IMPACT OF EXCHANGE CONTROLS ON SOUTH AFRICAN PUBLIC EQUITY INVESTMENT PERFORMANCE

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Declaration

I, Marc John Mathews declare that this research report is my own, unaided work. It is being submitted for the Degree of Master of Management in Finance and Investment at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

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Abstract

The study investigates the impact of changes in regulation which allowed for South African investors to diversify equity portfolios internationally. Since 1995 exchange control regulations have been relaxed from completely prohibiting international equity investment to allowing up to 40% exposure for institutional investors. Since 2010, in effect no limits are set on the ability of an individual to diversify internationally. No previous study has considered the impact that structural barriers such as exchange control have had on the ability of South African investors to diversify internationally. The mean-variance spanning test was utilised to determine the scope for diversification benefits each time regulations changed and the magnitude of the benefit was measured as a change in the Sharpe ratio. Overall, the study found that the relaxation of regulations would have allowed for improved investment performance. However, regulatory restrictions limited some of the benefit for institutional investors while individual investors could have been able to benefit slightly more.

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1. Introduction

1.1 Context

It is accepted that the diversification of an equity portfolio is an important consideration in balancing investor risk with a desired return (Markowitz, 1952; Rubinstein, 2002). Diversification can be achieved by ensuring a suitable portfolio of equities is chosen by the investor. A diversified portfolio is one that eliminates all non-systematic risk such that only systematic risk remains. That is the portfolio is constructed with enough different investments such that only unavoidable market risk remains (Markowitz, 1952).

In the context of diversification the global nature of the financial markets starts to play a role. A local equity portfolio which is fully diversified is still at higher risk than an internationally diversified portfolio (Odier & Solnik, 1993). Therefore, it is important in a more globalised financial system that investment portfolios are suitably diversified internationally.

In the South African context the ability to diversify an investment portfolio internationally has benefited significantly from changes in the South African exchange control regulations over the past 25 years. South Africa has moved from extremely strict exchange control regulations which allowed almost no foreign exposure to a system of regulation that allows for between 40% and a 100% exposure, dependent on the structure of the portfolio. A brief outline of the relevant changes to exchange control regulations are presented in Table 1**.**

Prior to 1995 exchange controls largely prohibited private and institutional investors from holding foreign investments (Gidlow, 2002). In 1995 a formal decision was made by the South African Reserve Bank to begin a relaxation of exchange control regulations to allow for foreign investment for South Africans (Farrell & Todani, 2006). The structure of this relaxation of policy was to follow a gradual approach to protect the country from capital flight (Farrell & Todani, 2006).

The result of this policy decision has been that private individuals have moved from being unable to invest offshore to being able to invest up to R11 million annually. For institutional investors the changing regulations have allowed them to move from being unable to gain exposure to foreign investments to being able to invest 30-40% of their total capital offshore depending on the type of institution.

An important additional benefit for private individuals was that local investments offering offshore exposure would not count against the private individuals' foreign allowance. Additionally, in 2017 inward listing of offshore exchange traded funds (ETFs) was allowed with no limits (South African Reserve Bank, 2017a). These securities would not count against an individual investors' capital allowance, however from the stand point of institutional investors these ETFs would count as foreign investments (South African Reserve Bank, 2017b).

Table 1: Exchange rate regulation in South Africa

Year	Institutional investors*	Private individual	Reference
Prior to March 1995	Largely prohibited	Prohibited	(Farrell & Todani, 2006; Gidlow, 2002)
March 1995	5%	R200k lifetime allowance	(Gidlow, 2002)
March 1997	15%	R400k lifetime allowance	(Gidlow, 2002)
February 2000	15-20%	R750k lifetime allowance	(Gidlow, 2002)
March 2008	20-30%	R1m discretionary allowance R2m lifetime capital allowance	(RandReview, 2018)
December 2010	25-35%	R1m annual discretionary allowance R4m annual capital allowance	(South African Reserve Bank, 2010b, 2010a)
March 2015	25-35%	R1m annual discretionary allowance R10m annual capital allowance	(RandReview, 2018)
March 2018 (Current regulations)	30-40%	R1m annual discretionary allowance R10m annual capital allowance	(South African Reserve Bank, 2018, 2020)

Notes: Institutional investors consist of retirement funds, long-term insurers, collective investment schemes and mutual funds. The reason there is a range of offshore holdings permitted is that different institutional investors are subject to different levels of offshore holdings.

To a large extent, since December 2010 private individuals no longer have limits on their ability to invest in foreign equities from within South Africa, or utilising their foreign allowances to invest offshore directly. However, it must be noted that the South African equity investment landscape is dominated by institutional investors in the form of mutual funds, pensions funds and insurers (Thomas, 2017). Thus, there are still substantial exchange control regulations on the typical investor who invests through these financial intermediaries. Therefore, it warrants investigation to determine whether changes to exchange control regulations which allow for greater offshore exposure have benefited South African equity investors.

1.2 Purpose

The objective of this study was to determine if the relaxation of exchange control regulations in South Africa improved the equity investment performance of South African investors. This was achieved by considering the risk and return metrics that arise from the ability of South African institutional investors to diversify their equity holdings by including international equity.

1.2.1 Research questions

Primary research question

1. Did the changes to exchange control regulations provide a performance benefit to South African institutional investors in terms of improved equity risk and return measures?

Secondary research questions:

1. How did currency volatility impact international investment performance for South African investors?
2. Would an individual investor have benefited more than institutional investors due to differences in regulations?

1.3 Problem statement

The reduction in exchange control regulations over the past two decades has provided South African investors with the ability to invest in international equity. No study has investigated the impact these changes have made on the performance of South African equity investors. Therefore, clarity is needed on the impact these changes have made on the investment landscape of South African investors.

It is important to determine whether the relaxation of exchange control rules provided improved investment performance to South African investors or not. If there is no benefit for the South African investor to invest internationally then there is less need to focus on these policies in the future. Additionally, South African investors making use of international investments are exposed to new risks such as currency volatility which could increase investment risk. It is important to determine whether such risks are worthwhile for the South African investor.

From the standpoint of policy makers it is important to determine whether the policy changes made were successful in improving the investment performance for South African investors. If the policies do not benefit South African investors then these policies might have to be reviewed. The results of this study will be able to guide policy decisions that will be made in the future.

1.4 Significance of the study

This study investigated the empirical evidence regarding international equity investment, from the standpoint of institutional investors in terms of improvements in investment portfolio performance. This study is the first to investigate the potential performance benefits that South African investors could have achieved by utilising international diversification subsequent to the relaxation of exchange control rules. Currency risk, as measured by increased volatility, associated with international investment was found to be significant but outweighed by the general performance benefit of a depreciating currency.

The phased relaxation of exchange control limits overtime coincide reasonably well with theoretical maximums for international exposure at the times that regulations were changed. Thus, the results of the study can be used as a basis to drive future policy decisions on the further relaxation of exchange control rules. Similar analyses could be carried out by policy makers before making amendments the exchange control limits in future.

1.5 Limitations of the study

The study has numerous limitations. Firstly, the study only considered public equity investments that are available on listed exchanges. The study did not consider public bonds, property, forex holdings or private asset holdings. Secondly, the study did not attempt to create the optimal international portfolio but uses market indices to approximate an efficient portfolio. Finally, the study did not consider short sales.

1.6 Outline of the study

1.6.1 Introduction

The introduction section presents the context for the study in terms of the ability of South African investors to diversify their equity holdings internationally. The purpose of the study is to empirically analyse the potential benefits of international portfolio diversification to South African investors.

1.6.2 Literature review

The literature review section summarises the current evidence in relation to international diversification. The most important factors which influence the viability of international portfolio diversification were identified as market correlation and currency effects. No existing studies were found which analysed the effect of structural barriers on South African investor performance. Other studies, utilising the mean-variance spanning framework to identify international diversification benefit, were discussed.

1.6.3 Methodology

The methodology section details the data required, and methodology used to investigate the effect international diversification had on investment performance. The methodology focuses on market correlation, scope for diversification, magnitude of benefit and currency effects. The mean-variance spanning test was used to statistically determine whether diversification benefits were possible as regulations changed. The improvement in investment performance was validated by measuring improvements in Sharpe ratios.

1.6.4 Results and discussion

The correlation of South African markets with other markets is presented before the results of mean-variance spanning are described. The performance of portfolios with the maximum international exposure allowed by regulations and optimal portfolios are compared. Performance was measured as the improvement in Sharpe ratio these portfolios offer versus a local only portfolio. The effect of currency depreciation and volatility are described before the results are discussed and the current standing of international diversification is noted.

1.6.5 Conclusion

The final section concludes the study in terms of the success of answering the research questions posed, the significance of the study is noted and recommendations for future work are made.

2. Literature review

The relaxation of exchange controls on South African investors has opened new avenues for international investment. However, in order to understand the potential benefits and concerns of these changes, a literature review was conducted. The objective of the literature review is to understand diversification and how it pertains to international diversification. Furthermore, the factors influencing the viability of international diversification and how they affect investment risk and return must be investigated. Finally the literature was analysed in relation to the standing of the South African investor and whether there is a basis for using international diversification to improve the standing of South African investors.

2.1 Diversification theory

Modern portfolio theory postulates using an efficient set of investable securities in combination with the risk appetite of an investor to determine the optimal risky portfolio for an investor (Markowitz, 1952; Sharpe, 1966). The efficient set of securities is the combination of available securities weighted in such a manner as to produce the lowest variance in returns (Markowitz, 1952). Variance of returns is used as a measure of risk and the investors risk appetite is measured through an investor dependent utility function.

