LEGAL	0.0981	-0.2031	1.0000	-- --
MARKET	0.1048	0.0945	0.4040	1.0000

Table IX. Time series regressions using equally weighted monthly contemporaneous market excess returns for 9 portfolios formed on size and illiquidity for period: 1996 – 2001, for all sample markets.

This table contrasts the performance of one factor CAPM with the four factor adjusted CAPM in modelling the nine size-illiquidity sorted portfolios. Stocks are sorted in ascending order on monthly basis in accordance to Amihud (2002) illiquidity measure. The size-liquidity portfolios are formed by first sorting stocks into three portfolios, Big, Medium and Small, depending on their market capitalisation and then further sorting stocks within each size portfolio into three further illiquidity portfolios, High, Medium and Low, on an annual basis. The SMB factor is formed through the difference between small and big size portfolios. Correspondingly the HML illiquidity factor portfolio is formed from the sum of the three high illiquidity portfolios less the sum of the three low illiquidity portfolios. The LEGAL factor is formed from the aggregate excess returns of Francophone markets less the aggregate excess returns of Anglophone markets. In this sample Francophone markets are assumed as those with legal and regulatory systems based on French civil code and are Egypt, Morocco and Paris. Anglophone markets with legal and regulatory systems based on English common law are South Africa, Kenya and London. Panel A presents parameter estimates of the capital asset pricing model, CAPM:

$$r_{it} - r_{ft} = \alpha_i + \beta_i (r_{mt} - r_{ft}) + \varepsilon_{it}$$

and panel B presents parameter estimates of the four factor adjusted CAPM model:

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

where r_{it} is the return of portfolio i in month t, r_{ft} is the one month T-bill risk free rate for month t, which is taken as the one month UK Gilt rate in this case. Numbers in parentheses are t-statistics.

Portfolio	**S/L**	**S/M**	**S/H**	**M/L**	**M/M**	**M/H**	**B/L**	**B/M**	**B/H**
Panel A: CAPM-adjusted performance									
$\hat{\alpha}(\%)$	0.0036	0.0070	0.0055	-2.98E-05	-0.0055	-0.0039	-0.0021	0.0014	-0.0079
	(1.07)	(2.02)	(1.47)	(-0.012)	(-2.23)	(-1.97)	(-0.78)	(0.59)	(-3.68)
$\hat{\beta}$	0.9444	1.0442	0.8893	1.1816	1.3097	0.8419	0.6506	0.7387	1.2100
	(13.47)	(14.60)	(11.42)	(23.95)	(26.05)	(20.40)	(12.01)	(15.12)	(27.40)
Adj R^2 (1)	**0.5610**	**0.6002**	**0.4788**	**0.8016**	**0.8269**	**0.7456**	**0.5039**	**0.6168**	**0.8409**
Panel B: Four-factor CAPM performance									
$\hat{\alpha}$	-0.0035	0.0025	0.0040	-0.0005	-0.0039	-0.0040	0.0011	0.0049	-0.0030
	(-1.49)	(0.82)	(1.55)	(-0.22)	(-1.57)	(-2.03)	(0.71)	(3.48)	(-2.04)
$\hat{\beta}$	0.9508	0.9996	0.8331	1.1222	1.2825	0.8649	0.7866	0.8354	1.1616
	(18.05)	(14.92)	(14.51)	(23.68)	(23.24)	(19.87)	(23.64)	(26.74)	(35.65)
$\hat{s}$	0.1938	0.1808	0.1464	-0.0111	-0.0356	0.0186	-0.1667	-0.1632	-0.1489
	(10.35)	(7.59)	(7.17)	(-0.66)	(-1.81)	(1.19)	(-14.1)	(-14.69)	(-12.86)
$\hat{h}$	-0.3026	-0.0066	0.2746	-0.1132	0.0781	0.0644	-0.1093	-0.0612	0.1358
	(-10.25)	(-0.18)	(8.54)	(-4.26)	(2.53)	(2.64)	(-5.86)	(-3.49)	(7.44)
$\hat{z}$	-0.0250	-0.0108	-0.0701	0.1914	0.0574	-0.0914	-0.1684	-0.0969	0.1594
	(-0.49)	(-0.17)	(-1.25)	(4.13)	(1.06)	(-2.15)	(-5.17)	(-3.17)	(5.00)
Adj R^2 (4)	**0.8049**	**0.7241**	**0.7771**	**0.8559**	**0.8360**	**0.7773**	**0.8528**	**0.8767**	**0.9318**

