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'The Opportunities and Costs of Portfolio Diversification in Southern Africa's Smallest Equity Markets'

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The Opportunities and Costs of Portfolio Diversification in Southern Africa's Smallest Equity Markets

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Abstract

This paper contrasts the performance of three time series models, a simple stochastic drift, GARCH, and a time varying parameter CAPM for four SADC equity markets in Namibia, Swaziland, Mozambique, plus South Africa. Analysis of the portfolio characteristics containing each reveals the level of integration from the optimised portfolio frontiers and the implications of the smaller states adopting a minimum investment retention levy. Namibia is found to exhibit the greatest degree of integration with South Africa, followed much further behind by Swaziland with Mozambique. The evidence suggests that investors in the smaller markets would face considerable additional costs should such a policy be adopted.

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1. Introduction

The drive towards integration of Africa's equity markets has already attracted interest in the literature, see for example, Irving (2005), Yartey and Adjasi (2007) and Piesse and Hearn (2008). This has largely concentrated on the larger markets, many of which are considered future integration hubs that extend outwards from regional centres to smaller surrounding markets. However, there is very little work modelling the smaller "micro" equity markets and those that do focus on single market studies such as Jefferis (1995), Lavelle (2001) and Marone (2003). These markets are not only very small but also complicated by the policy options favoured by governments and regulatory authorities who wish to impose an investment levy to retain liquidity in the home market.

This paper has two primary objectives. The first is to assess the potential opportunities for diversification that a group of very small markets within the Southern African Development Community (SADC) offer to investors based in the largest market, South Africa. The second is to examine the costs incurred by investors within these smaller markets of the policy to require that a minimum percentage of investment funds are retained within the home market. For example, Regulation 28 in Namibia requires a 35% minimum local investment for pension funds (Sherbourne and Stork, 2004).

Three approaches are used to model the time series of the respective markets total returns indices: a simple iid model, which implies a stochastic time series with drift; the generalised autoregressive conditional heteroskedasticity (GARCH) model developed by Bollerslev (1986); and a time varying parameter variation of the standard capital asset pricing model (CAPM) that employs the Kalman-Bucy filter (Faff et al, 1998). When the models have been specified, the one step-ahead forecast of mean and variance-covariance is be used within an optimised portfolio framework to assess the potential costs and benefits of diversification for investors.

There is a considerable literature that uses GARCH and related market models of GARCH-in-Mean (GARCH-M) models to capture time series effects within equity price series. Much of this owes its foundations to the work of Bollerslev (1986). It then was extended to include GARCH models to capture the dynamics of autoregressive means and volatility processes for valuation in stock options (Ritchken and Trevor, 1999) as well as a variety of applications in the areas of equity indices and stock price volatility (Engle, 2001). In addition, this literature itself has spawned the more recent related families of ARCH/ GARCH type models such as Exponential GARCH or EGARCH (Nelson, 1991). However, this paper models the conditional means of series through an autoregressive form augmented with simple generalised conditional heteroskedasticity techniques.

The theoretical and empirical literature using CAPM is vast and has recently been enhanced by the addition of covariance risk to other variables commonly used in equity valuation. For example, book-to-market ratios and company size have been incorporated into the original CAPM framework by Fama and French (1993) and Liu (2006) also added a liquidity premium. These additional parameters address some well documented anomalies of the original CAPM structure in modelling expected returns. Phylaktis and Ravazzolo (2004) explored another common issue in emerging equity market valuation: that of the covariance risk to exchange rate or currency premiums. A CAPM model augmented with a currency premium is found to outperform standard models and is of particular relevance given many emerging markets have undergone recent capital market liberalisation. Finally, Collins and Abrahamson (2006) apply a hybrid CAPM type function in calculating the cost of equity for a sample group of markets in Africa, while noting that the standard CAPM model is commonly used by investors to assess potential opportunities. Because of the difficulties of liquidity measurement in very illiquid markets, and given all countries in this study are members of a common monetary area, with the exception of Mozambique, currency premiums are unnecessary and the simple one factor CAPM model is adequate.

Another issue to note is that while the majority of the literature relating to the CAPM focuses on linear models, a more recent branch finds that time varying parameter specification of the essential CAPM structure, i.e. Jensen alpha constant term and market premium, offer improvements in modelling accuracy and address anomalies in the linear models. Faff et al (1998) build a time varying structure into their models explicitly assuming that the constant and market beta parameters follow a single order autoregressive process and are stochastic. The Kalman filter (Kalman, 1960; Kalman and Bucy, 1961) is employed in capturing the effects of the stochastic time varying nature of the parameters in modelling Australian industry portfolios and is the primary motivation for the methods used in this paper. The applications used by Faff et al (1998) follow the earlier work of Gombola and Kahl (1990) that uses the Kalman-Bucy filter to capture the stochastic time varying effects of Utility betas with the market premium. Other earlier applications include Conrad and Kaul (1988) in using the Kalman-Bucy filter to model excess returns thought to follow a stochastic single order autoregressive process.

Modern portfolio theory indicates that investors should hold mean-variance efficient portfolios of assets. However, one recent strand contrasts the ability to forecast means and covariances in terms of the consequent effects on optimal portfolio asset weights. Harvey (1994) compared the predicted mean and covariance matrix from a simple iid model, inferring an unconditional asset allocation strategy where managers have no other 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. The analysis focuses on exploring the benefits to investors of diversification into emerging markets through 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 as well as in relative portfolio weights in a minimum variance optimised portfolio setting. The focus is directed towards individual industries within developed OECD markets. In a further paper, Harvey (1995) follows a similar route but concentrates on market index level analysis.

This paper is organised as follows. Section 2 has two distinct parts: the first provides an overview of the institutional features of the four sample markets, while the second discusses data specific issues. Section 3 outlines the three approaches to modelling the total returns series, iid, GARCH and time varying CAPM using the Kalman filter, as well as describing the application of mean-variance portfolio optimisation techniques. Section 4 discusses the empirical results. The final section concludes and provides development policy inferences based on the evidence from this work.

2. African Equity Markets

(i). African Securities Markets

Many African equity markets have only been recently established. Particularly since 1990 and the end of the cold war, many countries were encouraged by the international financial institutions to create stock exchanges as part of wider economic development and structural adjustment programmes. The motivation was that they can act both as a vehicle to promote privatisations of former state owned enterprises but would attract foreign investment to supplement shortfalls in domestic savings. However, despite the global interest in investment opportunities in emerging markets, levels of investment in Sub Saharan Africa (SSA), with the exception of South Africa, has remained low. In 2003, only US$500 million out of a total of worldwide flows of foreign equity investment of US$14.3 Billion went to SSA, just at 3.5% (African Business, 2005).

There are considerable differences in the size and levels of activity between these stock markets as demonstrated in Table 1. While South Africa is the biggest market by a large margin (74.70% of total African market capitalisation) and has the highest turnover ratio (42.12%), the other markets are generally small and inactive. The only exceptions are those of the North African markets, such as Egypt, Tunisia and Morocco, which collectively account for 14.52% of the African market capitalisation and they also have the next highest turnover ratios after South Africa, at 35.20%, 16.04%, and 14.87% respectively. The plethora of markets in SSA, excluding South Africa, only account for 10.78% of Africa's market capitalisation. The lack of secondary market activity is mirrored in the primary markets, shown in Table 2. South Africa again dominates in facilitating a steady supply of capital from new issues (IPO's) while IPO activity on all other markets tends to be erratic and small, suggesting that firms do not use the stock market as a preferred source for development finance. Rather, the combination of high costs of capital, lack of liquidity, and often poor levels of regulation, together with macroeconomic uncertainty cause firms to source capital either through internal means or from relationship based finance through the banking system.

Tables 1 and 2

The Namibian stock exchange, and to some extent that of Swaziland, does record some persistent though infrequent IPO activity although given the size and institutional differences this is likely to be motivated by different criteria. The Namibian market is closely integrated with South Africa and attracts primary market activity in the form of secondary listings from its larger neighbour. The situation in Swaziland is somewhat different where the activity on the exchange is severely constrained through both its small size, and consequent limited ability to provide diversification, and lack of institutions. Activity in this market is dominated by political considerations where ownership is selectively transferred from state owned or influenced enterprises to royal institutional block-holders. The high costs of equity arising from a lack of formal regulation, limited infrastructure, and extreme illiquidity would normally cause firms to list elsewhere in order to raise finance though in this case the political economy of the country dominates. Similar situations are cited in the literature from the Lusaka stock exchange, Zambia (Marone, 2002) and the Abidjan regional bourse, Cote d'Ivoire (Lavelle, 2001). In the case of Mozambique, the lack of activity is attributable to the combination of a fragile domestic business environment and considerable uncertainty over macroeconomic stability. To date only one company, Cervejas de Mocambique, a joint venture majority controlled by South Africa's SAB Miller, has been able to meet the stringent listings requirements. Interestingly, due to an extremely high and volatile treasury discount rate, and subsequent negative excess returns, and very small free number of shares actually open to public ownership, this listing has been designated an example of "good corporate citisenship". However, this is largely because of its participation the local economy rather than to any financial decision making (Duncan, 2007).