The underlying theory for portfolio construction is thus to use an efficient set of investable risky assets and a risk free asset and to match the investors level of risk. This is done through the construction of a two asset portfolio consisting of the risky asset (portfolio containing equity, corporate bonds or property) and a risk free asset (typically government bonds) which are weighted so as to achieve the desired risk (variance) of the investor. (Bodie, Kane, & Marcus, 2018a)

It is clear that there are two ways for an investor to reduce the overall risk of their portfolio, the first and simplest solution is to change the utility function and reduce exposure to the risky portfolio. The second method is to change the composition of the efficient set of risky investable securities. The second method, if successful, has a benefit over the first in that it might be possible to increase expected return while maintaining the same level of risk.

Therefore, the aim of this study is not to identify the final portfolio to match a specific investor but rather to investigate the impact of international equity diversification on the efficient set of risky securities. The discussion that follows will focus on equity diversification and exclude bonds or other securities.

The construction of an efficient set of equities begins with the selection of investable equities using historical data as a proxy for the expected future return of these variables. Portfolios of equities are generated which minimise the variance of the expected returns and an optimal portfolio is chosen from these which will offer the greatest return for the lowest level of risk (Bodie *et al*., 2018a). While a portfolio of a number of equities might be efficient the more similar the included equities are the more risk will be shared by the underlying equities. Thus, an efficient set of investable securities is not necessarily the set with the lowest risk.

Risk can be categorised as either systematic or non-systematic. Non-systematic is risk that is not associated with the market in general and is rather related to specific equities or industries. This risk can be diversified away by holding different types of equities which are all subject to different types of risk. Systemic risk is that risk which is associated with all equities and cannot be diversified away and is typically considered market risk. (Bodie *et al*., 2018a)

Diversification is a direct function of the number of securities included in the set of investable securities. If all investable securities are included in the efficient set then non-systematic risk will have been diversified away. Such a fully diversified set of securities can be referred to as the market portfolio and is the capitalisation weighted set of investable equities (Bodie *et al*., 2018a). In the context of the study, the market portfolio before the relaxation of exchange controls would have been limited to the equities traded on the Johannesburg Stock Exchange (JSE).

It is clear that the construction of the efficient set is thus limited by the set of investable securities used. Different sets of investable securities will deliver different efficient frontiers and thus different risk and return characteristics. Therefore, a possible means of reducing the level of systemic risk of a portfolio is through increased diversification (Levy & Sarnat, 1970). The more uncorrelated securities available in the pool of investable securities the lower the overall risk of the portfolio. Thus, it seems logical to conclude that increased diversification by investing in foreign security markets could lead to improved risk characteristics of a portfolio.

2.2 International diversification

Seminal work on international diversification of investment portfolio's was conducted by Levy and Sarnat in the 1970's where the importance of correlations between markets was identified (Levy & Sarnat, 1970). The higher the level of positive correlation is between international markets the smaller the effect of diversification would be in investing in these markets. Lower levels of correlation or levels of negative correlation have larger effects on reducing overall risk. Solnik (1974) demonstrated the practical benefit in risk reduction achievable with these correlations in terms of international diversification (Solnik, 1974).

Meric and Meric (1989) further validated the importance of diversification in terms of country correlation in their study. They found that there was more benefit to be gained by diversifying across country rather than diversifying across industry (Meric & Meric, 1989). In an early study of international diversification French and Poterba identified numerous factors affecting the willingness of investors to diversify internationally (French & Poterba, 1991). They postulated that institutional limits on foreign investments and behavioural considerations such as perceived foreign investment risk limited the uptake of foreign diversification.

Odier and Solnik (1993) identified some important lessons for international portfolio diversification. The authors once again emphasised the importance of equity market correlation in the risk reduction impact of international diversification. Furthermore, they noted a distinct contribution of currency risk to overall portfolio risk in international portfolio's. For the world index used in the study the contribution of currency risk to total risk was 10-15% while this could be even higher for countries with more volatile currencies (Odier & Solnik, 1993).

A review and analysis of the then state-of-the-art by Shawky *et al*. (1997) identified numerous concerns and unanswered questions considering international portfolio diversification (Shawky, Kuenzel, & Mikhail, 1997). One of these concerns was that the structure of correlation between international markets is unstable in that it changes significantly overtime. This implies that it is difficult to make a diversification decision based on historical data.

The consensus is that international diversification is beneficial when there is evidence of low or negative correlation between markets (Asness, Israelov, & Liew, 2011; Levy & Sarnat, 1970; Odier & Solnik, 1993; Viceira & Wang, 2018).

2.3 Correlation and Comovement

Correlation is the measure of the comovement between two variables (Odier & Solnik, 1993). In the case where two markets move in the same direction at the same time correlation is said to be positive and where they move in opposite direction the correlation is negative. Correlation coefficients can take the values between +1 and -1, where +1 is perfectly positively correlated and -1 is perfectly negatively correlated. What this means to portfolio diversification is that if two markets are highly positively correlated the inclusion of both markets in a portfolio will not significantly increase diversification. If markets are uncorrelated (correlation near 0) then there is a greater diversification benefit from investing in the different markets. In scenarios where there is negative correlation between markets the addition of the negatively correlated market can be used to completely remove risk since it will move in the opposite direction to the other market.

In reality the correlation of international equity markets is typically positive with developed markets being more closely correlated with each other (Inaba, 2020). Developing markets are less correlated with developed markets but are more correlated with other developing markets (Inaba, 2020). The concept of international diversification indicates that improved risk and performance characteristics are achievable by utilising the differences in correlation between international equity markets.

In the years since the original studies on international portfolio diversification, globalisation has further increased financial integration (Steinberg, 2018). Numerous factors have led to this increased integration including advances in technology, capital control liberalisation and financial innovation (Berben & Jansen, 2005; Steinberg, 2018). This interconnectedness is highlighted by the fact that the higher the level of financial interconnectedness between countries the higher the level of equity market comovement (Chuluun, 2017).

This increase in correlation is most evident in developed markets where correlation between countries is high but less prevalent in emerging economies where correlation to developed economies is low (Singh & Singh, 2017). Driessen and Laeven (2007) found that the increasing correlation between developed markets means that investors in these developed markets have less diversification benefit than those in developing markets. Diversification benefits for investors in developing markets investing in an internationally diversified portfolio were significantly higher than for investors in developed markets investing in the

same portfolio. This is likely due to the lower level of financial integration in developing markets compared to developed markets (Driessen & Laeven, 2007).

However, contrary to these general findings, İlhan *et al*. (2016) found that the South African market is highly correlated with developed equity markets. This could substantially reduce the diversification benefit for the South African investors investing in developed countries (İlhan, Ding, & Meriç, 2016). However, it must be noted that the data set used covered a period of strong growth in the South African market (2003-2013) which has since reduced drastically. Therefore, there is a need to investigate whether the correlation identified during that period still holds.

2.4 Currency effect

A further important consideration for international portfolio diversification is that of currency or exchange rate effects. The purchase or sale of international equity requires the concomitant purchase or sale of foreign exchange to facilitate the transaction. In this regard capital appreciation or depreciation of equity can occur in combination with appreciation or depreciation of the currency which further influences risk (Driessen & Laeven, 2007; Grubel & Fadner, 1971; Odier & Solnik, 1993). Therefore, it is evident that currency volatility will have an effect on the overall variance (risk) of an international equity portfolio.

An early study by Kaplanis and Schaefer (1991) found that unhedged international portfolio's may actually be riskier than similar domestic portfolios (Kaplanis & Schaefer, 1991). However, later studies indicate that currency returns are an important component to taking advantage of the diversification benefits of international portfolios (Driessen & Laeven, 2007; Eiling, Gerard, Hillion, & De Roon, 2012). Thus, currency is an important component of both the risk and return characteristics of international diversification. On the one hand currency depreciation or appreciation directly affects return, and currency volatility directly affects the risk of the international portfolio.

From the perspective of the investor, the currency risk will be largely associated with the degree of international diversification required. If the investor is required to hold the majority of their portfolio in foreign equities there will be a higher need for foreign exchange and thus risk (Driessen & Laeven, 2007). If the investor is required to hold less foreign equity, such as US investors, the currency effect will be less (Driessen & Laeven, 2007). This is especially important when considering investors from developing countries, where the majority of an international portfolio will be held in foreign equity and these countries typically have more

volatile foreign exchange in comparison to their developed peers (De Santis & Imrohoroğlu, 1997).

Currency volatility is driven by numerous factors (Mpofu, 2016). However, these factors are outside of the control of an investor and thus investors need only consider the impact of currency volatility and potential methods of managing them (Celebuski, Hill, & Kilgannon, 1990). Fortunately, there is only a weak link between ZAR volatility and the South African market (Mlambo, Maredza, & Sibanda, 2013). Thus, South African investors need only concern themselves with the currency effect of the offshore component of their investment portfolios. The effect of currency volatility on international portfolio returns is of substantial importance to South African investors due to the possibility that a large portion of invested assets will be held internationally (40%). This exposes South African investors to significant foreign exchange risk. The South African Rand (ZAR) has a historical tendency to depreciate against the currencies of developed economies (Goda & Priewe, 2020). This implies that changes in currency values will increase the overall return of an international equity portfolio from the perspective of the South African investor. The ZAR is also prone to periods of excess volatility due to political and macroeconomic events (May & Farrell, 2018). This excess volatility will directly increase the risk of holding an international portfolio.