Table X. Pooled cross-section regression for equally weighted monthly excess returns on country portfolios with size and illiquidity for 1996 to 2007

This table contrasts the performance of the one factor CAPM model with its multifactor counterparts augmented by each of the additional three factors, size, liquidity and legal regime in turn. Regression results are presented for aggregate market portfolios for each of the six sample group markets. The four factor CAPM:

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

where r_{it} is the return of portfolio i in month t, r_{ft} is the one month T-bill risk free rate for month t, which is taken as the one month UK Gilt rate in this case. Numbers in parentheses are Newey-West HAC covariance adjusted t-statistics.

Explanatory Variables	$\hat{\alpha}$	$\hat{\beta}$	$\hat{s}$	$\hat{h}$	$\hat{z}$	**Adj R^2**
Panel A: London (FTSE100 constituents)						
Excess Market alone	0.0032 (1.23)	0.5924 (8.19)				0.5230
Excess Market and SMB	0.0066 (3.89)	0.6308 (11.77)	-0.1378 (-8.53)			0.7216
Excess Market and ILLIQ	0.0024 (1.04)	0.6075 (8.73)		-0.0918 (-3.39)		0.5583
Excess Market and LEGAL	0.0032 (1.22)	0.5860 (6.99)			0.0150 (0.26)	0.5200
***Excess Market and SMB and ILLIQ**	**0.0061 (3.75)**	**0.6353 (12.05)**	**-0.1312 (-7.94)**	**-0.0388 (-1.87)**		**0.7261**
All Four Factors	0.0062 (3.69)	0.6264 (13.65)	-0.1321 (-8.12)	-0.0354 (-1.45)	0.0203 (0.38)	0.7247
Panel B: Paris (CAC40 constituents)						
Excess Market alone	0.0032 (0.72)	0.7900 (7.71)				0.4053
Excess Market and SMB	0.0087 (3.09)	0.8512 (9.98)	-0.2198 (-6.72)			0.6257
Excess Market and ILLIQ	0.0021 (0.49)	0.8122 (7.77)		-0.1346 (-2.56)		0.4374
Excess Market and LEGAL	0.0029 (0.73)	0.9458 (6.57)			-0.3675 (-2.46)	0.4838
Excess Market and SMB and ILLIQ	0.0081 (2.74)	0.8570 (9.98)	-0.2112 (-6.26)	-0.0493 (-1.04)		0.6276
***All Four Factors**	**0.0067 (2.77)**	**1.0276 (11.60)**	**-0.1912 (-8.38)**	**-0.1146 (-2.48)**	**-0.3901 (-4.91)**	**0.7111**
Panel C: South Africa						
Excess Market alone	-0.0042 (-1.75)	1.4570 (18.39)				0.8646
Excess Market and SMB	-0.0047 (-2.12)	1.4517 (17.54)	0.0190 (0.71)			0.8647
Excess Market and ILLIQ	-0.0047 (-1.89)	1.4661 (19.44)		-0.0556 (-1.67)		0.8675
Excess Market and LEGAL	-0.0038 (-2.83)	1.2581 (35.06)			0.4689 (16.19)	0.9474
Excess Market and SMB and ILLIQ	-0.0056 (-2.47)	1.4596 (18.79)	0.0308 (1.28)	-0.0681 (-2.24)		0.8691
***All Four Factors**	**-0.0039 (-2.88)**	**1.2527 (34.25)**	**0.0065 (0.44)**	**0.0110 (0.46)**	**0.4731 (14.88)**	**0.9470**
Panel D: South Africa JSE Top 40						
Excess Market alone	-0.0067 (-1.85)	1.4462 (13.63)				0.6919
Excess Market and SMB	-0.0045 (-1.39)	1.4708 (14.34)	-0.0884 (-2.73)			0.7081
Excess Market and ILLIQ	-0.0073 (-2.04)	1.4576 (13.58)		-0.0697 (-1.15)		0.6946
Excess Market and LEGAL	-0.0063 (-1.77)	1.2511 (18.06)			0.4600 (6.90)	0.7554
Excess Market and SMB and ILLIQ	-0.0050 (-1.48)	1.4750 (14.16)	-0.0820 (-2.66)	-0.0365 (-0.63)		0.7073
***All Four Factors**	**-0.0032 (-1.05)**	**1.2561 (17.26)**	**-0.1077 (-4.32)**	**0.0472 (0.89)**	**0.5007 (9.96)**	**0.7771**