The lack of activity and high levels of illiquidity is a serious problem confronting SSA markets but is a particular problem in Africa's smallest markets such as Swaziland and Mozambique. The number of days between a buy or sell order is initially submitted to the trading venue, an order matched and a trade executed is sometimes as high as twenty days, as is the case in Mozambique in Table 3. This is a serious additional problem for investors and accounts for the lack of foreign institutional investors on the Mozambique market. This is qualitatively different from Swaziland, where the size of institutional trades is significantly larger than those by individual investors. Given that illiquidity is comparable between the two exchanges the greater degree of activity on the Swaziland market is more representative of the differences in political motivation behind the establishment of the two exchanges. Trading activity in Swaziland is almost entirely dominated by domestic individuals and institutions with only very occasional trades undertaken by individuals from South Africa, especially KwaZulu-Natal (Matimela, 2007). In contrast, Mozambique has a combination of a weak investor base and high illiquidity on the demand side and a very small and undercapitalised business environment, which has only very recently started to adopt formal auditing practices, on the supply side. This severely restricts the exchange in its ability to channel savings and investment.

Table 3

(ii). Market characteristics

Four emerging markets are examined in this paper and there are clear differences in their institutional design, market capitalisation and level of development. The standard of regulation has a substantial effect on trading activity and the price discovery mechanism for shares and this differs markedly. Namibia shares the same regulatory regime as South Africa, as shown in Table 4. Swaziland's securities market regulations are still waiting for formal ratification into law by parliament and the market has only been able to implement informal regulatory arrangements based on an amended 1975 Banking and Financial Institutions Act that has enabled the Central Bank to exercise greater influence over the fledgling market. Swaziland follows a self regulatory model, similar to that in South Africa and Namibia, although its market is constrained by its small size, with few brokers and a lack of appropriate institutions. Mozambique's regulation is enforced by the Central Bank and is based on the fundamentally different Portuguese civil code legal. The regulatory regime was designed with the assistance of the New York and Lisbon stock exchange but largely remains untested in a market with only one listing and so little activity.

Table 4

The major characteristics of these markets are summarised in the following sections (see Piesse and Hearn (2005) for an extended discussion of African stock markets):

South Africa

The Johannesburg Stock Exchange (JSE) is the largest market in Africa. It is the most developed, with high standards of regulation and supervision. The JSE adopted the Stock Exchange Electronic Trading Shares (SETS) order-driven electronic trading platform used by the London Stock Exchange in 2002. Trading takes place daily and the market has a pre-opening electronic call auction 8-25am and 9-00am and continuous trading 9-00am to 4-00pm. Despite being classified as an emerging market there is very active institutional investor participation and ownership is highly diversified (Bloomberg LP, 2006). Settlement is through a central depository on a rolling contractual basis of trade date plus five working days (T + 5) and is largely G30 compliant (STRATE website, 2007).

The South African market has had two distinct periods of transition during the period of this study. The first was 1990 to 1995 when the market was closed to foreign investors, largely due to sanctions by the rest of the world. Also at this time domestic investors had to comply with the National Party's "prescribed assets" regulation, which required investment in domestic equities rather than money or bond market instruments (Grandes and Pinaud, 2004). The second follows the ending of apartheid in 1995 and the subsequent real and financial market liberalisation that followed, including the opening up of markets to foreign institutional investment, the move to electronic trading and the introduction of formal legislation to ensure international levels of corporate governance.[1] Further revision of the King II report in 2002 has led to increased investor confidence and market development although volatility of the domestic currency and high risk premiums that have a negative impact on overseas investors (Grandes and Pinaud, 2004). This has also resulted in a loss of liquidity in the domestic market and the tendency for primary listings to take place on overseas exchanges such as London and New York in preference to the JSE.

Namibia

The Namibian Stock Exchange (NSX) is the second largest market in the Common Monetary Area (CMA). It shares the electronic trading system, central depository, market infrastructure, settlement cycle and reporting with South Africa and given these common factors the markets have a high degree of integration (Hearn and Piesse, 2002). However, despite the advanced stage of development, the market lacks liquidity and some 68% of 31 currently listed companies have primary listings in Johannesburg. There is also evidence of further decreases in liquidity in the local primary listed market, partly due to dual listing being classified as Namibian. Block trades in these assets are booked in Johannesburg with only surplus unmet demand transferred to the related Namibian shares. This suggests that Regulation 28, the Namibian version of the domestic minimum holdings policy, is not working (Sherbourne and Stork, 2004).

Swaziland

The Swaziland stock exchange in Mbabane was incorporated in July 1990 and since inception has been hindered by both lack of infrastructure and formal regulation. Trading was initially conducted by a single broker until a second brokerage house was established as an over-the-counter in 1998. The Securities Markets Regulation Bill has still to be ratified by parliament

[1] The King II Report that regulates corporate governance practices in South Africa is very similar to the UK Cadbury Report and the US Sarbanes Oxley Act.

and not surprisingly, this has been a major barrier to the growth and development of the market. However, in 2000 the Central Bank of Swaziland extended the existing Financial Services regulation to cover the stock market, and has also provided some trading facilities within the Bank premises. Trading takes place daily 10-00am and 12-00 midday as a call auction where orders are pooled and then matched and executed at the price that most accurately reflects all information available to the market.

Interesting, although liquidity is very low, Swaziland is part of an economic and currency union with South Africa and therefore domestic currency premiums are directly comparable to others in the rand zone. However, given the small size of market and lack of regulation only one company has been dual listed on the JSE, Masterfridge. Due to lack of domestic demand the local brokerage community relied on the South African market for a price discovery mechanism and price quotes to match those on the JSE to prevent potential cross border arbitrage (Matimela, 2007). Despite the size of this market, since 1998 two brokerage houses, African Alliance and South Africa's Interneuron Asset Manager, have registered as local dealers. Asset allocations in favour of Swazi listed instruments in excess of those in South Africa and other regional centres is very low, often less than 5% of portfolio inventories (African Alliance, 2007). Ownership is highly concentrated and free float capitalisations available to the public are very low (Swaziland Stock Exchange, 2007). Settlement is by physical transfer of assets between the holdings of local banks with sufficient capitalisation to act as market custodians.

Mozambique

The Maputo Stock Exchange, the Bolsa de Valores de Maputo (BVM), is a fledgling market with only one listed stock, the former national brewing company Cervejas de Mocambique. This listing is a joint venture with South African Breweries and was part of the privatisation programme recommended by the IMF. Despite its small size this market has been well designed from inception, with assistance from the New York and Lisbon exchanges. However, regulation is weak, particularly with respect to the protection of small and minority investors. Trading is predominantly government treasury bills and bonds with maturities of up to 3 years, with the exchange acting as a second outlet for debt issues outside the Central Bank auctions. Despite a network of licensed brokers including recently privatised commercial banks, trading activity in the single equity remains tightly focussed on providing the interbank market for debt with an additional instrument to broaden holding portfolios.

Trading is by a delocalised electronic order book system where trades are matched on a price-bargain basis. Licensed brokers have access to an online trade entry system run from the Stock Exchange website. Levels of illiquidity are severe with trades taking place only once every several months and the time from submission of an order to market execution can be 25 working days. Official trading hours are 10-00 am to 12-00 midday on Tuesday, Thursday and Friday (BVM, 2007). Free float percentages are some of the lowest in Africa and have fallen since from 6-5% in 2001 to the current level of 4% (BVM, 2007). Ownership is highly concentrated and settlement by local market custodians similar to Swaziland. Trading and settlement for the single listed equity is dominated by the South African broker Standard Bank. There clearly is a lack of investor confidence in local institutions, which is not surprising given the 2000 financial crisis when two newly formed commercial banks failed due to bad debt overhang from the previous socialist era.

All four markets have poor liquidity compared with developed world markets, but particularly Swaziland and Mozambique. They both lack transparency and liquidity and fall far short of best practice in terms of corporate governance. In Swaziland there is a complex state ownership structure of cross holdings between various listed entities. In Mozambique the very small formal sector has only recently adopted auditing techniques into national accounting practices (Standard Bank, 2007). They are both a very long way from the highly regulated standards in South Africa and Namibia. This group of countries provide an interesting sample. Two are very small with high levels of risk and illiquidity. Three are members of the CMA and consequently lack exchange rate risk. Two are highly integrated and a third partly integrated, while the fourth is segmented from others. As a group they provide a unique opportunity to assess the performance of time series models, within a mean-variance optimised portfolio framework.

(iii). Data: Sources and Total Returns Indices

Values of the end of month total returns of the market index for South Africa are from Datastream. The Standard & Poors frontier market total returns index was used for Namibia from December 1998, when the market was established. For Swaziland and Mozambique, total returns indices for stocks are not available through local or international media sources, and so were collected directly. Stock splits and rights issues, stock prices, number of shares outstanding, dividend payments history, daily trading volumes and market capitalisation data were from the national Stock Exchanges. Individual stocks total returns indices were constructed and then aggregated to form a market index following the method used by Standard & Poors. Companies that are delisted were not deleted from the sample prior to their delisting to prevent survivorship bias.