2.5 International diversification in the South African context

Prior to the relaxation of exchange controls the South African investable equity landscape was dominated by equities available on the JSE. While the JSE is a large bourse in the African context equities listed on it make up less than 1.5% of the investable equities in the world (Coeurdacier & Guibaud, 2011). With the relaxation of exchange controls South African investors have gained access to the other 98.5% of investable equities in international markets.

The main aim of this study is to measure whether diversification benefits are available by including international investments to a local portfolio of South African assets. A relevant statistical analysis which can be used to determine this is the mean-variance spanning framework initially proposed by Huberman and Kandel (1987) and then refined by Kan and Zhou (2012) into a step-down approach.

Huberman and Kandel (1987) presented a methodology based on mean-variance spanning to determine whether the addition of an asset to a benchmark asset set would improve the mean-variance frontier of the benchmark assets (Huberman & Kandel, 1987). In brief, mean-

variance spanning determines whether the mean-variance frontier of a test asset spans the mean-variance frontier of the benchmark asset. If spanning is rejected it implies that the addition of the test asset could improve either the minimum variance frontier or the tangency portfolio of the benchmark asset. The original methodology was further refined over time and Kan and Zhou (2012) proposed an improved test with more statistical power in terms of understanding the source of rejection for the spanning test (Kan & Zhou, 2012).

Numerous studies have utilised the mean-variance spanning procedure or the improved step-down approach to determine if there are diversification benefits to adding various additional assets to a benchmark portfolio. Belousova and Dorfleitner (2012) showed the diversification benefits of including commodities in a portfolio of traditional assets from the perspective of a European investor (Belousova & Dorfleitner, 2012). Bikas (2017) investigated the diversification benefit of adding structured products to investments in various market segments, including emerging markets (Bikas, 2017). Glabadnidis *et al.* (2012) used mean-variance spanning to test whether adding indices to a portfolio provides increased diversification benefits (Glabadanidis, Obaydin, & Zurbruegg, 2012).

However, as described by Mensah and Premaratane (2019), there is limited literature available on the diversification benefits of international diversification from perspectives other than that of the United States (US) or Europe (Odei Mensah & Premaratne, 2019). A study by de Roon *et al.* (2001) investigated the inclusion of emerging market securities in portfolios from the perspective of the US investor. The study found that the inclusion of emerging markets provided diversification benefits but noted that investment constraints and transaction costs had significant impacts on the extent of diversification benefit (de Roon, Nijman, & Werker, 2001).

Arif *et al.* (2017) used cointegration analysis to determine the extent of portfolio diversification from the perspective of the BRICS countries and found that South African equity investors could significantly benefit from investing in certain developing and developed countries (Arif, Iqbal, Ali, & Sohail, 2017). Most notably the US was identified as an opportunity for diversification from the South African perspective.

Driessen and Laeven (2007) investigated international diversification from the perspective of numerous countries and found significant benefit for South African investors but the study did not consider structural constraints prohibiting the level of international investment allowable. However, they did find that generally, the benefits from international

diversification are largest for countries that have high country risk (Driessen & Laeven, 2007).

Historically South African investors have had a relatively high level of home bias in that investors hold substantially more local equity than international equity. Coeurdacier and Guibaud (2011) note that the share of local equity in South African portfolio's is 89%. This is a high level of home bias when considering the work of Kellner and Rösch (2019) which found that South African investors would have significant missed opportunities if their home bias was more than 50%. The study did not use actual home bias values but used 50% as a baseline indication of missed opportunity (Kellner & Rösch, 2019). The results of this study are interesting since they imply that a minimum of 50% offshore exposure is required for South African investors which are currently more than that which is allowed by regulations.

A further study which analysed international diversification by limiting the weighting of the international portfolio to varying degrees (McDowell, 2018). The study showed that there was less diversification benefit the smaller the percentage of the portfolio was available for international investment. While relaxing the optimization constraints (i.e. no weight limits) increases the potential for diversification gains. Unfortunately the South African market was not analysed in this study, but South African investors face similar conditions in that there is a regulatory maximum imposed on international investment.

A few studies have described the benefit of international diversification from the perspective of the South African investor (Arif *et al*., 2017; Driessen & Laeven, 2007; Kellner & Rösch, 2019). However, these studies did not consider the effect of structural barriers (such as exchange controls) on international diversification. Thus, care needs to be taken when considering these results as they may not be practically applicable to South African investors. This is therefore the first study to consider the benefit of international diversification from the perspective of the South African investor, while considering the structural barriers of exchange controls which regulate the investment in international equities.

3. Methodology

The study investigates the impact of exchange controls on South African public equity investment performance by specifically looking at the diversification benefit achieved through access to international investments. The following factors were investigated as they pertain to South African equity investment:

1. Market correlation between South Africa and other markets
2. Scope for diversification using the mean-variance spanning test
3. Magnitude of performance benefits of international diversification
4. Effect of relative currency value on international diversification

3.1 Data

Monthly price data were obtained for the period from March 1993 to March 2018 for the MSCI South Africa Index, MSCI All World Index, MSCI Developed markets index, MSCI Emerging markets index and USDZAR exchange rate. Data for index prices were obtained in US Dollars from MSCI (MSCI, 2020a). The risk free rate used was the South African Government Treasury bills which was obtained along with the exchange rate from the Federal Reserve Bank of St. Louis (Federal Reserve Bank of St. Louis, 2020). Monthly data sets are used as this study is concerned with the long run implications of international diversification. Monthly data will not adversely affect expected returns but the accuracy of variance and standard deviation measures could be slightly improved by a higher frequency of observations (Bodie, Kane, & Marcus, 2018b). However, monthly data is more readily available for emerging market economies and will thus be used in this study.

The MSCI All World index is a market capitalisation weighted index of all international investable equities and it is used as a proxy for the international market index. The MSCI South Africa index is a market capitalisation weighted index comprising 85% of the market value of the South African equity market. The MSCI Developed market index is a market capitalisation weighted index of all available equities in the developed markets. The MSCI emerging market index is a market capitalisation weighted index of all available securities in emerging markets.

Only secondary data are used in this study and thus an ethics clearance waiver was obtained from the University of Witwatersrand Graduate School of Business Administration ethics committee. Ethics waiver number: WWBS/FI1766625/815.

3.2 Returns and Variance of Returns

The price data obtained in US Dollars for the different markets was converted to local returns using the USDZAR exchange rate at the time. This ZAR price data was then converted into returns and variance of returns data. The returns for each market are determined from the monthly price data using the following formula.

$$\boldsymbol{R_i = \frac{P_i - P_{i-1}}{P_{i-1}}} \tag{1}$$

Where R_i is the return for the period, P_i is the price at the end of the period and P_{i-1} is the price at the start of the period. The variance of each market was determined using the following formula.

$$\boldsymbol{\sigma^2_{index} = E(R_i - \overline{R_{index}})^2} \tag{2}$$

Where σ^2_{index} is the variance of the index returns, E is a function of the expected returns which will be historical returns in this case, R_i is the return of the market at time i and $\overline{R_{index}}$ is the mean return of the market over the entire period.

3.3 Correlation

The correlation of the returns of the markets with each other was measured over time. The average correlation was determined for the full period using the entire data set. In addition, a rolling correlation was determined on a rolling 24 month basis, to identify trends in correlation over time. Correlation between the indices was measured by the covariances among returns using Pearson's correlation coefficient given by

$$\boldsymbol{p_{x,y} = \frac{Cov(x,y)}{\sigma_x \sigma_y} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sigma_x \sigma_y}} \tag{3}$$

Where x_i is the return of an index at time i and $\bar{x}$ is the mean return of that index, y_i is the return of index y at time i and $\bar{y}$ is the mean return of index y, σ_x is the standard deviation of the returns of index x and σ_y is the standard deviation of the returns of index y. The correlation coefficients were determined for all the markets relative to each other.

The correlation coefficient was computed over a rolling period in order to identify changes in correlation between South Africa and other markets over the analysis time period. This was achieved by calculating the correlation coefficient using a rolling 24 month interval. The correlation coefficient was calculated on a monthly basis using the previous 24 months data. Specific attention was given to points at which exchange controls rules were relaxed and a new decision about international portfolio diversification could have been made.

3.4 Mean-variance spanning test

To test whether international diversification is beneficial to a local portfolio the mean-variance spanning test was used. The mean-variance spanning test was first described by Huberman and Kandel (1987) to test the effect of including an additional risky asset (*N*) on the mean-variance frontier of a benchmark asset (*K*). The test determines whether the mean-variance frontier of the portfolio of assets (*N*+*K*) spans that of the benchmark asset (*K*). If spanning is statistically significant it implies that there is no benefit to the investor of including the test assets in a portfolio with the benchmark asset. For this study, the benchmark asset was considered as the South African market, while the test assets were the World, Developed and Emerging markets indices. Each of these test assets was tested individually against the benchmark asset (South Africa).

This study will use the updated version of the mean-variance spanning test proposed by Kan and Zhou (2012) as it provides more statistical relevance due to the step down procedure. The step down procedure allows for the determination of why spanning would be rejected, which can be due to either an improved tangency portfolio or an improvement in the mean-variance frontier of the portfolio (*N*+*K*), measured against the benchmark asset (Kan & Zhou, 2012).