Panel E: Egypt						
Excess Market alone	0.0013 (0.24)	0.8137 (4.39)				0.2307
Excess Market and SMB	-0.0024 (-0.48)	0.7707 (4.76)	0.1541 (3.03)			0.2853
Excess Market and ILLIQ	0.0029 (0.58)	0.7802 (4.69)		0.2035 (2.14)		0.2703
Excess Market and LEGAL	0.0004 (0.08)	1.2633 (6.59)			-1.0603 (-5.74)	0.6000
Excess Market and SMB and ILLIQ	-0.0006 (-0.13)	0.7531 (5.02)	0.1277 (2.54)	0.1519 (1.57)		0.3037
***All Four Factors**	**-0.0044 (-1.16)**	**1.2373 (7.67)**	**0.1846 (5.26)**	**-0.0333 (-0.40)**	**-1.1074 (-7.44)**	**0.6766**
Panel F: Morocco						
Excess Market alone	0.0044 (1.42)	0.2911 (4.60)				0.1079
Excess Market and SMB	0.0037 (1.30)	0.2838 (4.75)	0.0264 (0.80)			0.1083
Excess Market and ILLIQ	0.0059 (2.04)	0.2588 (5.47)		0.1965 (3.63)		0.2604
Excess Market and LEGAL	0.0041 (1.46)	0.4418 (6.08)			-0.3552 (-4.60)	0.2605
Excess Market and SMB and ILLIQ	0.0062 (2.16)	0.2606 (5.53)	-0.0083 (-0.34)	0.1999 (3.87)		0.2557
***All Four Factors**	**0.0052 (1.95)**	**0.3844 (7.08)**	**0.0062 (0.25)**	**0.1525 (3.24)**	**-0.2833 (-4.31)**	**0.3438**
Panel G: Kenya Overall						
Excess Market alone	0.0081 (1.49)	0.4485 (3.99)				0.1132
Excess Market and SMB	0.0044 (0.98)	0.4075 (3.71)	0.1471 (3.60)			0.1979
Excess Market and ILLIQ	0.0088 (1.66)	0.4321 (4.21)		0.0994 (1.58)		0.1248
Excess Market and LEGAL	0.0078 (1.43)	0.5383 (4.69)			-0.2118 (-1.79)	0.1318
Excess Market and SMB and ILLIQ	0.0049 (1.05)	0.4026 (3.82)	0.1396 (3.08)	0.0430 (0.59)		0.1953
***All Four Factors**	**0.0041 (0.87)**	**0.5056 (4.78)**	**0.1517 (3.08)**	**0.0036 (0.04)**	**-0.2357 (-2.31)**	**0.2180**
Panel H: Kenya Main Market						
Excess Market alone	0.0092 (1.58)	0.4438 (3.63)				0.0945
Excess Market and SMB	0.0056 (1.14)	0.4037 (3.31)	0.1438 (3.18)			0.1630
Excess Market and ILLIQ	0.0099 (1.72)	0.4291 (3.76)		0.0897 (1.47)		0.1006
Excess Market and LEGAL	0.0091 (1.51)	0.5251 (4.13)			-0.1913 (-1.47)	0.1056
Excess Market and SMB and ILLIQ	0.0061 (1.19)	0.3998 (3.39)	0.1378 (2.66)	0.0340 (0.44)		0.1587
***All Four Factors**	**0.0053 (1.03)**	**0.4951 (4.15)**	**0.1490 (2.65)**	**-0.0024 (-0.03)**	**-0.2180 (-1.86)**	**0.1737**
Panel H: Kenya AIMS Market						
Excess Market alone	0.0017 (0.24)	0.4748 (3.16)				0.0503
Excess Market and SMB	-0.0025 (-0.44)	0.4275 (3.46)	0.1698 (1.68)			0.0953
Excess Market and ILLIQ	0.0029 (0.38)	0.4493 (3.91)		0.1548 (0.59)		0.0621
Excess Market and LEGAL	0.0014 (0.21)	0.6150 (2.93)			-0.3306 (-1.63)	0.0694
Excess Market and SMB and ILLIQ	-0.0014 (-0.21)	0.4167 (3.87)	0.1537 (2.24)	0.0927 (0.38)		0.0950
***All Four Factors**	**-0.0026 (-0.44)**	**0.5665 (3.95)**	**0.1713 (2.47)**	**0.0354 (0.15)**	**-0.3426 (-2.46)**	**0.1142**