Prices in Namibia and Swaziland are quoted in local currency, but transformed to South African Rand. As Mozambique is outside the CMA the data series were converted to Rand in order to present the South African and CMA investor perspective. This also removes the effects of high and volatile local currency premiums from the calculation of excess returns. The exchange rate data is from Datastream and the Central Banks. Conversion of the total returns series and prices by the South African Rand exchange rate assumes long term parity between individual domestic currencies and the US$. The use of the South African Treasury yield for all time series denominated in South African Rand is entirely appropriate as this reflects analysts' best short term expectations of economic conditions within CMA and the South African economy. South African Treasury Bill data are from Datastream. The one-month South African Treasury Bill yield rate is used as the risk free rate although this is adjusted to take account of monthly excess returns as opposed to the quoted equivalent annualised rates. This is not ideal given the high and variable risk premiums associated with it (Grandes and Pinaud, 2004). However, it is the most stable Treasury rate in a region with a history of high and volatile inflation and all CMA member countries have interest rate movements tied very closely to South Africa because of the currency board. It would also be reasonable to assume that the smaller, less capitalised and largely dispersed investor communities in these markets would be unlikely to access conventional Treasury instruments, such as those of the US and Europe, in order to include them in local portfolios.

3. Models

This section first considers the two classes of model used, that is, the unconditional investment strategy implied by the naive iid model, and the two conditional strategies, GARCH and time varying coefficient CAPM that use time series autoregressive and market risk premium conditional components respectively. Then, portfolio construction is briefly reviewed and optimisation techniques discussed within a minimum variance framework.

(i). IID model: Unconditional asset allocation

This strategy is considered unconditional as it implies that there is no other information relevant for forecasting the next period's price other than the previous price, that is, stock returns are not predictable. The expected returns are modelled as a rolling window of the mean returns over the previous 24 months. Despite the movement in these mean returns as the 24-month window moves, using the average returns assumes that the best forecast of the equity returns is its past average. This is consistent with the random walk model of stock prices with a drift component and has a core assumption that the underlying time series is weak form efficient.

The 24 month rolling window is extended for the calculation of standard deviation, and hence variance, as well as correlations from which updated covariance estimates are calculated. The simple model can be represented by

$$y_t = \mu + \varepsilon_t \ldots\ldots \varepsilon_t \sim N(0, \Sigma), \quad (1)$$

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

(ii). GARCH model: Conditional asset allocation

As discussed in Bollerslev (1987), there is evidence that the change in prices and rates of return are approximately uncorrelated over time, but characterised by tranquil and volatile periods. Allowing for such dependence this study takes the conditional mean $y_{\langle t|t-1\rangle}$ as being dependent only on its first order lagged and a constant,

$$y_t = \alpha_0 + y_{t-1} + \varepsilon_t \tag{2}$$

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

$$E\left(\varepsilon_t^2 \mid \psi_{t-1}\right) = h_{t|t-1} \tag{3}$$

$$h_t = \omega_0 + \sum_{i=1}^{p} \delta_i h_{t-i|t-1-i} + \sum_{j=1}^{q} \gamma_j \varepsilon_{t-j}^2 \tag{4}$$

where ω > 0, $\delta \geq 0$, $\gamma \geq 0$. It can be seen in (2) and (4) that there is a tendency for large (small) residuals to be followed by other large (small) residuals but of unpredictable sign. Equation (4) says that the value of h_t depends on past values of shocks (the *q* moving average terms), which are captured by the lagged squared residual terms, and on past values of itself (the *p* autoregressive terms), which themselves are captured by lagged h_t terms. Furthermore Bollerslev (1987) allows assumptions concerning mildly leptokurtic conditionally normal errors to be relaxed, and an adherence to conditionally t-distributed errors. This gives the GARCH model greater flexibility with financial time series with very fat-tailed distributions, which are typical in emerging market time series.

(iii). Time varying CAPM and Kalman Filter Method: Conditional asset allocation

The simple Capital Asset Pricing Model (CAPM) is used in this paper. This model assumes market equilibrium under conditions of risk (Sharpe, 1964) and takes account of options faced by investors and the optimal valuation of assets (Lintner, 1965). These models make a number of critical assumptions, which may be invalidated by the time series data in this study, although due to lack of alternatives are still in use on some trading floors (Collins and Abrahamson, 2006). The most controversial assumptions in the mean-variance framework are weak-form efficiency of all component time series, and investors utility that may be modelled by functions with moments no higher than two.

The time varying coefficient method to estimating the conditional constant term and market beta of the CAPM relies on the concept of state space. This is commonly represented by an observation or signal equation and a transition, or state, equation, that in combination define the structure and dynamics of a time varying system. A state space model is specified where an observation at time t is a linear combination of a set of variables, state variables, which comprise the state vector at time t. Assuming the number of state variables is m and the (m x 1) vector is θ_t then the observation equation can be represented by:

$$y_t = z_t \theta_t + \mu_t \quad (5)$$

where z_t is assumed to be a known (m x 1) vector, and μ_t is the observation error. The disturbance μ_t is assumed to be normally distributed with zero mean, $\mu_t \sim N(0, \sigma_\mu^2)$. The set of state variables is defined from the minimum set of information from past and present data and future values of time series are completely determined by the present values of the state variables (the Markov property). The state space model incorporates unobserved variables and estimates them alongside the observable model, by imposing a time varying structure of the CAPM beta. Thus, the Kalman filter framework estimates the conditional beta using the following observation equation:

$$R_{it} = \alpha_t + \beta_{it}^{Kalman} R_{Mt} + \varepsilon_t, \quad \varepsilon_t \sim N(0, \Omega) \quad (6)$$

where R_{it} and R_{Mt} are the excess returns of the individual portfolio and market portfolios at time t and ε_t is disturbance term. The exact form of the transition equation depends on the stochastic process the betas are assumed to follow. Here a simple random walk process is imposed as outlined in Faff et al (1998). The state equation is defined:

$$\beta_{it}^{Kalman} = \beta_{it-1}^{Kalman} + \eta_{t,} \quad \eta_t \sim N(0, Q) \quad (7)$$

Together equations (6) and (7) constitute a Kalman filter state space model. However a set of prior conditional values are necessary for the Kalman filter to forecast the future value and is expressed as:

$$\beta_0^{Kalman} \sim N(\beta_0^{Kalman}, P_0) \quad (8)$$

Faff et al (1998) cite that this technique uses the first two observations to establish the prior conditions and then recursively estimates the entire series providing conditional estimates of both β_{it}^{Kalman} and α_{it}^{Kalman}.

(iv). Portfolio Strategies: Unconditional versus Conditional

Following Jackson and Staunton (2003) and Harvey (1994) in a mean-variance framework (Markowitz, 1959) an investor's utility preference function can be expressed

$$U = E(r_p) = \frac{1}{2} \lambda \sigma_p^2 \quad (9)$$

where the higher the value of the risk aversion coefficient, λ, the larger the portfolio risk that is subtracted from the portfolios expected return. At a given λ the portfolio return and variance can be expressed

Portfolio Return (conventional notation): $E(r_p) = \sum w_i E(r_i)$

(10a)

Portfolio Return (matrix notation): $w^T \mu$ (10b)

Portfolio Variance (conventional notation):

$$Var(r_p) = \sigma_p^2 = \sum \sum w_i w_j \operatorname{cov}(i, j) \quad \text{where } \operatorname{cov}(i, j) = \sigma_i^2 \tag{11a}$$

Portfolio Variance (matrix notation): $w^T V w$ (11b)

where $E(r_i)$ is the expected return for the i[th] asset, and σ_i is the risk (standard deviation of returns) for the i[th] asset. w represents N x 1 vectors of the weights of the individual assets and V is the N x N variance-covariance matrix, and N is the number of markets under consideration. In this paper, N = 2.

(v). Unconditional Strategy

In this strategy the investment proportions are unrestricted in size but must sum to unity. However, this does allow extremely large short and long positions in any of the markets under consideration. As thin trading is a widespread problem across emerging markets, and particularly so in the three micro-markets (not South Africa), a plausible constraint is that all short sales be disallowed, that is, $w_i \geq 0$ for i = 1,….N. This adds a second constraint to the mean-variance optimisation problem.

The strategies evaluated in this paper involve solving (10a), subject to the global minimum of (11a) at the end of each month and holding the implied portfolio for the next month. The sample is updated using a 24-month moving window and the portfolio is re-optimised at each point in time. In all strategies, transactions costs are ignored. In each case the minimum variance portfolio is analysed, that is, the investment weights match the weights implied by the minimum variance portfolio over the previous 24 months. These weights are used to form a portfolio that is held over the next month.

The strategy is considered unconditional because of the way that expected returns, variances and covariances are selected. The expected returns are the rolling mean returns over the previous 24 month window. Although these mean returns change through time as rolling window moves, using the average returns assumes that the best forecast of the equity return is its past average. This is consistent with a random walk model of stock prices with drift, as defined above.