The method is based on a regression analysis of the returns of the test asset (*N*) on the returns of the benchmark asset (*K*). The regression is then tested for statistical significance under the null hypothesis which has two conditions (equation X). Thus, the realised monthly returns of the benchmark (*K*) and test (*N*) asset will be R_{1t} and R_{2t} respectively. The returns of a combined portfolio of *K*+*N* will be R_t.

The expected returns of the combined portfolio (*K*+*N*) will be $\mu = E(R_t) \equiv \begin{bmatrix}\mu_1 \\ \mu_2\end{bmatrix}$ where $\mu_1 = E(R_{1t})$ is the expected return of the benchmark asset (*K*) and $\mu_2 = E(R_{2t})$ is the expected return of the test asset (*N*). The variance-covariance matrix of the portfolio of assets (*K*+*N*) is defined as $Var[R_t] = \begin{bmatrix}V_{11} & V_{12} \\ V_{21} & V_{22}\end{bmatrix}$, where V is assumed to be non-singular. Following the regression framework, the return of the test asset *N* (R_{2t}) can be projected on the benchmark asset *K* (R_{1t}) to obtain the following regression,

$$\boldsymbol{R_{2t} = \alpha + \beta R_{1t} + \varepsilon_t} \quad (4)$$

Where $\alpha = \mu_2 - \beta\mu_1$, $\beta = V_{21}V_{11}^{-1}$ and $E[\varepsilon_t] = 0_N$ and $[\varepsilon_t R_{1t}'] = 0_{N\times K}$ which implies the error terms are homoscedastic with mean zero, 0_N is a N-vector of zeroes and $0_{N\times K}$ is an $N \times K$ matrix of zeroes (Chen, Chung, Ho, & Hsu, 2010). If the returns are normally distributed and the error terms are homoscedastic the null-hypothesis for spanning is given by equation (5). If these conditions are not met the use of a different test is required, to adjust for non-normality and heteroscedasticity (in this study it was not necessary to account for these).

$$H_0: \alpha = 0_N, \quad \delta = 0_N \tag{5}$$

where $\delta = 1_N - \beta 1_k$ with 1_N being an *N*-vector of ones and 1_k being a *K*-vector of ones. When the null-hypothesis of spanning holds, it implies that the test assets span the benchmark asset and there is no benefit from including the test assets in a portfolio with the benchmark assets. When it does not hold, it implies that the test assets do not span the mean-variance frontier of the benchmark assets and there is a diversification benefit of including the test assets in a portfolio with the benchmark assets. Using the step-down procedure described by Kan and Zhou (2012) it is possible to determine source of rejection (Either $\alpha = 0_N, \ or \ \ \delta = 0_N$).

The step-down procedure tests the null hypothesis in sequential order starting with $\alpha = 0_N$ to determine whether inclusion of the test assets improves the tangency portfolio, followed by $\delta = 0_N$ to test whether inclusion of the test assets provides an improvement in the mean-variance frontier, conditional on $\alpha = 0_N$.

The spanning hypothesis can only be accepted if both tests do not reject the null-hypothesis. Thus, the null hypothesis can be rejected at the first step but not the second, which will indicate there is no spanning due to an improvement in the tangency portfolio but not a change in the global minimum variance. Alternatively, the null hypothesis can be rejected in the second step but not the first, which indicates there is no spanning due to an improvement in the mean-variance frontier. The spanning test was conducted each time the regulations changed making use of the data set for the entire period prior to the change.

3.5 Optimal portfolios

The mean-variance spanning test provides a statistical test to determine whether there is evidence for a diversification benefit. However, the test does not provide the economic relevance of this benefit. In order to assess the economic importance of including an international asset in a local portfolio, it is required to determine the relative weights of the South African and International portfolio.

The process to calculate the optimal portfolio weight is based on the assumption that investors would choose the portfolio that presents the highest risk adjusted return (Chen *et al*., 2010). In practice this would be the portfolio which has the maximum Sharpe ratio. Therefore, the weights are determined by maximising the Sharpe ratio under certain conditions.

The portfolio Sharpe ratio (S_{port}) is given by equation (6),

$$\boldsymbol{S_{port} = \left(\frac{\overline{R_{port}} - R_f}{\sigma_{port}}\right)} \tag{6}$$

Where R_f is the risk free rate, σ_{port} is the standard deviation of the portfolio as calculated using equation (8) and R_{port} is the return of the portfolio given by equation (7),

$$\boldsymbol{R_{port} = w_{int}R_{int} + w_{SA}R_{SA}} \tag{7}$$

Where R_{int} is the return of the international index under consideration in ZAR, w_{int} is the weight of international equity, w_{SA} is the weight of the South African equity and R_{SA} is the return of South African equities. The variance of the portfolio can be calculated as follows

$$\boldsymbol{\sigma^2_{port} = w^2_{int}\sigma^2_{int} + 2w_{int}w_{SA}\sigma_{intSA} + w^2_{SA}\sigma^2_{SA}} \tag{8}$$

Where σ_p^2 is the variance of the portfolio, σ_{int}^2 is the variance of the international equity returns, σ_{SA}^2 is the variance of the South African equity returns and σ_{intSA} is the covariance between the international and South African equity returns.

The maximum Sharpe ratio can then be determined under the condition that no short sales are allowed.

$$\begin{gathered}(\mathbf{1})\sum_{i=1}^{N} \boldsymbol{w_i} = \mathbf{1} \\ (2)\ w_i \geq 0\ all\ i\end{gathered} \tag{9}$$

Substituting equations (7) and (8) into equation (6) and then maximising through differentiation in respect to w_{int} results in equation (10). This is relevant where there are only two assets, when more assets are included there will be a matrix version of the formula.

$$\boldsymbol{w_{int}} = \frac{(\boldsymbol{R_{SA}})\boldsymbol{\sigma_{int}^2} - (\boldsymbol{R_{int}})\boldsymbol{\sigma_{intSA}}}{(\boldsymbol{R_{SA}})\boldsymbol{\sigma_{int}^2} + (\boldsymbol{R_{int}})\boldsymbol{\sigma_{SA}^2} - [\boldsymbol{R_{SA}} + \boldsymbol{R_{int}}]\boldsymbol{\sigma_{intSA}}} \tag{10}$$

The optimal portfolio weights are then recalculated each time the regulations change using equation (10). The return and variance of the portfolio can then be calculated from equation (7) and (8) respectively.

3.6 Performance

The performance of the various markets as well as diversified portfolios constituting the South African market (benchmark asset) and one of the international markets (test asset) was measured using the Sharpe ratio. The Sharpe ratio was calculated for a portfolio including the South African market and one of the international markets (World, Developed or Emerging). This was done under two different conditions. The first condition was utilising the maximum international weighting as per regulations and secondly utilising the optimal international as calculated in the previous section. This process was carried out each time the regulations changed and the data set used was all data before the change in regulations. The same process was repeated for each of the three different test assets. The Sharpe ratio was calculated using equation (6)

$$\boldsymbol{S_{port}} = \left(\frac{\overline{\boldsymbol{R_{port}}} - \boldsymbol{R_f}}{\boldsymbol{\sigma_{port}}}\right) \tag{6}$$

Where S_{port} is the Sharpe ratio for a specific portfolio of benchmark and test asset, $\overline{R_{port}}$ is the average return of the portfolio, R_f is the current risk free rate as given by the South African Government Treasury Bill rate and σ_{port} is the standard deviation of the returns of the portfolio.

3.7 Currency effect

The extent of currency effects on the performance metrics of the various markets was tested by determining what percentage of return, risk and Sharpe ratio was due to depreciation of the ZAR. Returns on the test assets (international portfolios) were calculated in US Dollars. The mean return and standard deviation of the returns were calculated at the end of the data period to determine the average currency effect. The difference in mean return, standard deviation and Sharpe ratio were calculated between the US Dollar data set and the ZAR data set (Elton, Gruber, Brown, & Gotzmann, 2014). From these, the percentage increase or decrease in mean return, risk (standard deviation) and Sharpe ratio as a result of the exchange were calculated.

4. Results and Discussion

4.1 Overview of markets

Equity indices were used in the study to represent various international and local portfolios of investable equities. MSCI indices for the World, Developed markets, Emerging markets and South Africa were used. In each case the index is made up of numerous equity holdings determined by the market capitalisation of the underlying equity markets.

The MSCI South Africa Index was used as a proxy for the local market. The index comprises 39 stocks, which account for approximately 85% of the free float-adjusted market capitalisation of the South African equity market (MSCI, 2020d). The MSCI All World Index was used as a proxy for the returns of an internationally diversified portfolio including all countries. The index comprises 2 990 stocks spanning 23 developed markets and 26 emerging markets, which account for approximately 85% of international equity markets (MSCI, 2020b).

The MSCI Developed Market index was used as a proxy for the returns of a diversified portfolio including equity from only developed countries. The index comprises 1 600 stocks spanning 23 developed markets and accounts for approximately 85% of the market capitalisation of developed equity markets (MSCI, 2020e). The MSCI Emerging markets index was used as a proxy for the returns of a diversified portfolio including equity only from emerging countries. The index comprises 1 390 stocks spanning 26 emerging market economies. The index accounts for approximately 85% of the market capitalisation of emerging markets (MSCI, 2020c).

A breakdown of the weighting by 5 largest countries for the international indices is given in Figure 1. The US makes up the majority of the weighting in the World index as well as the Developed markets index. This is due to the fact that the US has the largest equity markets by capitalisation. In the Emerging markets index China makes up the majority of the index weighting due to having the largest stock market capitalisation.