* indicates models selected from which Cost of Equity are estimated

Table XI. Cost of Equity estimates

This table presents the annualized cost of equity estimates generated at 12/2007 from the total risk premium, which is the sum of the constant, market premium and all relevant additional premiums (size, illiquidity and/or legal regime). The UK Gilt/ Treasury rate is used in each case for risk free rate. Values are percentages.

	Cost of Equity from regression
London (FTSE100)	12.39
Paris (CAC40)	15.36
South Africa	32.70
South Africa JSE Top 40	28.04
Egypt	29.51
Morocco	10.10
Kenya overall	19.04
Kenya MAIN Market	19.85
Kenya AIMS Market	22.73

Table XII. Performance of conditional strategies

This table presents descriptive and summary statistics for conditional portfolio optimisation strategies. All statistics are represented in their annualised forms. Portfolio returns and standard deviations are the annualised forms of series generated by quadratic technique of portfolio optimisation of the two underlying component series in each case. The four Sharpe ratios highlighted in bold are the largest for each respective portfolio combination across all models used to construct the sample means indicating that these portfolios offer the best returns in relation to risk, or standard deviation. The annualised average Sharpe ratios are defined as the mean return in excess of the Treasury Bill rate (in this case the UK Gilt 3 Month rate), divided by the standard deviation. Anglophone portfolio indicates inclusion of markets following English Common law, i.e. London, Kenya and South Africa. Francophone indicates those with French civil code i.e. Paris, Morocco and Egypt.

Universe	Mean return (Annual)	Standard Deviation (Annual)	Maximum (Annual)	Minimum (Annual)	Sharpe Ratio (Annual)
Strategy: Conditional (Multifactor CAPM)					
Anglophone portfolio	29.83%	27.91%	88.63%	-10.65%	**6.5139**
Francophone portfolio	14.61%	23.01%	70.90%	-18.02%	1.0308
London - Morocco and Egypt	13.56%	19.31%	55.66%	-10.98%	0.6677
Paris – Kenya and South Africa	32.14%	32.09%	102.11%	-13.10%	3.6456

Table XIII. Minimum variance asset weights for conditional Multifactor CAPM strategy

This table presents the results of the optimised asset weights resulting from the recursive solution to the quadratic mean-variance optimisation of three asset portfolio combinations.

	2000	2001	2002	2003	2004	2005	2006	2007
Panel A: Linear Multifactor CAPM								
Panel 1: Anglophone Portfolio								
London	24.73%	23.50%	23.45%	25.37%	24.05%	14.18%	22.89%	23.22%
Kenya	15.98%	14.45%	14.20%	14.21%	14.38%	15.38%	12.08%	12.28%
South Africa	59.28%	62.05%	62.35%	60.42%	61.57%	70.44%	65.04%	64.49%
Panel 2: Francophone Portfolio								
Paris	26.50%	26.62%	28.72%	36.61%	38.42%	27.84%	31.33%	32.77%
Morocco	33.75%	31.77%	34.50%	35.17%	31.77%	34.27%	32.99%	32.87%
Egypt	39.76%	41.61%	36.78%	28.22%	29.82%	37.89%	35.68%	34.35%
Panel 3: London-Morocco-Egypt Portfolio								
London	21.37%	21.88%	35.45%	43.23%	45.25%	25.30%	45.17%	39.76%
Morocco	41.46%	32.01%	33.52%	42.27%	39.23%	38.86%	27.68%	32.33%
Egypt	37.17%	46.11%	31.03%	14.50%	15.52%	35.84%	27.15%	27.91%
Panel 4: Paris-Kenya-South Africa Portfolio								
Paris	7.33%	10.24%	10.28%	12.75%	12.09%	10.55%	6.49%	6.51%
Kenya	25.91%	20.99%	17.53%	14.05%	14.71%	15.34%	16.05%	15.17%
South Africa	66.76%	68.77%	72.19%	73.20%	73.21%	74.11%	77.46%	78.32%

Figure 1. Efficient Frontiers for portfolios (2000M12 to 2007M12)

These figures plot the efficient frontiers for the various combinations of the three incumbent assets within the mean-variance portfolio optimisation problem. The z-axis represents the sample time period and optimal asset weights are recalculated through monthly re-optimisation. Frontiers with the flattest vertical profiles are optimal in relation to potential improvements in portfolio mean in relation to additional incremental risk, or standard deviation.