The unconditional strategy also places restrictions on other inputs to the optimisation problem. The variances and covariances are assumed to be unconditional variances and covariances over the previous 24 months. This excludes the possibility that these measures move in more complex ways. Although the optimisation function is considerably more sensitive to changes in the expected return, the recursively updated variance-covariance matrix values are also important.

All strategies are in South African Rand and assume that no currency hedging takes place, which is reasonable given the CMA. In the case of Mozambique, if this problem were to be implemented in local currency terms this would be consistent with perfect foresight hedges being initiated relative to South Africa. While this assumption is reasonable for developed and larger emerging markets it is not for smaller emerging markets. It is also an assumption that there is a market for suitable future and forward contracts as well as analyst coverage generating a sufficient supply of economic information. Thus, this study uses the Rand as the common numeraire currency[2].

(vi). Conditional Strategy

In the mean variance optimisation problem in (10a)/ (11a), three sets of inputs are needed: means, variances and covariances. At the end of each month the investor attempts to design the portfolio that guarantees the highest possible expected return for the minimum level of volatility. In solving the unconditional problem a set of portfolio weights are obtained that guarantees the highest ex post returns for minimised risk over the past 24 months. Thus, the unconditional mean-variance problem delivers a set of investment weights that are relevant only over the past history. The only way for the manager to obtain an efficient portfolio in the unconditional problem is to hold the investment weights implied by the actual data, but evaluation is assessed on the basis of the efficiency of managers derived from their ability to construct a portfolio as close as possible to the efficient frontier. However, using the unconditional strategy the the manager can obtain this frontier portfolio is by knowing the historic data that guarantees the portfolios efficiency over the past but not in the future.

Using conditional models is preferential for the mean-variance problems in terms of opening the possibility to provide the best possible forecasts of the expected returns, variances and covariances for the next period. The past averages are not meaningful as investment manager focussing more on the future than the past and past averages are only of benefit when the means, variances and covariances are completely unpredictable. This highlights the rationale for inclusion of the unconditional model in the portfolio optimisation problem in this paper. The difficulties in the literature on conditional model construction for very small micro-emerging markets have been noted above where extremely high illiquidity in this sample renders many time series models obsolete in capturing effects in the time series.

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[2] Harvey (1993b) analyses the international asset allocation problem and makes the assertion that portfolio selection should include currency portfolios in the form of local deposits or loans. The solution to the quadratic programme should deliver the optimal asset allocation as well as optimal currency hedges. It is likely that this method would be preferential to models where perfect foresight of exchange rates is required, such as currency covariance augmented CAPM models as holdings of existing domestic deposits could be recursively modified within the optimisation process.

The conditional asset allocation implements forecasting models for the inputs of the mean-variance problems. The combination of a time varying constant and the product of a time varying parameter and underlying market term are adopted as the conditional mean for the time varying CAPM while a first order auto-regression is used for the mean equation in the GARCH model. The regression models of conditional means use a number of information variables,

$$E(r_{it} \mid Z_{t-1}) = Z_{t-1}\delta_i \qquad (12)$$

where r_{it} is the return on country *i* from t–1 to T and Z_{t-1} is a 1 x *l* vector of *l* global or market specific information variables. In the time varying CAPM this is the market premium, while in the GARCH model it is the first order lagged dependent variable, known at time t–1. δ_i is a *l* x 1 matrix of coefficients. The errors from these mean regressions, ε_{it}, are assumed to be unrelated to the conditioning information Z_{t-1}. The market premium used in the CAPM is a financial time series index, using the last trading day of the month to ensure a suitable time frame of data availability.

The portfolio problem also requires a forecast of the variance-covariance matrix. Consider the covariance between asset i and j:

$$\operatorname{cov}[r_{it}, r_{jt} \mid Z_{t-1}] = E[(r_{it} - E[r_{it} \mid Z_{t-1}])(r_{jt} - E[r_{jt} \mid Z_{t-1}]) \mid Z_{t-1}] \qquad (13)$$

Given the regression errors in (13) it is possible to rewrite this as

$$\operatorname{cov}[r_{it}, r_{jt} \mid Z_{t-1}] = E[\varepsilon_{it}\varepsilon_{jt} \mid Z_{t-1}] \qquad (14)$$

The conditional covariance is the forecasted value of the product of the residuals for the regression models for asset i and asset j.

In principal, the conditioning information for asset *i* and asset *j* is different. Additionally, the conditioning information on the product of the two residuals could be the intersection of the two information sets plus additional variables. Therefore, the GARCH model includes lagged values of the product of the residuals in the information set.

The approach in this paper follows Harvey (1994) by using the unconditional mean of the product of residuals as the forecasted variance-covariance matrix. This implicitly assumes that the product of the residuals is not predictable as in Solnik (1993). However, the matrix used here is not the unconditional variance-covariance matrix but the average conditional variance-covariance matrix where the Z_{t-1} variables are permitted to affect the means. This approach greatly simplifies the estimation.

In a similar manner to the unconditional asset allocation, the variance-covariance matrix is based on a 24 month moving window average of the product of the regression residuals throughout the sample. In the analysis the regressions are estimated over the full sample which implies that the regression coefficients, δ_i, are constant.

4. Results

(i). Summary Statistics

Summary statistics for all four component markets are presented individually in Tables 5 and 6 for the entire period. In all cases the total returns indices are in Rand and explicitly take into account full reinvestment of dividends as well as stock splits and other corporate actions. Table 4 reports the annualised arithmetic and geometric mean, standard deviation and autocorrelations.

Table 5

The arithmetic mean returns for the sample indicate a large variation with Namibia the lowest (1.07%), then South Africa (1.59%) and much higher values for Swaziland (1.76%) and Mozambique (2.33%). There is a similar profile for the standard deviation with Namibia (6.34%), South Africa (5.94%) and much higher values for Swaziland (9.82%) and Mozambique (14.75%). The autocorrelation profiles of the four markets demonstrate that South Africa has no autocorrelation coefficients over 10% for the first 24 lags, which is in line with results for tests of weak-form price efficiency reported in Jefferis and Smith (2005). In contrast, Namibia and Swaziland have only one lag with an autocorrelation coefficient of greater than 10%. In Mozambique, there are three coefficients of the lagged autocorrelation that are over 10% and the first order lag has a value of 18.8%, which suggests that returns in this market are predictable given past information. In contrast to previous studies analysing the price indices of Namibia and South Africa (Piesse and Hearn, 2002, and 2005), where consistently high values of correlation are found, there is no evidence of a relationship between total returns indices. All correlations reported in Table 5 are low indicating a general lack of correlation between these markets, which in turn implies considerable potential for diversification opportunities for local investment fund managers.

The geometric means in Table 5 are important as these reflect the average returns to a buy and hold strategy, which is typically employed by institutional investors and pension funds and this is especially evident when a minimum domestic markets investment retention policy is imposed. Very high volatility can cause significant differences to emerge between the arithmetic and geometric mean returns. This is clear in these countries, especially in Mozambique where the arithmetic mean is 2.33% and geometric mean is 0.89%.

Further descriptive statistics are in Table 6. These highlight the large difference between the arithmetic mean and median values, particularly in the series for Swaziland and Mozambique, and to a much lesser extent for Namibia and South Africa. Swaziland and Mozambique have the greatest differences between maximum and minimum. Swaziland consistently exhibits the greatest degree of skewness (1.1809) and kurtosis (9.8521) while Mozambique demonstrates very little skewness (0.4339) and kurtosis (4.3031). Given the extreme differences of liquidity across the sample it is quite likely that this explains the very high values of skewness and kurtosis in Swaziland, whereas lowest values in Mozambique are likely caused by equally extreme inactivity in this market, with trades taking up to 24 days to execute (Standard Bank Maputo, 2007).

Table 6

Jarque-Bera tests for normality in Table 6 provide strong evidence of non-normality of returns in South Africa and Swaziland, while Namibia has a high degree of normality. The results for Mozambique are ambiguous, given the high level of autocorrelation in Table 5, and the extreme illiquidity. Despite the above differences in diagnostic statistics for the sample the hypothesis of a unit root is clearly rejected for all returns series.

(ii). Performance of unconditional asset allocation strategy

The unconditional minimum variance portfolio performance results are reported in Table 10 and the recursively optimised portfolio holding weights are in panel 1 of Table 9 for each two asset portfolios of South Africa combined with Swaziland, Namibia and Mozambique respectively. The Swaziland-South Africa portfolio has a high annualised average mean (19.57) which is partly offset by the high level of risk, (standard deviation = 77.52), although the Sharpe ratio (0.309) is the second highest of the three portfolios indicating an attractive ratio of return to risk. In Table 9, the analysis of the investment holdings shows that South Africa dominates, indicating that in this case optimal portfolios are formed with South Africa taking a major holding. Given greater integration between South Africa and Namibia, Table 9 shows a more even investment weighting between the two markets. However the results in Table 10 indicate that is using an iid model the portfolio mean (14.99) and standard deviation (66.67) is lower than either of the other two portfolio combinations. The Sharpe ratio is also unexpectedly low (0.2574) indicating that using the iid model to represent the mean leads to relative underperformance of this portfolio relative to the others. The recursively estimated asset allocation profile for the portfolio including Mozambique shows a clear trend throughout the sample period with the Mozambique weight decreasing towards 0% with South Africa, correspondingly increasing towards 100%. This portfolio also has the highest mean (28.90), the second highest standard deviation (73.27) and the highest Sharpe ratio (0.4308), indicating that the Mozambique-South Africa combination outperforms all comparable portfolios.