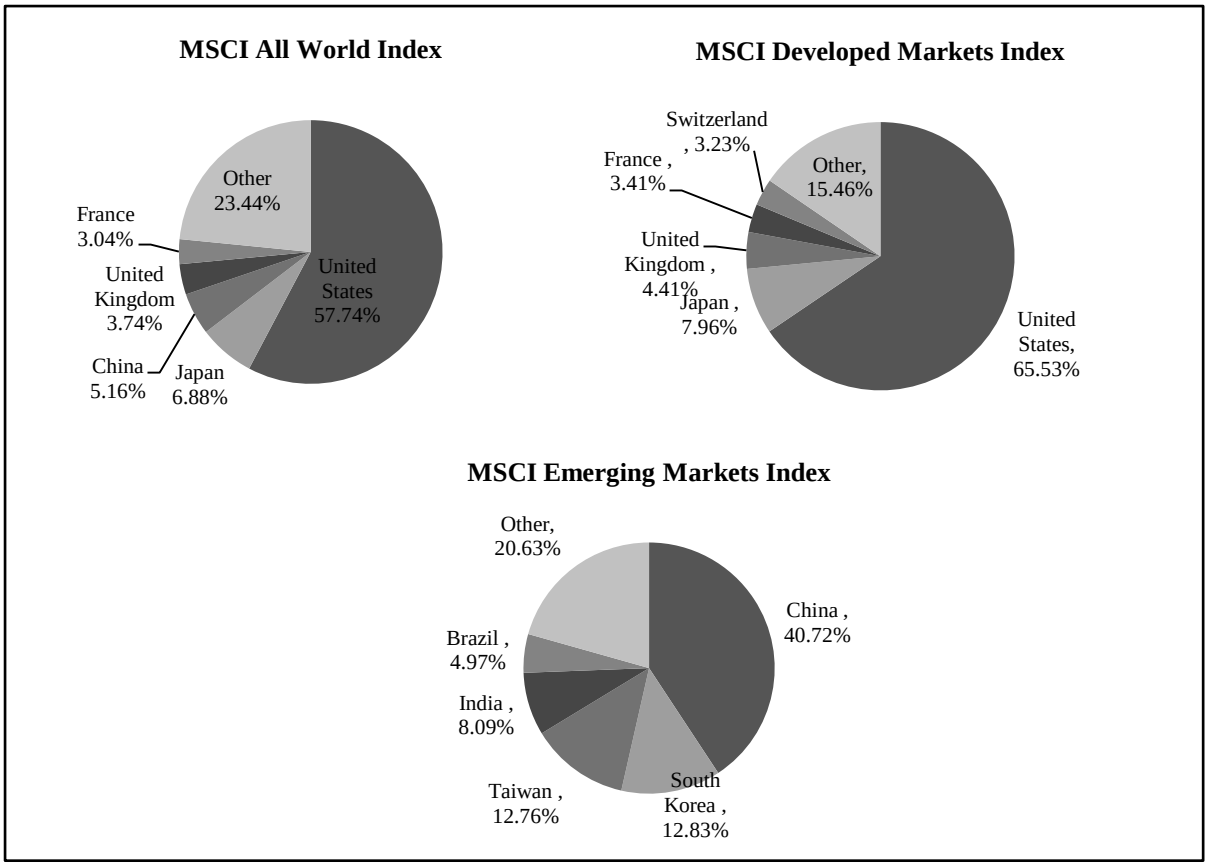

Figure 1: Index country weights

Notes: All the weightings shown change over time and are thus not an accurate depiction of the exact weightings of these markets over the full time period, but present a relative indication of country weightings.

The descriptive statistics for the monthly returns of the South African market, World index, Developed markets index and Emerging markets index during the period March 1993 till March 2018 are given in Table 2. The annual returns in ZAR were between 10.95% and 12.42% with the South African market returning the largest return over the period.

Table 2: Descriptive statistics

Region	Mean return (annual)	Mean return	Median return	Max return	Min return	Standard Deviation	Skewness	Kurtosis
South Africa	12.42%	0.98%	1.46%	20.78%	-40.48%	7.01%	-0.85	7.23
World	11.22%	0.89%	0.76%	23.99%	-18.87%	4.93%	-0.21	5.81
Developed	11.35%	0.90%	0.84%	23.78%	-18.04%	4.91%	-0.15	5.60
Emerging	10.95%	0.87%	1.47%	27.97%	-38.25%	6.53%	-0.84	8.43

Notes: All descriptive statistics are for monthly returns except for the first column which is the annualised return.

The mean monthly returns ranged between 0.87% for the Emerging markets index and 0.98% for South Africa. The largest monthly returns were observed during November 2001 with

Emerging markets gaining the most at 27.9%. The largest drawdowns occurred during August 1998 with South Africa and the Emerging markets losing 40.48% and 38.25% respectively. The World and Developed markets lost 18.87 and 18.04% respectively.

All the markets have a measure of negative skewness with the World and Developed markets being less negatively skewed than South Africa and the Emerging markets index which have similar levels of skewness. Negative skewness is desirable for equity investors due to the implication that the return distribution has more values concentrated on the right side and a longer tail on the left. Practically this implies that returns are generally higher than the mean but there exists a possibility of large negative returns (long tail).

The kurtosis values are all greater than 3 indicating that all the indices have leptokurtic distributions and can be prone to large positive or negative returns. The World and Developed markets have lower levels of kurtosis and are thus less prone to these excessive returns in comparison to South Africa and Emerging markets.

South Africa and the Emerging markets had higher standard deviations in their returns compared to the World and Developed markets. From the perspective of risk, this indicates that the South African market has a higher level of volatility in returns and thus overall risk compared to the World and Developed markets. This is also corroborated by the larger negative skewness and higher kurtosis of the South African market compared to that of the World and Developed markets.

4.2 Correlation

The average correlation between the various markets over the entire data period between March 1993 and March 2018 is shown in Table 3. There is an almost perfect positive correlation between the World index and the Developed Market index. This is likely due to the fact that the weighting of the constituent countries was similar during the period under consideration. South African markets showed a moderate positive correlation to the World and Developed markets with coefficients of 0.58 and 0.55 respectively. South Africa and the Emerging markets were more strongly correlated with a coefficient of 0.74. These results indicate that there is potential for diversification based on imperfect correlation between South Africa and other markets. The magnitude of the benefit is likely to be larger between South Africa and the World and Developed markets rather than the Emerging markets.

Table 3: Average Correlation Coefficients

	South Africa	World market	Developed markets	Emerging markets
South Africa	1.00			
World	0.58	1.00		
Developed markets	0.55	0.99	1.00	
Emerging markets	0.74	0.80	0.77	1.000

The correlation coefficients presented in Table 3 are the average correlation coefficients for the entire period under investigation. However, it is known that correlations change over time and that it might be more suitable to determine correlations for a rolling period. The rolling correlations between South African markets and the World, Developed and Emerging markets are given in Figure 2.

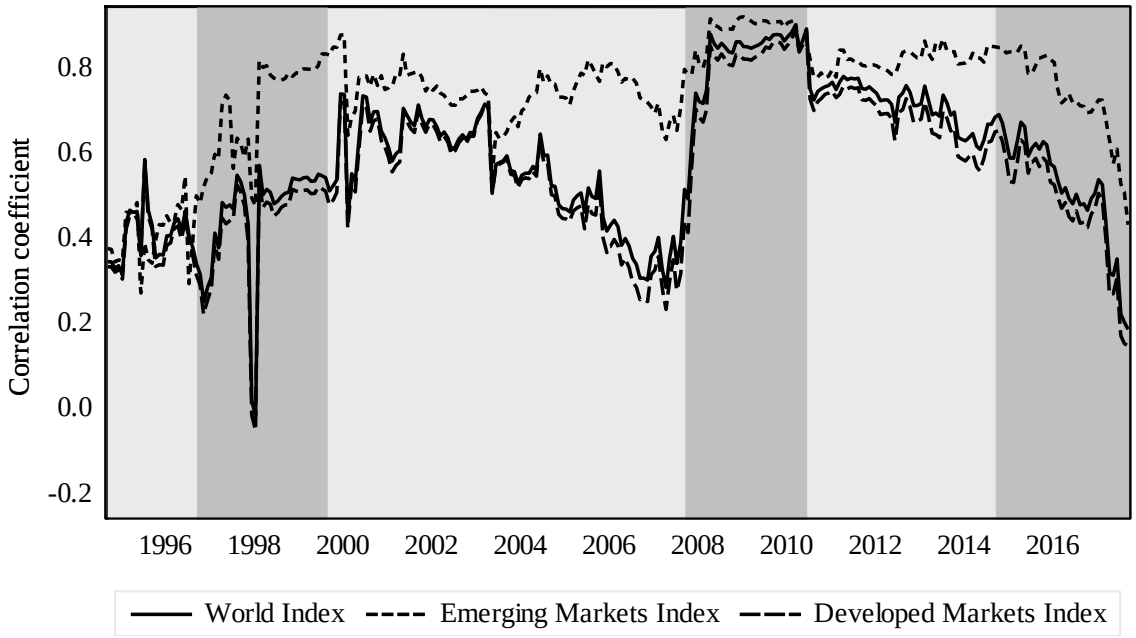

Figure 2: Correlations of South Africa with other markets over a 24-month rolling period

Shaded areas indicate the periods where regulations change.