Figure 1.1 Anglophone portfolio (London-Kenya-South Africa)

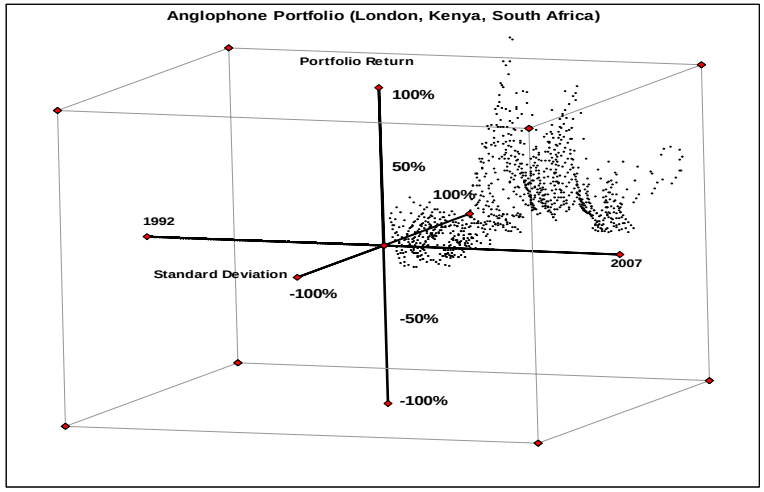


Figure 1.2 Francophone portfolio (Paris-Morocco-Egypt)