The results in panel 1 of Table 9 and Table 10 are further clarified in Tables 10 and 11, which report the performance of the portfolio strategies and the relative cost premiums when imposing a minimum 30% holding in the non-South African markets in each portfolio. This simulates the possible domestic retention policy considered by these countries. Table 10 shows that the Mozambique – South Africa portfolio has both the highest annualised return and the second highest annualised standard deviation across the sample for the unconditional strategy. The returns profile also exhibits the largest difference between minimum and maximum annualised returns values. The Namibia – South Africa portfolio demonstrates the lowest return (15.24%) but also the lowest risk (66.67%) with both measures falling short of those for the Swaziland – South Africa portfolio, which has an 18.94% return and 82.11% risk level.

These results are further reflected in Table 11 where yearly annualised geometric means are presented in basis points of the returns differences between a 0% and 30% minimum holdings in the non-South African market. These clearly indicate sizeable premiums likely to be incurred by investors forced to carry a minimum 30% asset weight in the smaller markets, especially Swaziland and Mozambique. There is a very small premium for having a 30% minimum weight in Namibia which despite the level of integration between the markets reflects the differences in size and depth of the local market in Namibia.

(iii). Performance of conditional asset allocation strategy

Tables 7 and 8 outline the coefficients for both the mean equations in each model as well as the coefficient values for all lags within the GARCH model error matrix. The total returns index used as a proxy for the market return in the time varying CAPM model is the Standard & Poors Emerging Middle East and Africa index while the treasury yield used in calculations of excess returns is the South African 3 month Treasury Bill rate converted into monthly values. Thus, the $\boldsymbol{\beta}$ in the time varying CAPM measures the time variation of the beta to the market, which is shown as both an overall average across the entire sample period as well as the annual averages. The $\boldsymbol{\beta}$ in the linear GARCH model is the coefficient on the first order lagged autoregressive variable.

Tables 6, 7 and 8

The parameters in the GARCH only models in Table 7 that have a simple first order autoregressive term and constant in the mean equation also present problems of acceptable confidence levels. However, in each case, apart from the Namibia GARCH (1,1), South Africa GARCH (2,6) and South Africa GARCH (3,1) models, the autoregressive term is significantly different from zero at a confidence level of greater than 60%. The means for each respective year and for the overall period for the time varying constant $\boldsymbol{\beta}$ in the time varying CAPM model are given in Table 8[3]. In all cases the maximum likelihood estimation of the time varying Kalman filter models converged. While there was considerable variation

[3] Individual time series profiles for the constant and beta terms for each market over each respective time period are available from the authors on request.

in the time varying profiles of both the **β** and the constant term in each case, only for Namibia was the **β** frequently negative leading to a negative overall average. This suggests that as the market price and value increases stocks in Namibia fall in value and vice-versa implying a strong hedge against market activity. However, this anomaly can be explained by the serious distortions in the Namibia data due to the effects of illiquidity and small size of listed companies..

Table 9

Table 10 and panel 2 of Table 9 show asset weight allocations between South Africa and each of the other three markets within the two asset portfolio universe. In each case a similar situation can be seen to that of the unconditional model, although it is accentuated in the results using the time varying CAPM model. Panels 2 and 3 of Table 9 show that there is a persistent decline in the weight of Mozambique in its portfolio, while holdings are relatively evenly distributed between Namibia and South Africa and the holding of South Africa dominates in the portfolio containing Swaziland. The results in Table 10 show that the portfolios using the GARCH and time varying CAPM model to construct the conditional means are largely in line with the unconditional iid model, although there are significant differences. Although the means and standard deviations for the South Africa-Namibia portfolio are the lowest there are considerable differences between the South Africa-Swaziland and South Africa-Mozambique portfolios. The portfolios using the GARCH method tend to produce lower average means (18.89) and standard deviations (74.68) for South Africa-Mozambique than the time varying CAPM, where the mean and standard deviation are 34.04 and 88.09, respectively. There is also considerably greater variation between the maximum and minimum values for all three portfolio combinations when the time varying CAPM is used as opposed to GARCH. Finally, the differences between the portfolio means of GARCH and the time varying CAPM are considerably greater than the differences between the standard deviations between the portfolios using the various approaches to modelling the conditional mean. Consequently, the Sharpe ratios are highest of all the unconditional and conditional strategies for those portfolios that use the time varying CAPM method. This would indicate that the time varying CAPM using the Kalman filter provides improved performance in investment portfolio performance.

This is further confirmed in Table 10. These portfolios contain Swaziland and Mozambique and use the GARCH only model that shows relatively huge and persistent basis point premiums in the presence of the 30% holding constraint compared with that for portfolios containing Namibia. In contrast, the retention cost premiums derived from using the time varying CAPM are apparent for all three portfolios while also showing a similar profile of large premiums incurred in the holding constraint of Swaziland and Mozambique.

This is marked when compared to a holding of Namibia, where the values are much smaller and more variable in contrast to the GARCH model. The results demonstrate that across all three models, both unconditional and conditional, there are persistent and high premiums incurred from a minimum 30% domestic holding in the very small markets of Swaziland and Mozambique. The premiums incurred from a minimum holding of Mozambique are considerably larger than those of Swaziland, which is to be expected given the latter market is more highly integrated with South Africa while the former is largely segmented.

Further confirmation of the degree of market segmentation between South Africa and Swaziland and Mozambique can be seen in the loci of the investment frontiers (Figure 1). The frontiers of the Mozambique portfolio (Figure 1(c)) show a strong leaning towards horizontal, inferring that changing the combinations of asset holdings result in substantial increases in risk for every incremental increase in return achieved. The Namibian portfolio frontier (Figure 1(b)) shows a more vertical profile with much less dispersion implying the potential for more investment opportunities with little variation of risk relative to that of Swaziland (Figure 1(a)). Although the inclusion of Swaziland in preference to Mozambique provides improved performance with the loci of frontiers both less dispersed and considerably more vertical, neither market can match the characteristics of the frontiers achieved by Namibia and South Africa. The generation of optimal asset combination frontiers using mean-variance theory provides a strong alternative measurement of the relative degree of integration between markets, for example, between South Africa and Namibia.

Figure 1

5. Conclusions

This study reviews and assesses the potential for portfolio investment between South Africa and the much smaller markets of Swaziland, Namibia and Mozambique. The sample is broadly split into two groups: those of South Africa and Namibia and the two extremely small markets of Swaziland and Mozambique. This division is clearly seen with South Africa and Namibia having comparable mean returns, standard deviation and autocorrelation profiles compared to the considerably higher values for Swaziland and Mozambique. In contrast to previous work that has found substantial correlation between the price indices of South Africa and Namibia the cross correlations between all markets are found to be minimal, which also suggests the potential for portfolio risk diversification.

Three models are applied to the time series data with considerable differences in suitability and benefit of each. In practical terms the unconditional iid strategy is questioned as it is only necessity for an investment manager to only be able to predict future trends on the basis of past activity, despite the intuitive appeal of this strategy and the logical results obtained. This model shows that South Africa dominates the asset weights in a portfolio with

Swaziland, while the weight of Mozambique is steadily decreased almost to 0% and the Namibia holding is roughly equal to that of South Africa for the respective time periods. The conditional models are assessed by comparing their respective Sharpe ratios (portfolio excess returns divided by standard deviation) for each of the three portfolio combinations for each of the three respective strategies: iid, GARCH and time varying CAPM. The Sharpe ratios provide strong support for the use of the time varying CAPM model that uses the Kalman filter as those associated with the portfolios formed from the time varying CAPM are significantly higher than from portfolios constructed using either the iid or GARCH models. These results merit the extension of the analysis focussed on portfolios constructed using the time varying CAPM and the construction of portfolio efficient frontiers. The frontiers that represent investment opportunities in terms of incremental changes in the mean return and associated risk are diffuse and almost horizontal for the South Africa – Mozambique portfolio. This suggests that a portfolio including Mozambique carries a disproportionately high level of risk with respect to any changes of asset weights of the two component assets. Frontiers for South Africa – Swaziland are slightly flatter and vertical, suggesting a much greater level of potential investment opportunities in relation to relatively small proportional increases in risk. Finally, the flattest and most vertical profiles are those of Namibia - South African portfolio. This is intuitively expected given the highly integrated nature of these two markets.