Similar to previous studies, Figure 2 shows that correlations increase during times of global panic such as the Dotcom bubble in 2000 and the Global Financial Crisis in 2008. However, there seems to be a trend of decreasing correlation after these events. Of importance to this study is the correlation when investment regulations have been changed (these are indicated on the figure with the shaded areas). In 2008 and 2018 correlations were low when regulations allowed for further international investment, while in 2010 correlations were high. In the period from 2010 the correlation of all markets are decreasing which indicates that the South African market has disconnected from other markets to a certain degree. Therefore, diversification is more likely to be beneficial.

4.3 Mean-variance spanning test

A mean-variance spanning test as described in the methodology was used to test whether diversification benefits exist for including various international equity portfolios to a local South African equity portfolio. Short selling of securities was excluded from the investigation. The results of the mean-variance spanning test are presented in Table 4. The step down approach used shows whether the null-hypothesis of spanning is rejected due to a change in the tangency portfolio (F1) or a change in the minimum variance portfolio (F2). Thus, F1 tests whether there would be an improvement in the maximal Sharpe ratio with a diversified portfolio and F2 tests whether the minimum variance frontier of the portfolio would be improved versus the benchmark asset. Results were regarded as statistically significant at a 95% confidence level. Appendix A presents the mean-variance spanning test results including detail P-Values.

Table 4: Mean-variance spanning test

Year	World index		Developed market index		Emerging market index	
	F1	F2	F1	F2	F1	F2
March 1995	1.33	107.73[a]	1.37	106.15[a]	0.26	22.81[a]
March 1997	6.86[a]	112.51[a]	6.89[a]	109.70[a]	1.76	36.21[a]
February 2000	12.04[a]	147.70[a]	12.69[a]	149.37[a]	0.66	26.87[a]
March 2008	4.06[b]	232.91[a]	4.11[b]	239.28[a]	0.98	47.02[a]
December 2010	1.24	239.29[a]	1.23	247.34[a]	0.21	48.54[a]
March 2015	3.73[b]	278.48[a]	4.06[b]	287.17[a]	0.26	60.31[a]
March 2018*	4.37[b]	309.42[a]	4.67[b]	318.61[a]	0.55	71.83[a]

*Notes: * The last regulation change occurred in March 2018 and these are thus the current regulations.* [a] *denotes statistical significance at 1% and* [b] *denotes significance at 5%.*

Both F1 and F2 need to be rejected in order to conclude that the joint test of spanning holds which would imply no diversification benefit. Overall the null-hypothesis of spanning was rejected at 99% confidence for the inclusion of international assets at all time periods. The source of rejection however differed somewhat across time periods.

During the initial change of regulations in March 1995, rejection of the spanning hypothesis was due to improvements in the mean-variance frontier and not a change in the tangency portfolio. This implies that the addition of international investments would not necessarily provide an improved Sharpe ratio of the diversified portfolio versus the local only portfolio. However, the inclusion of international investments would provide a better minimum variance frontier.

After the February 2000 regulation change the null hypothesis of spanning was rejected for the World and Developed markets on both the tangency and mean-variance front while the emerging markets did not provide a statistically significant improvement in tangency portfolio. This would result in improved Sharpe ratios and minimum variance frontier with the inclusion of international investments in a local portfolio.

The main trend in the results indicate that the inclusion of international assets in a local portfolio can provide a diversification benefit largely due to an improved mean-variance frontier rather than improved tangency portfolios. The mean-variance spanning test shows that there is a statistically significant benefit to including international assets in local portfolios. However, the results do not indicate the magnitude of benefit that could be achieved through international diversification. The next section will determine the optimal portfolio weights based on maximising the Sharpe ratio in order to determine the effective benefit that could be achieved by adding international investments to a local investment portfolio.

4.4 Optimal portfolios

The mean-variance spanning test in the previous section clearly showed that local investors could benefit from including international equities in their portfolios. However, the mean-variance spanning test does not indicate what the magnitude of this benefit is and how best it could be achieved. In order to quantify the effect of international diversification, the optimal portfolio weights of local and international assets must be determined. This will be determined by calculating the maximum Sharpe ratio achievable with a two asset portfolio containing the South African market and an international market index.

The change in Sharpe ratios for the local investor was determined in two manners, the first was using the maximum regulatory allowed portfolio weightings and the second was using the optimal portfolio weighting determined from Markowitz portfolio theory. The portfolio weights at the time of regulation changes are presented in Table 5.

Table 5: Institutional limits and theoretical portfolio weights

Year	Maximum weights based on regulations		Maximum weights based on portfolio theory optimisation		
	South Africa	International	World markets	Developed markets	Emerging markets
March 1995	95.00%	5.00%	0.00%	0.00%	0.00%
March 1997	85.00%	15.00%	40.95%	43.33%	18.22%
February 2000	80.00%	20.00%	97.35%	96.50%	49.47%
March 2008	70.00%	30.00%	36.06%	35.39%	40.07%
December 2010	65.00%	35.00%	20.56%	19.66%	18.24%
March 2015	65.00%	35.00%	53.38%	55.17%	14.65%
March 2018*	60.00%	40.00%	52.65%	54.32%	21.88%

*Notes: The table shows the regulatory limit for institutions and in the last three columns the optimal weighting for the international component of a portfolio based on maximising the Sharpe ratio using traditional portfolio theory. * The last regulation change occurred in March 2018 and these are thus the current regulations.*

For the majority of date ranges the investment regulations allow for less international diversification than portfolio theory suggests being optimal. However, in March 1995 regulations allowed for international exposure of 5% while portfolio theory suggested that no international exposure should be held in any form, to the extent that it proposed short selling of international markets. However, this is in line with the results from the spanning test which indicated that the F1 (tangency portfolio) for the period indicated spanning and that a change in maximal Sharpe ratio was not expected.

In December of 2010 regulations allowed for 35% exposure while portfolio theory suggested less than that, in this case it would have been possible to adjust international exposure as desired since it is possible to reduce exposure below regulated limits but not above. In the period between March 2015 and March 2018 optimal weightings remained relatively stable with only Emerging markets increasing significantly.

From the results in Table 5 it is clear that the optimal portfolio weights for international investment are not always achievable due to the regulatory limits placed on international investment. The next section will determine what influence the utilisation of the limits or optimal portfolio weights have on investment performance through changes in the Sharpe ratio. The mean-variance frontiers for portfolios including the various markets and South Africa are given in Appendix B for each period regulations changed.

4.5 Performance

The trends in Sharpe ratio for the different markets are given in Figure 3. These trends explain the trends in optimal portfolio weighting observed in Table 5. Initially the data shows that there were significant differences in Sharpe ratios between markets during the period between 1995 and 2008. The high Sharpe ratio for South Africa explains why the initial optimal portfolio did not include international markets. The spike in the Sharpe ratio in 2000 for the World and Developed markets explains why the optimal weightings for these markets were so high during the time.

However, more recently it appears that Sharpe ratios share similar trends between the markets. This could in part be due to the large effect that changes in the USDZAR exchange rate have on the returns of these markets in ZAR. This is investigated in more detail later. The differences in Sharpe ratios during the time period indicate that portfolio weights, when optimised to maximise portfolio Sharpe ratios, can change drastically, especially between 1995 and 2008.

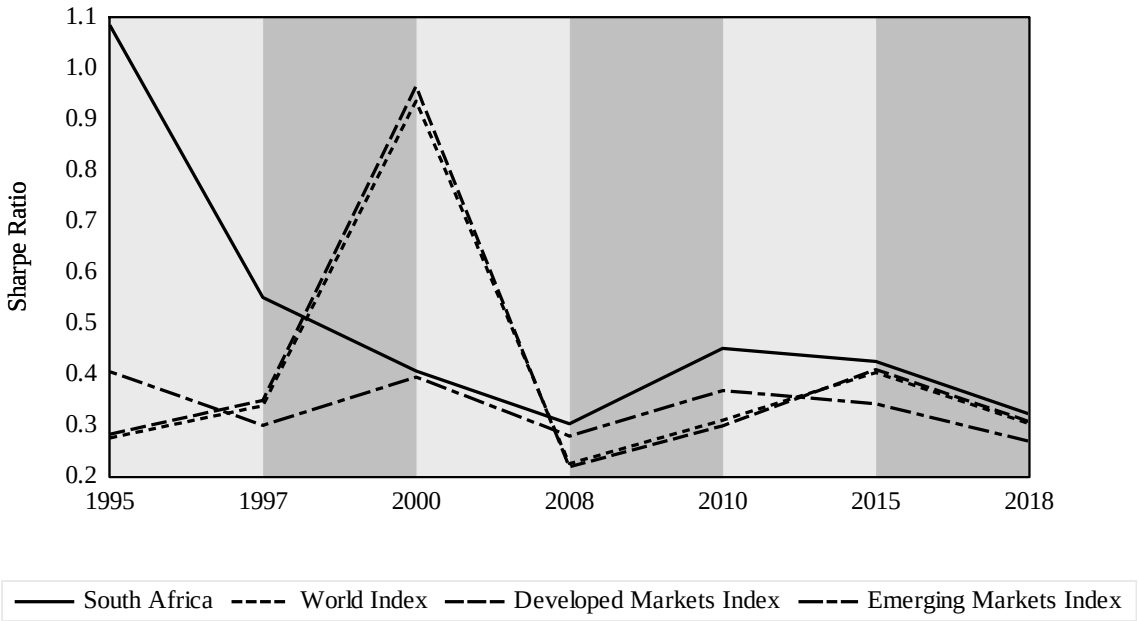

Figure 3: Sharpe Ratios

Notes: The graph shows the Sharpe ratios for the different markets over the period under investigation. Shaded areas indicate the periods where regulations change.