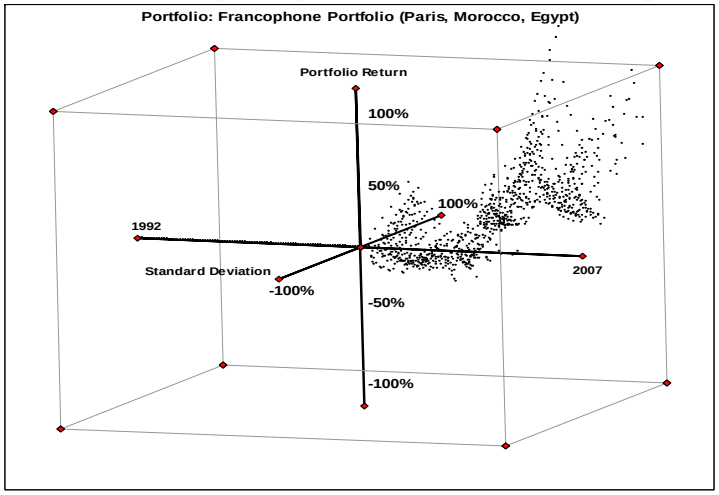


Figure 1.3 London-Morocco-Egypt portfolio

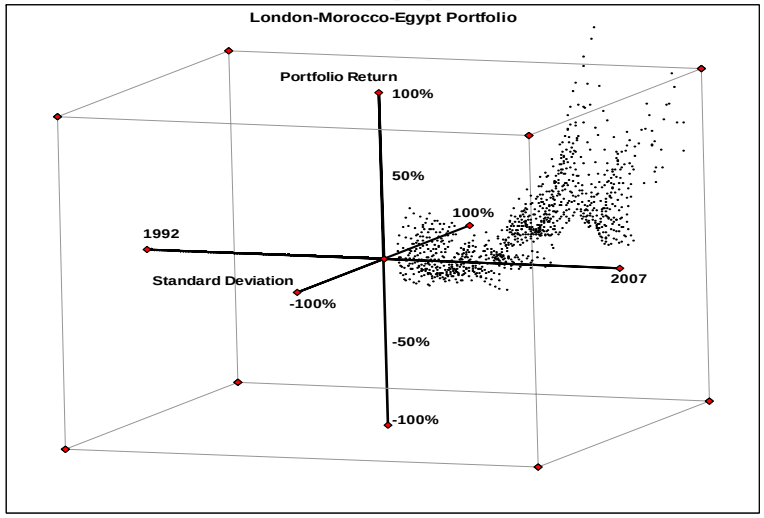
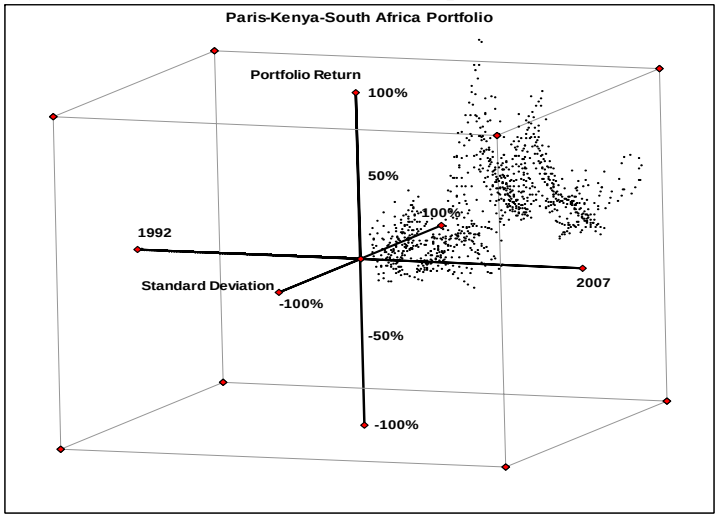


Figure 1.4 Paris-Kenya-South Africa portfolio



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

	London (FTSE 100)	Paris (CAC40)	South Africa	Kenya	Egypt	Morocco
Legal Origin	English Common Law	French Civil Code	Roman-Dutch (Regulation: English Common Law)	English Common Law	French Civil Code	French Civil Code
Capital Gains Tax	Exempt	Exempt	Exempt	Exempt	Exempt	Exempt
Other Taxes and Fees	None	None	VAT at commission rate 0.5% marketable security. 1.0% stamp duty Investor Protection fee: 0.0002%	Withholding Tax on Dividends is 10% for non-residents and 5% for residents. Otherwise no Capital Gains, Stamp Duty, nor VAT	None	VAT applied to the amount of commissions is 10%. No other tax/ fees.
Commission	Total direct costs of trading (brokerage commission and fees): 0.0401% Total indirect trading costs: 0.0101% Total trading costs: 0.0502%	Trade fees are contingent on level of market activity of broker. Fees fall within range of 0.0000875% to 0.001% of trading value and are dependent on level of traded value.	Main Market: 1.4%, trades < R1,500,000 and 0.21%, trades > R1,500,000 Equities main market minimum fee: R7.42 or R8.46(incl. VAT) on both buy and sell legs of a position Clearing and Settlement Fee: 0.0026% Subject to minimum of R2.33 (R2.66 incl. VAT) on buy leg and R9.43 (R10.75 incl. VAT) on sell side leg	Main Market: Brokerage commission charged as follows, Trade value < KSh 100,000 fee of 1.80% Trade value > KSh 100,000 fee of 1.50% 0.14% of trade value in Kenyan Shillings applied to buy and sell legs. 0.01% applied to buy and sell legs for the investment compensation fund.	Listed securities, the Exchange service fees are levied at 0.012% of the value of each side of the transaction with a maximum amount of LE (Egyptian Pounds) 5000. Clearing fee: 0.125 per thousand of transaction value	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.

Appendix 2. Vuong likelihood ratio test

Following Lesmond (2005) a likelihood ratio test is used that was originally proposed by Vuong (1989). This is specific for non-nested model selection in testing whether a reference model and comparison model do equally well at explaining the underlying data. The reference model is either the Amihud measure (Amihud 2002) or alternatively the Turnover measure, which is a measure of trading frequency, and the comparison models are the remaining liquidity measures, i.e. Liu derived from Liu (2006) and the liquidity determinants of Stoll (2000). Each of the comparison models are tested independently against the reference Amihud or Turnover measure with each individual regression stated as:

Reference Model: $S + C_j = \theta_0 + \theta_1$ (reference liquidity measure$_j$) $+ \varepsilon_j$, (8)

Comparison Model 1: $S + C_j = \gamma_0 + \gamma_1$ other liquidity measure(s)$_j + \varepsilon_j$, and (9)

Comparison Model 2: $S + C_j = \gamma_0 + \gamma_1 \text{ price}_j + \gamma_2 \text{ volume}_j + \gamma_3 \sigma_j^2 + \gamma_4 \text{ size}_j + \varepsilon_j$, (10)

where $S + C_j$ refers to the average, proportional bid ask spread plus commission cost for each firm-month j within each country. The comparison liquidity measures are those of Liu (2006). Price is the average annual daily stock price in local currency, and volume is the average annual daily trading volume. σ_j^2 is the daily average volatility. Size is the monthly market capitalization and is defined as the share price times the number of shares outstanding. Share price is measured at the beginning of each month, while number of shares outstanding is measured at the beginning of the year.