All portfolio strategies, unconditional and conditional, provide evidence of significant cost premiums that are likely to be incurred by domestic investors if the smaller markets were forced to adopt a 30% minimum local asset investment retention in their portfolios. All models support a very large cost premium that would be incurred if this policy were implemented for Mozambique, and to a lesser extent, Swaziland. The results in both cases show that the GARCH models report very large premiums despite this model being a poor fit, and the time varying CAPM model reporting small but persistent costs. The minimum inclusion policy in Namibia is every case carries little cost premium compared to the other two micro markets.

Overall, this study provides substantial evidence that there is considerable scope for diversification of investment portfolios between South Africa and Namibia with very little benefits relative to proportionally increased levels of risk for Swaziland and Mozambique. However, the costs borne by local investors in these markets if the minimum local investment policy of 30% were enforced is very high and the policy that was intended to enhance small domestic exchanges and increase liquidity would almost certainly fail.

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Table 1. Trading Statistics on Selected African Stock Exchanges - 2005

Market	Established	Market capitalization (current US$ mil)	Market capitalization as % of GDP	Stocks traded, turnover ratio (%)
Panel 1: Individual Country statistics				
South Africa	1887	566,972.33	232.70	42.12
Egypt (Alexandria/ Cairo)	1888/1903	80,050.00	85.21	35.20
Morocco	1929	27,280.66	51.17	14.87
Nigeria	1960	15,134.36	24.69	10.69
Botswana	1989	13,399.60	148.9	1.80
Kenya	1954	5,860.04	32.00	7.90
Tunisia	1969	2,853.11	10.32	16.04
Cote d'Ivoire (BVRM)	1973/1998	2,787.58	79.97	1.33
Mauritius	1988	2,645.90	40.23	5.68
Zambia	1994	2,456.00	26.55	0.63
Zimbabwe (2000)	1896	1,941.00	33.73	10.80
Ghana	1990	1,660.58	15.49	4.12
Uganda (2006)	1998	742.00	32.73	0.02
Tanzania	1998	587.86	4.67	4.08
Namibia	1992	414.94	6.67	128.3
Swaziland	1990	197.09	7.50	0.003
Malawi	1996	101.93	5.36	1.98
Mozambique	2001	28.77	0.45	0.08
Sudan (2003)	1995	0.08	0.001	12.65
Panel 2: Regional statistics				
UK	-- --	5,022,868.20		
Africa	100.00%	758,992.14		
Sub-Saharan Africa	85.48%	648,808.38		
South Africa	74.70%	566,972.33		
North Africa (Egypt, Morocco, Tunisia)	14.52%	110,183.77		
Sub-Saharan Africa (ex South Africa)	10.78%	81,836.05		

Source: Compiled by authors from national stock exchange websites and IFC Statistics database.
Note: Where Market Capitalization data is unavailable for 2005 the date of the value used is in parentheses in column 1. Two dates for the Cote d'Ivoire exchange indicate transition in October 1998 from former national stock exchange in Abidjan to new Francophone West African regional exchange.

Table 2. Funds raised from IPO's in selected African stock markets (US$ Millions)

	1998	1999	2000	2001	2002	2003	2004	2005	2006
UK (London)	7,267.08	8,732.04	19,147.71	9,588.65	8,650.74	6,225.32	11,839.11	10,278.49	16,484.62
Egypt	225.78	174.58	43.36	0.00	0.00	0.00	0.00	746.26	225.84
Morocco	-- --	-- --	110.36	10.76	0.00	0.00	1,185.31	43.28	425.61
Nigeria	-- --	-- --	-- --	0.00	0.00	516.44	2,022.93	11.83	903.16
Cote d'Ivoire	391.31	104.77	36.20	0.00	0.00	5.78	0.00	0.00	0.00
Kenya	0.00	5.78	4.89	18.65	0.00	0.00	0.00	0.00	189.45
Mauritius	0.00	0.00	45.59	17.43	21.67	11.74	28.63	151.52	0.97
South Africa	608.38	96.06	229.12	591.96	168.06	0.00	81.94	179.18	3,335.56
Namibia	153.53	6,879.72*	0.00	0.00	23.78	0.00	21.97	0.00	21.05
Swaziland	10.91	3.90	0.00	0.00	0.00	0.00	14.79	0.00	0.00
Mozambique	-- --	-- --	0.00	58.14	0.00	0.00	0.00	0.00	0.00

Source: National stock exchange websites and direct sources from stock exchanges. Bloomberg used for South Africa and Thomson One Banker for Egypt. *denotes 3 IPO's of South African primary registered stock on local market as a secondary dual listing

Table 3. Trading characteristics for Swaziland and Mozambique

Market		2002	2003	2004	2005	2006	2007
Mozambique	Annual Mean time from order submission to trade execution (days)	-- --	9.43	8.86	-- --	12.71	20.00
	Institutional Foreign Investor Mean Value (US$)	-- --	-- --	2,006.56	0.00	8,336.54	5,850.51
	Institutional Foreign Investor Mean Shares	-- --	-- --	9,050	0.00	12,750	1,479
	Individual Domestic Investor Mean Value (US$)	-- --	-- --	3,962.64	5,311.87	1,744.07	6,245.55
	Individual Domestic Investor Mean Shares	-- --	-- --	4,350	3,650	1,035	1,817
Swaziland	Institutional Domestic Investor Mean Value (US$)	1,105.90	3,154.36	3,765.54	2,335.07	8,385.15	-- --
	Institutional Domestic Investor Mean Shares	6,500	4,517	8,000	5,578	6,350	-- --
	Individual Domestic Investor Mean Value (US$)	411.22	1,078.01	2,042.98	401.42	1,489.25	-- --
	Individual Domestic Investor Mean Shares	658	3,026	2,790	682	2,113	-- --

Source: Compiled by authors from African Alliance (for Swaziland) and Standard Bank Maputo (for Mozambique)

Table 4. Contrast of primary and secondary market regulations

	South Africa	Namibia	Swaziland	Mozambique
Panel 1: Primary Market Regulation				
Nature of Regulator	Self Regulatory model practised.		Self Regulatory model practised.	Monitoring and surveillance undertaken by central bank.
Commercial Law	Roman-Dutch. Commercial code based on English Common Law		As South Africa	Portuguese civil code. Closely related to French civil code.
Minimum Requirement	Min. capital base of Rand 25m. Min pre-tax audited profit in last 3 years of Rand 8m. Disclosure and corporate governance in accordance with King II report. 13 core principals of JSE listings rules. Net asset worth of Rand 25m verified by JSE approved auditor.		As South Africa	Min Capital base: USD 1.5M. Audited annual report for at least 1 year. Must meet disclosure requirements of regulator (Central Bank).
Listings Fees	Listings fees are on a sliding scale (incl VAT) with min/max as Rand 827/ 1.71m for listed capitalisation of Rand 0.5m/ 50b. Sliding scale of information inspection fee also implemented. Annual payable continuation listings fee 0.06% of the market cap. of the listed securities subject to a min/max. of Rand 0.2m/1.5m.		No formal fee structure owing to lack of legislation. Informal arrangements based on South Africa	Exchange quotation fee of 0.00025% although this is subject to min/max fee levels of 25m MT/ 300m MT. An ongoing quotation fee is levied at min 0.0001% with min/ max levels of 10m MT/ 225m MT capitalisation amount. Banco do Mozambique regulatory fee (for information verification and search costs of prospectus) is fixed: 6m MT
Panel 2: Secondary Market Regulation				
No. Brokers	101	6	3	5
Short Sales Permissible?	Yes	Not in local market	No	No
Derivatives?	Yes	Not in local market	No	No
Securities Clearance Depository	Yes (STRATE)		No	No
Market Clearance Procedures	Fully G30 compliant including custodial facilities. DVP undertaken T + 3.		Physical settlement with custodial facilities provided by brokers.	Physical settlement with custodial facilities provided by brokers.
Trade/ Clearance Guarantee Fund	Yes		No	No
Capital Gains Tax	Exempt		Exempt	Exempt
Commission	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		No formal fee structure owing to lack of legislation. Informal arrangements based on South Africa	Fixed exchange fee: Min 50,000MT up to a maximum value of 0.002% of trade value. Order cancellation fees levied by exchange are 10,000MT Market trading fees of 0.001% for equities and 0.006% for all bonds

Notes: The Group of Thirty is the most influential body to encourage the standardisation and improvement in global securities administration. Following a symposium in London in March 1989, the following recommendations were agreed: i) Brokers should match trades on day after deal date (T+1); ii) Trade confirmation on trade day plus 2 days (T+2); iii) Central Depository for safe keeping of shares; iv) Net basis settlement of cash and stock; v) Settlement takes place as delivery vs. payment or receipt vs. payment; vi) Settlement in same day funds; vii Settlement effected on trade date plus 3 days (T+3) 8; viii) Securities lending should be permitted; ix) International securities numbering system must be adopted (ISIN code).