The next step was to quantify by how much the local investor would have benefited from the inclusion of international assets in their portfolio. This was done by calculating the improvement in Sharpe ratio of a portfolio including international assets versus a portfolio

including only South African assets. The results given in Figure 4 are the percentage improvement in Sharpe ratio when the regulatory limits were used as the portfolio weights. The improvement in Sharpe ratio was between 0.04% and 29.98% at the different stages, with the World and Developed markets offering greater improvements compared to Emerging markets.

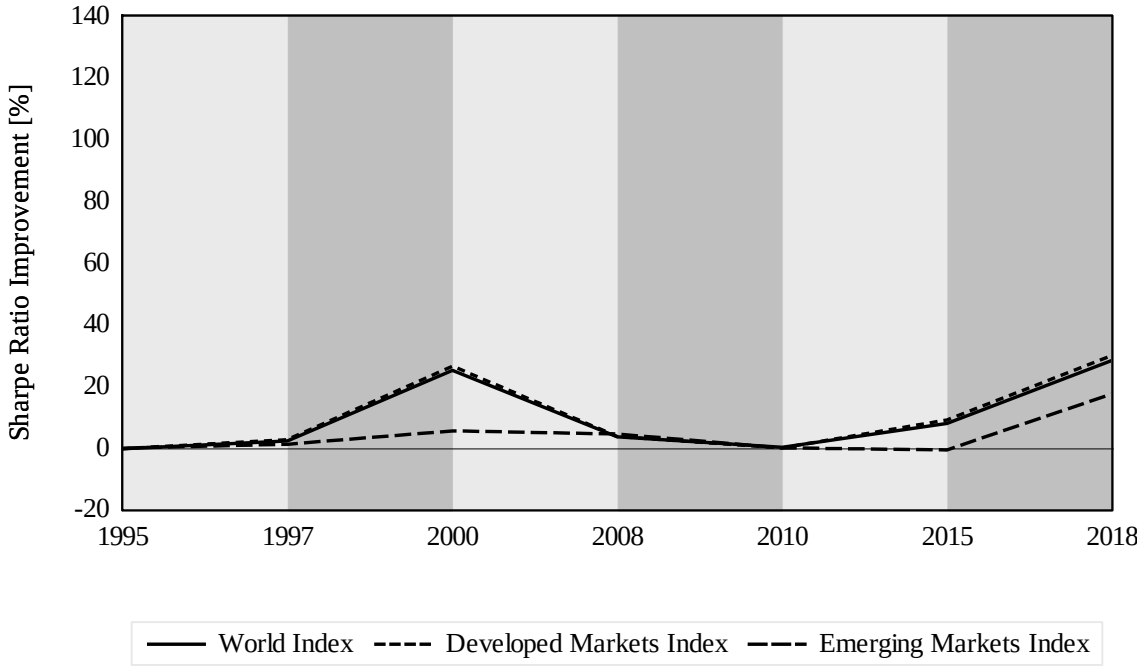

Figure 4: Sharpe ratio improvements under regulations

Notes: The graph shows the Sharpe ratio improvement possible from diversifying using various international equities under the constraints of the regulations. For instance, World Index implies a portfolio which includes the World Index and South African equities where the portfolio weight for the international component was used as the regulatory maximum unless the optimal weighting was less (such as during December 2010). Shaded areas indicate the periods where regulations change.

The same analysis was done by removing the regulatory constraints and utilising the optimal portfolio weights from Table 5. The results are shown in Figure 5 where it can be seen that there is a significant spike in 2000, where the inclusion of the World or Developed markets at the optimal portfolio weights of 97.35% and 96.50% respectively, would have achieved Sharpe ratio improvements of greater than 130%. The regulations thus created a large missed opportunity for South African investors during this time. For the period between 2000 and 2018 the improvement in Sharpe ratio above that achievable using the regulated limits is less drastic and the missed opportunity is between 4.48% and 7.16% in total.

These results show that investors could obtain improved Sharpe ratios with the relaxation of exchange controls rules. While the regulation weights are not optimal they were close at the last change and provided reasonable room for international diversification. Improved Sharpe ratios of between 0.04% and 29.98% were possible at various stages during the time period between 1995 and 2018. There is likely still need for further relaxation of exchange control rules in order to allow investors to make use of the optimal international portfolio weights which are generally higher than what is allowed by regulations.

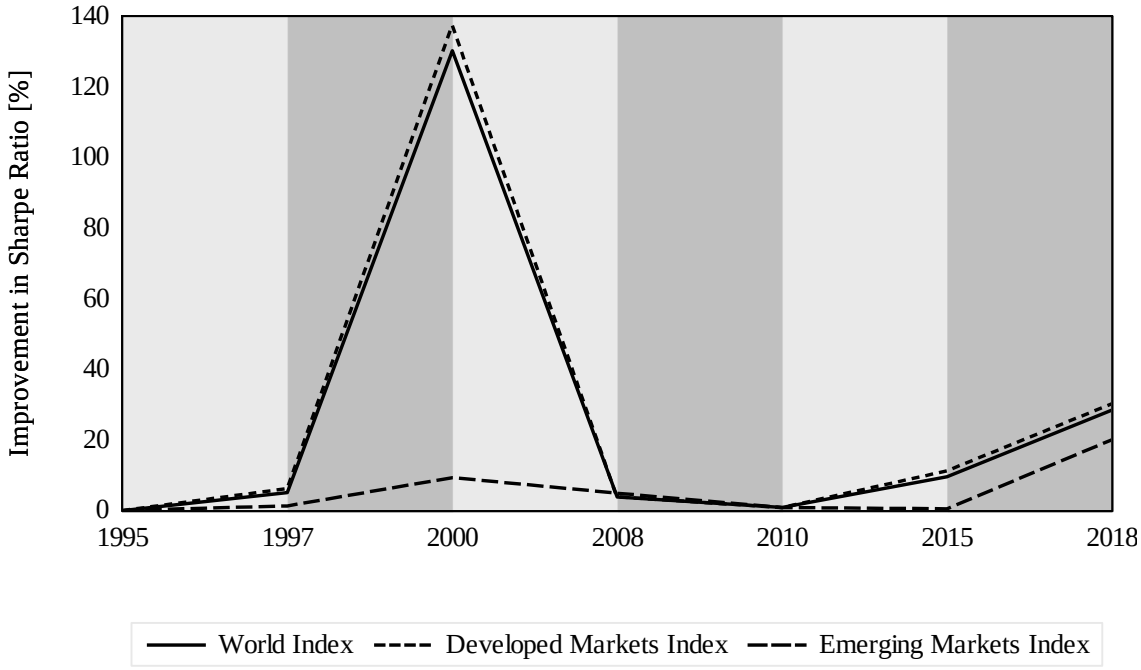

Figure 5: Sharpe ratio improvements without regulations

Notes: The graph shows the maximum Sharpe ratio improvement possible from diversifying using various international equities without considering the regulatory maximums for offshore investment. For instance, World Index implies a portfolio which includes the World Index and South African equities where the portfolio weight for the international component was determined as the optimal weighting to maximise the Sharpe ratio from traditional portfolio theory. Shaded areas indicate the periods where regulations change.

4.6 Currency effects

It is important to note that due to the depreciating nature of the ZAR changing exchange rates can have a large impact on the return of international investments. In addition to depreciation, the exchange rate could also have effects on the volatility of international investments. Table 6 quantifies the magnitude of the currency effect on return, standard deviation and Sharpe ratios. The exchange rate accounts for about 50% of the return from international markets. The exchange rate volatility increases the standard deviation by 13.59% for the World market and 15.80% for Developed markets. This leads to a reduction in Sharpe ratio of 8.07% and 10.35% respectively.

Interestingly, the effect of the exchange rate on the Emerging markets is different and reduces the standard deviation by 2.25% which leads to a 7.33% increase in the Sharpe ratio. This is likely due to there being more similarities between the ZAR and other emerging market currencies. Close correlations between the ZAR and other emerging market currencies have been shown by other research (Karoui, 2006). This would lead to less volatility between the ZAR and other emerging market currencies, resulting in the smaller change in standard deviation.

Table 6: Currency effects on performance and risk

Region	Change in returns	Change in standard deviation	Change in Sharpe ratio
World	50.56%	13.59%	-8.07%
Developed markets	50.00%	15.80%	-10.35%
Emerging markets	51.72%	-2.25%	7.33%

It is important to note that the volatility of the currency can have substantially different effects during different periods. In this study the long term effect was measured but the effect can be positive or negative during specific shorter periods. During periods of long term currency depreciation, the currency effect is largely positive overall for the investor in terms of increased returns. However, during shorter periods of large volatility with the currency depreciating and appreciating in turn the currency effect has a less positive impact on returns while increasing standard deviation and overall risk.

4.7 Discussion

The results from the spanning test show that there is a statistically significant benefit in adding international investments to a local portfolio in terms of either improving the tangency portfolio (improved Sharpe ratio) or the minimum variance frontier. This was the case across all periods when regulations changed.

The diversification benefit of including one of the test assets in a local portfolio varied over time due to the changing levels of correlation between markets over the period. On average the correlation between the South African market and the developed or world market were less than the correlation between South Africa and other emerging markets. Intuitively this makes sense as South Africa has more in common with its emerging market peers than developed economies. Additionally the world index is dominated by developed economies due to the absolute size of their equity markets. The varying nature of correlations during the test period from 1995 to 2018 means that optimal portfolio weightings for the international component of a portfolio varied widely from lows of 0% to highs of 97.35%.