The basis of the test is a likelihood ratio of the log likelihood function for the reference model to the log likelihood function for the comparison model. Using R to represent the reference model and C to represent the comparison model:

$$LR_n\left(\hat{\theta},\hat{\gamma}\right) \equiv L_n^R\left(\hat{\theta}\right) - L_n^C\left(\hat{\gamma}\right) = \sum_{i=1}^{n} \log \frac{f\left(S + C \mid Z_i;\hat{\theta}_n\right)}{g\left(S + C \mid Z_i;\hat{\gamma}_n\right)}, \tag{11}$$

Where LR_n is the likelihood ratio function for n firm-month observations in each country. Z_i is a vector of m independent standard normal variables, $\hat{\theta}_n$ is the maximum likelihood parameter estimates for the reference model, and $\hat{\gamma}_n$ is the maximum likelihood parameter estimates for the comparison model. The variance of the likelihood function is given by Vuong as

$$\hat{\omega}_n^2 = \frac{1}{n}\sum_j^n \left(\frac{1}{2}[\log\left(\hat{\sigma}_C^2\right) - \log\left(\hat{\sigma}_R^2\right)] + \frac{1}{2}\left[\frac{\varepsilon_{Cj}^2}{\hat{\sigma}_C^2} - \frac{\varepsilon_{Rj}^2}{\hat{\sigma}_R^2}\right]\right) - \left[\frac{1}{2}LR_n\right]^2 \tag{12}$$

where ε is the residual using the fitted parameters for either the Amihud regression case of the comparison model case. Vuong shows that the likelihood ratio statistic converges to a normal distribution:

Under H_0 : $$n^{-1/2}\frac{LR_n\left(\hat{\theta}_n,\hat{\gamma}_n\right)}{\hat{\omega}_n^2}\xrightarrow{D}N(0,1) \tag{13}$$

The resultant test statistic is stated as

$$Z=\frac{1}{\sqrt{n}}\frac{LR_n\left(\hat{\theta}_n,\hat{\gamma}_n\right)}{\hat{\omega}_n} \tag{14}$$

A one-sided Z-statistic tests whether either of the reference models, in this case being either the Amihud or Turnover measure, is more highly associated with the underlying S + C cost than the comparison model(s). The test is directional, given by a positive or negative Z-statistic, indicating which model is more highly associated with the underlying S + C cost. A positive and significant Z-statistic indicates that the reference measure is more highly associated with the underlying S + C cost than the comparison measure(s). A negative and significant Z-statistic indicates the comparison measure is more highly associated with the underlying S + C cost.

Alternatively, the Z-statistic can be obtained from a linear regression if the log ratio is defined at every month j as

$$m_j=\frac{1}{2}\log\left[\frac{\hat{\sigma}_C^2}{\hat{\sigma}_R^2}\right]+\frac{1}{2}\left[\frac{\varepsilon_{Cj}^2}{\hat{\sigma}_C^2}-\frac{\varepsilon_{Rj}^2}{\hat{\sigma}_R^2}\right] \tag{15}$$

Vuong states that a useful abstraction of the test statistic in above equation "$\frac{1}{\sqrt{n}}\frac{LR_n\left(\hat{\theta}_n,\hat{\gamma}_n\right)}{\hat{\omega}_n}$ is numerically equal to $[(n-1)/n]^{1/2}$ times either the usual t-statistic on the constant term in a linear regression of m_j on only the constant term, or the usual t-statistic on the coefficient of m_j in a linear regression of one on m_j." Stated another way, the Z-statistic can be obtained by regressing m_j on unity and multiplying the t-statistic from this regression by $[(n-1)/n]^{1/2}$. This procedure involving the running of two subsequent sets of regressions is employed in this paper.