Table 5. Means, Standard Deviations and autocorrelations of market total returns indices

Country	Start	Arithmetic Mean	Geometric Mean	Standard Deviation	Autocorrelation P_1	P_2	P_3	P_4	P_6	P_{12}	P_{24}
South Africa	1990M7	0.0159	0.0140	0.0594	0.003	-0.019	-0.040	-0.074	-0.004	0.051	-0.002
					(0.967)	(0.963)	(0.938)	(0.814)	(0.454)	(0.732)	(0.990)
Swaziland	1990M7	0.0176	0.0131	0.0982	0.049	0.061	-0.067	0.019	0.114	-0.011	0.092
					(0.474)	(0.525)	(0.525)	(0.679)	(0.182)	(0.452)	(0.191)
Namibia	1999M1	0.0107	0.0077	0.06342	-0.006	0.065	0.124	0.068	-0.004	-0.041	-0.042
					(0.953)	(0.792)	(0.541)	(0.614)	(0.848)	(0.588)	(0.467)
Mozambique	2001M12	0.0233	0.0089	0.1475	0.188	0.095	0.168	0.041	-0.146	0.090	-0.075
					(0.108)	(0.197)	(0.146)	(0.239)	(0.152)	(0.158)	(0.108)

Correlation Matrix

	South Africa	Swaziland	Namibia	Mozambique
South Africa	1	-- --	-- --	-- --
Swaziland	0.165	1	-- --	-- --
Namibia	0.042	-0.162	1	-- --
Mozambique	-0.0343	-0.186	-0.262	1

Source: compiled by authors for South Africa from Datastream, Namibia from Standard & Poors (Frontier Market series) and Swaziland and Mozambique direct from national stock exchanges. All data reported in South African Rand end of period values. Values in parentheses for autocorrelations represent respective probabilities
.

Table 6. Descriptive Statistics

Country	South Africa	Swaziland	Namibia	Mozambique
Observations	207	207	105	70
Mean	0.0159	0.0176	0.0107	0.0233
Median	0.0179	0.0018	0.0189	-0.0085
Maximum	0.2022	0.5137	0.1491	0.4291
Minimum	-0.3234	-0.4001	-0.1651	-0.3979
Standard Deviation	0.0594	0.0982	0.0634	0.1475
Skewness	-0.7637	1.1809	-0.1211	0.4339
Kurtosis	7.7322	9.8521	3.1696	4.3031
Jarque Bera	213.27	453.06	0.3825	7.1491
Probability	0.0000	0.0000	0.8259	0.0280
Unit Root Test (ADF)	-14.24***	-13.59***	-10.04***	-6.48***

*** indicates hypothesis of unit root rejected at 99% confidence levels. Critical values at 90%, 95% and 99% significance levels are: -2.5896, -2.9042, -3.5285

Table 7. GARCH model parameters

	Period: 1990M07 – 2007M09				Period: 1999M01 – 2007M09				Period: 2001M12 – 2007M09			
	Coefficient	Z-statistic	Coefficient	Z-statistic	Coefficient	Z-statistic	Coefficient	Z-statistic	Coefficient	Z-statistic	Coefficient	Z-statistic
	South Africa (4,4)		Swaziland (9,6)		South Africa (2,6)		Namibia (1,1)		South Africa (3,1)		Mozambique (1,1)	
Mean Equation												
α	0.017	5.155 (0.000)	0.008	2.303 (0.021)	0.019	3.750 (0.0002)	0.011	2318.058 (0.000)	0.019	4.786 (0.000)	-0.009	-0.603 (0.546)
β	-0.065	-1.118 (0.264)	0.142	1.609 (0.107)	-0.034	-0.393 (0.6942)	0.067	0.613 (0.539)	-0.074	-0.746 (0.456)	0.041	24.436 (0.000)
GARCH representation for Residuals												
ω_0	0.0017	2.8649 (0.0042)	0.000152	2.0892 (0.0367)	0.00328	0.90942 (0.3631)	0.00016	1.2286 (0.2192)	0.00166	1.3478 (0.1777)	0.000193	0.7077 (0.4791)
δ1	0.059	0.419 (0.674)	1.112	4.084 (0)	-0.201	-0.209 (0.834)	1.095	14.240 (0.000)	-0.0094	-0.217 (0.828)	1.167	12.655 (0.000)
δ2	-0.214	-1.688 (0.091)	-0.131	-0.354 (0.722)	-0.399	-0.462 (0.644)	--	--	--	--	--	--
δ3	-0.038	-0.255 (0.798)	0.045	0.250 (0.801)	-0.394	-1.071 (0.283)	--	--	--	--	--	--
δ4	0.199	1.824 (0.068)	-0.409	-2.653 (0.008)	0.592	1.255 (0.209)	--	--	--	--	--	--
δ5	--	--	-0.137	-0.525 (0.599)	0.124	0.163 (0.870)	--	--	--	--	--	--
δ6	--	--	0.357	1.983 (0.047)	-0.166	-0.151 (0.879)	--	--	--	--	--	--
δ7	--	--	--	--	--	--	--	--	--	--	--	--
δ8	--	--	--	--	--	--	--	--	--	--	--	--
δ9	--	--	--	--	--	--	--	--	--	--	--	--
γ1	-0.055	-3.084 (0.002)	0.224	3.017 (0.003)	-0.002	-0.032 (0.973)	-0.125	-2.776 (0.005)	0.4538	4.258 (0.0000)	-0.132	-2.114 (0.034)
γ2	0.140	1.791 (0.073)	-0.227	-2.367 (0.017)	0.091	1.225 (0.220)	--	--	0.5404	11.723 (0.0000)	--	--
γ3	0.146	1.431 (0.152)	-0.0007	-0.008 (0.993)	--	--	--	--	-1.0191	-28.781 (0.0000)	--	--
γ4	0.328	2.466 (0.013)	0.019	0.243 (0.808)	--	--	--	--	--	--	--	--
γ5	--	--	0.102	1.168 (0.242)	--	--	--	--	--	--	--	--
γ6	--	--	0.122	1.331 (0.183)	--	--	--	--	--	--	--	--
γ7	--	--	0.017	0.162 (0.871)	--	--	--	--	--	--	--	--
γ8	--	--	-0.202	-1.837 (0.066)	--	--	--	--	--	--	--	--
γ9	--	--	0.106	1.938 (0.052)	--	--	--	--	--	--	--	--

GARCH lag order chosen via Akaike informational criterion (AIC). Values in parentheses are probabilities. Z-statistic significance levels are as follows: 60% confidence is 0.84; 70% confidence is 1.04; 80% confidence is 1.28; 90% confidence is 1.65; 95% confidence is 1.96; 99% confidence is 2.58.

Table 8. Time varying CAPM model parameters

Country		Overall Mean	Overall High/ low	1994 Mean	1995 Mean	1996 Mean	1997 Mean	1998 Mean	1999 Mean	2000 Mean	2001 Mean	2002 Mean	2003 Mean	2004 Mean	2005 Mean	2006 Mean	2007 Mean
South Africa (1992M01-	Constant	0.011	0.197/ -0.116	0.041	-0.002	0.014	0.005	0.018	-0.009	0.013	0.011	0.001	0.008	0.019	0.014	0.006	0.012
2007M09)	Beta	0.604	1.33/ -0.31	0.300	0.582	0.775	0.572	0.691	1.073	1.003	0.975	0.603	0.630	0.452	0.556	0.938	0.613
Swaziland (1992M01-	Constant	0.020	0.485/ -0.401	0.024	0.013	0.058	-0.006	-0.031	-0.021	0.023	0.013	0.073	0.074	0.035	0.012	-0.007	0.012
2007M09)	Beta	0.269	1.29/ -0.441	0.140	0.174	0.060	0.141	0.617	0.830	0.983	0.547	0.762	-0.202	0.024	0.069	0.030	-0.033
South Africa (200M12-	Constant	0.011	0.132/ -0.091	-- --	-- --	-- --	-- --	-- --	-- --	-- --	0.011	0.003	0.011	0.018	0.010	0.011	0.013
2007M09)	Beta	0.758	1.071/ 0.677	-- --	-- --	-- --	-- --	-- --	-- --	-- --	0.964	0.771	0.729	0.694	0.684	0.722	0.712
Namibia (2000M12-	Constant	0.019	0.139/ -0.12	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-0.015	0.006	0.056	0.018	0.037	0.012	0.033
2007M09)	Beta	-0.270	1.566/ -3.886	-- --	-- --	-- --	-- --	-- --	-- --	-- --	0.484	-0.491	0.226	-1.853	-0.527	0.345	-0.105
South Africa (2003M12-	Constant	0.010	0.077/ -0.062	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	0.015	0.013	0.001	0.017
2007M09)	Beta	0.478	2.311/ -0.563	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	0.114	0.591	0.991	0.085
Mozambique (2003M12-	Constant	0.037	0.422/ -0.418	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	0.016	-0.043	0.088	0.051
2007M09)	Beta	0.509	0.761/ 0.364	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	0.652	0.505	0.419	0.414

Notes: Means calculated both annually and across entire sample period. High/ Low values given for the entire sample period

Table 9. Annual average asset weights of each country in two-asset portfolio depending on strategy

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Panel 1: Unconditional iid Strategy																
South Africa	----	----	----	----	----	----	----	----	----	22.03	44.37	54.06	62.85	70.31	68.70	62.11
Namibia	----	----	----	----	----	----	----	----	----	77.97	55.63	45.94	37.15	29.69	31.30	37.89
South Africa	----	9.41	30.33	42.55	67.65	89.37	87.29	77.55	72.28	59.59	83.49	85.35	84.42	81.34	61.45	52.00
Swaziland	----	90.59	69.67	57.45	32.35	10.63	12.71	22.45	27.72	40.41	16.51	14.65	15.58	18.66	38.55	48.00
South Africa	----	----	----	----	----	----	----	----	----	----	----	----	86.76	86.97	86.55	89.41
Mozambique	----	----	----	----	----	----	----	----	----	----	----	----	13.23	13.02	13.45	10.59
Panel 2: Conditional GARCH strategy																
South Africa	----	----	----	----	----	----	----	----	----	37.67	53.60	55.73	65.41	76.35	59.62	56.50
Namibia	----	----	----	----	----	----	----	----	----	62.33	46.40	44.27	34.59	23.65	40.38	43.50
South Africa	----	24.99	32.10	44.25	70.79	99.76	99.60	91.46	82.97	65.25	92.71	93.23	81.89	79.30	52.79	41.80
Swaziland	----	75.01	67.90	55.75	29.21	0.24	0.40	8.54	17.03	34.75	7.29	6.77	18.11	20.70	47.21	58.20
South Africa	----	----	----	----	----	----	----	----	----	----	----	----	80.95	88.64	91.13	93.71
Mozambique	----	----	----	----	----	----	----	----	----	----	----	----	19.05	11.36	8.87	6.29
Panel 3: Conditional Time-varying CAPM Strategy																
South Africa	----	----	----	----	----	----	----	----	----	51.46	55.89	71.03	85.39	96.72	75.31	61.76
Namibia	----	----	----	----	----	----	----	----	----	48.54	44.11	28.97	14.61	3.28	24.69	38.24
South Africa	----	25.44	27.87	33.80	70.97	99.29	99.31	100.00	92.64	67.66	85.36	93.79	93.55	84.95	69.58	51.67
Swaziland	----	74.56	72.13	66.20	29.03	0.71	0.69	0.00	7.36	32.34	14.64	6.21	6.45	15.05	30.42	48.33
South Africa	----	----	----	----	----	----	----	----	----	----	----	----	91.61	93.65	89.77	92.70
Mozambique	----	----	----	----	----	----	----	----	----	----	----	----	8.39	6.35	10.23	7.30

Values reported are the annual average asset weights which are obtained from each month's recursive quadratic portfolio optimisation process.

Table 10. Performance of unconditional and conditional strategies

Universe	Mean return (Annualised)	Standard Deviation (Annualised)	Maximum (Annualised)	Minimum (Annualised)	Sharpe Ratio (Annualised)
Strategy: Unconditional (iid model)					
South Africa - Swaziland	19.57	77.52	49.17	-0.53	0.3090
South Africa – Namibia	14.99	66.67	42.00	-16.63	0.2574
South Africa - Mozambique	28.90	73.27	53.08	-0.28	0.4308
Strategy: Conditional (GARCH model)					
South Africa - Swaziland	19.10	86.44	58.04	3.11	0.2687
South Africa – Namibia	21.19	68.45	27.90	12.36	0.3193
South Africa - Mozambique	18.89	74.68	29.46	2.18	0.2580
Strategy: Conditional (Kalman Filter model)					
South Africa - Swaziland	19.62	92.87	568.44	-88.97	0.4051
South Africa – Namibia	25.32	80.89	355.09	80.50	0.5659
South Africa - Mozambique	34.04	88.09	669.91	-63.43	0.6319

Notes: 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 three 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 South African 3 Month rate), divided by the standard deviation.

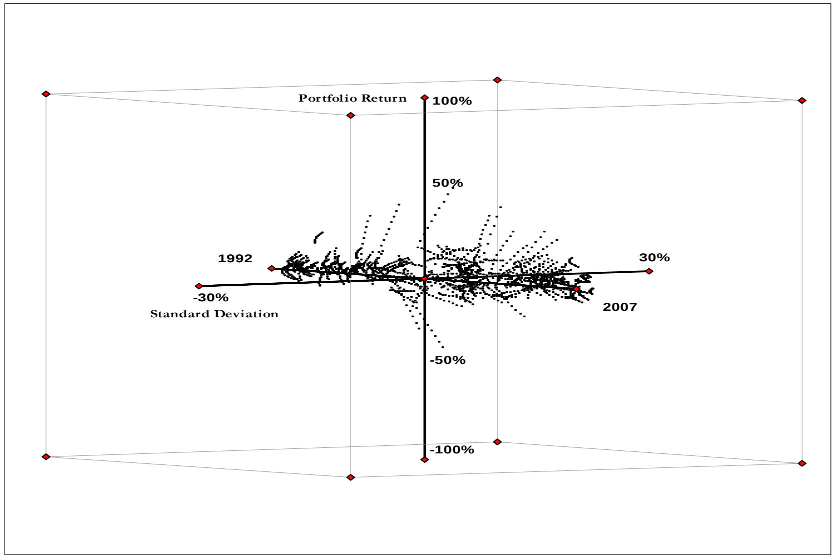
Table 11. Annual comparison of cost premiums derived from 30% minimum holding of micro-market alongside South Africa (Basis Points)

Year	Unconditional (iid model)			Conditional (GARCH model)			Conditional (Kalman Filter model)		
	South Africa - Swaziland Geometric Mean	South Africa - Namibia Geometric Mean	South Africa - Mozambique Geometric Mean	South Africa - Swaziland Geometric Mean	South Africa - Namibia Geometric Mean	South Africa - Mozambique Geometric Mean	South Africa - Swaziland Geometric Mean	South Africa - Namibia Geometric Mean	South Africa - Mozambique Geometric Mean
1993	0.00	--	--	0.00	--	--	0.00	--	--
1994	0.00	--	--	0.00	--	--	0.00	--	--
1995	0.00	--	--	0.00	--	--	0.00	--	--
1996	77.80	--	--	15.85	--	--	18.78	--	--
1997	462.33	--	--	37.18	--	--	80.77	--	--
1998	-65.11	--	--	-719.91	--	--	-237.94	--	--
1999	-167.88	--	--	-194.42	--	--	7.18	--	--
2000	-45.64	0.00	--	-112.35	--	--	48.37	0.00	--
2001	20.11	0.00	--	-8.04	0.00	--	-16.05	0.00	--
2002	235.83	0.00	--	154.68	0.00	--	76.40	0.00	--
2003	760.70	0.00	-614.13	0.84	0.00	-196.09	109.19	19.41	7.62
2004	894.47	0.00	-613.37	5.96	0.00	-346.09	104.58	-63.67	5.67
2005	362.80	-13.80	-439.45	-67.06	-40.68	-619.29	-37.38	-52.21	-157.06
2006	0.00	-9.91	-101.51	-14.63	0.00	-526.15	-13.50	0.55	165.05
2007	0.00	0.00	567.95	0.00	0.00	-477.69	-2.28	0.00	247.15

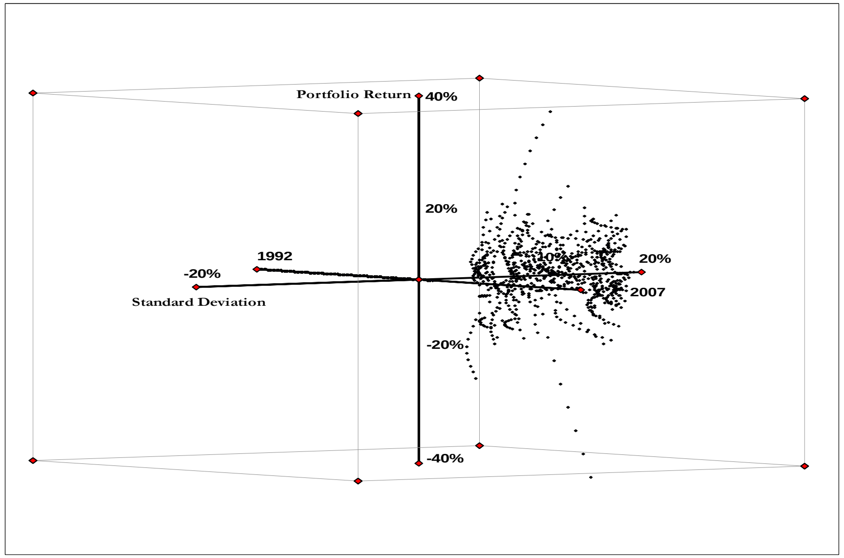
Values represent the difference or premium of holding a minimum investment weight of 30% over a 0% holding of the micro market within the two asset universe in the optimisation problem. Geometric mean is the annualised geometric mean for each respective year in Basis points.

Figure 1. Conditional asset allocation using time varying CAPM model (no short sales)

1(a) South Africa – Swaziland portfolio (12/1992 – 07/2007)



1(b) South Africa – Namibia portfolio (12/2000 - 07/2007)



1(c) South Africa – Mozambique portfolio (12/2003 – 07/2007)