The performance improvement achievable for institutional investors through international diversification was largely limited by the regulatory maximums. However, international diversification to any degree would have benefited investors during all time periods except for the initial period in 1995. This was due to the extremely strong local market in the two years preceding which eclipsed any benefit from moderate correlations during the period. Overall, maximising the utilisation of regulatory offshore allowances by institutional investors between 1995 and 2018 would have provided on average 9.65% improvement in Sharpe ratios.

From the standpoint of an individual investor they would have been able to achieve a slightly higher improvement in average Sharpe ratio (9.98%) over the period between 1995 and 2018. This is largely, due to there being fewer limits on the ability to diversify internationally using either annual allowances or inward listed offshore products such as offshore feeder mutual funds or exchange traded funds subsequent to 2008.

If institutional investors were not bound by regulatory maximums for international investment an average 15.81% improvement in Sharpe ratio would have been possible between 1995 and 2018. Thus, institutional investors are at a disadvantage in the fact that they have an upside limit to the amount of funds that can be invested offshore. In general the regulatory international investment allowances were less than what the optimal weights

required. This implies there was generally need for more international diversification than what was allowed. In 2018, at the time of the last change in regulation institutional limits were not drastically different to the optimal weightings (40.00% vs 52.62%). Based on historical precedent by the South African Reserve Bank it is likely that regulations will be further amended in the future.

Due to the depreciating nature of the ZAR the currency plays an important role in the returns and risk of international diversification. During the period currency affects accounted for more than 50% of the overall return of international equities. Currency volatility substantially affected the risk of international portfolios and decreased Sharpe ratios of the World and Developed markets while having less of an effect on other emerging market equities. In the long term the depreciation of the Rand outweighed the increased volatility and produced improved overall Sharpe ratios in portfolio's including international assets. However, this does emphasise the need to consider currency volatility in the short to medium term as it can significantly influence returns and standard deviation (risk).

Literature showed that, historically, typical South African investors have a high level of home bias with around 89% of invested equities being invested locally (Coeurdacier & Guibaud, 2011). This high level of home bias was likely due to the regulatory restrictions that were in place during the time which restricted international exposure to a maximum of 35% (home bias of 65%). However, this still implies that in reality South African investors are not fully making use of the regulations allowing for offshore exposure and are missing out on substantial improvements in investment performance.

Continued high levels of home bias for South African investors could unnecessarily reduce the performance of South African investor's investment portfolios. This is concerning since current regulations already allow for substantial international investment. Furthermore, since the last change in regulations in March 2018 the South African markets have disconnected from the majority of other markets as seen in Figure 6.

During the period from 1993 to 2018 the South African market (Bold line) followed the general trend of international markets. However, as of 2015 the South African market has trended sideways while the international markets have trended upwards with substantial increases in value. This is true even when currency effects are removed. This suggests that there might be a change in correlation between South African markets and international markets in past few years.

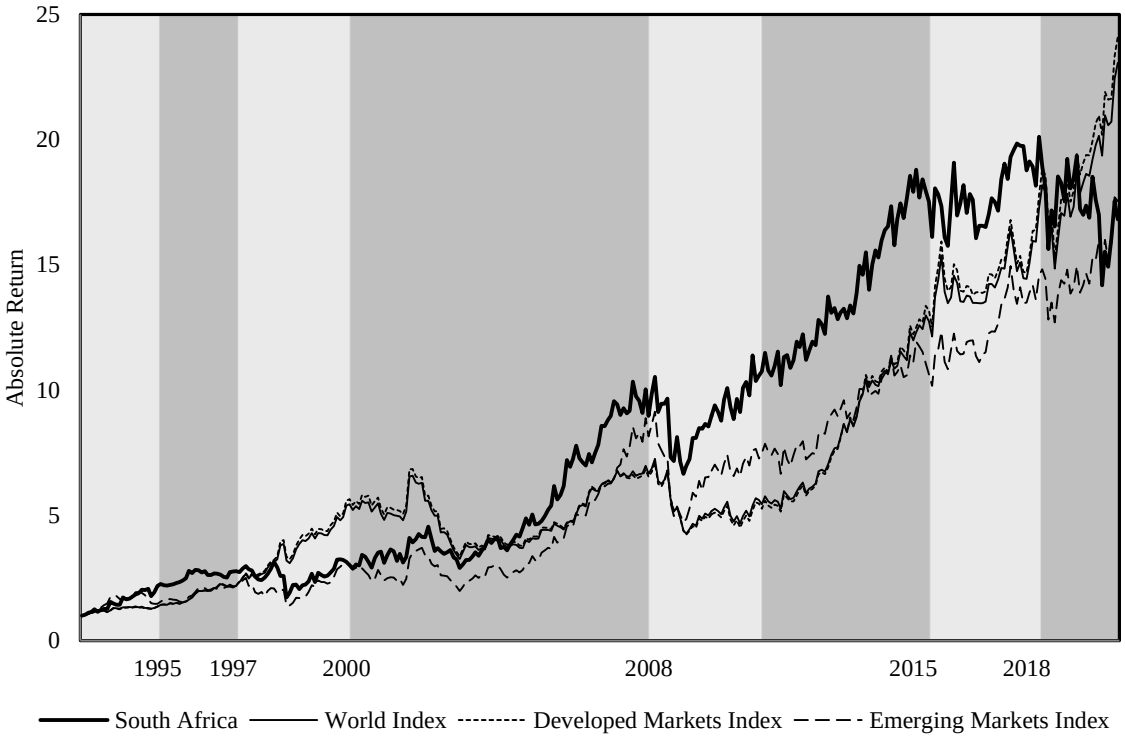

Figure 6: Market trends

Shaded areas indicate the periods where regulations change. The last period is under the latest regulations but no new changes have been made since March 2018.

However, the correlation of the markets during this time was relatively high (0.71 with World index) which is likely due to comovement during periods of shock such as during the initial Covid-19 market correction in March 2020. However, using portfolio theory to determine the optimal weightings at the end of August 2020 indicates that the optimal portfolio for a South African investor would be diversified 100% offshore, with no exposure to South Africa. This would be possible for most individual investors but regulatory limits on institutions prevent them from taking the same course of action. Therefore, there is likely a need for further relaxation of investment allowances for institutional investors in the future.

On the whole the relaxation of exchange rate rules by the South African Reserve Bank for institutional and individual investors provided improved performance possibilities for South African investors. During the period under investigation, it was possible to improve the performance of an investor by including international equities as measured by improvements in Sharpe ratios.

5. Conclusion

The aim of this study was to empirically determine the impact of exchange controls on South African public equity investment performance. No previous studies have investigated the impact of these structural barriers on international diversification for South African investors.

The main research question was whether changes to exchange controls provided a diversification benefit to South African institutional investors in terms of improved risk and return measures. The results indicate that institutional investors could deliver significantly improved Sharpe ratios by making use of their foreign investment allowances.

A secondary research question was whether an individual investor would have benefited more than an institutional investor due to differences in regulations. The results show that individual investors could gain a slightly larger improvement in Sharpe ratios after March 2008 due to increased annual allowances and the inward listing of certain offshore investment vehicles. These allowed individual investors the ability to diversify internationally (through SA listed investments) without limits and they could thus take full advantage of optimal portfolio weightings not limited by regulations.

The final research question was to determine what the impact of currency volatility was on international diversification for South African investors. The results indicate that currency volatility played a significant role in risk acting to decrease Sharpe ratios. However, the depreciating nature of the Rand played a larger positive role by increasing returns over the long term.

5.1 Recommendations for future work

While this study was able to satisfactorily answer all the research questions posed, it is possible to improve on the results of this study in future.

- The study could be conducted at a higher resolution in terms of utilising country indices instead of general market indices. This could be taken even further by considering sector indices. This should provide better optimal portfolios and could provide data which is of practical use to fund management.
- Future studies may want to include short sales in their investigations. These were not particularly relevant during the sample period for this study but may prove more important as correlations between markets change over time.

- Future studies could analyse the diversification benefit of other international asset classes such as property, unlisted shares, listed and unlisted bonds.
- Future studies could develop a more efficient international portfolio by developing portfolios of low correlation markets. Instead of using the various market portfolios used here.
- Investment timing could be investigated by considering when funds are typically invested internationally by South African investors. By looking at fund flow (when ZAR is converted to FX) it would be possible to determine if investors are proactive or reactive. To determine whether international portfolio investment decisions are made in response to shocks to the Rand (e.g. firing of finance minister in 2016) or primitively due to possible weakening of the Rand (e.g. South African junk rating).
- Future studies could investigate in detail the various financial institutions and their actual use of international diversification.

6. References

Arif, I., Iqbal, A., Ali, S. F., & Sohail, A. (2017). International Stock Market Diversification among BRICS-P: A Cointegration Analysis. *Journal of Management Sciences*, *4*(2), 269–285. https://doi.org/10.20547/jms.2014.1704208

Asness, C. S., Israelov, R., & Liew, J. M. (2011). International Diversification Works (Eventually). *Financial Analysts Journal*, *67*(3), 24–38. https://doi.org/https://doi.org/10.2469/faj.v67.n3.1

Belousova, J., & Dorfleitner, G. (2012). On the diversification benefits of commodities from the perspective of euro investors. *Journal of Banking and Finance*, *36*(9), 2455–2472. https://doi.org/10.1016/j.jbankfin.2012.05.003

Berben, R.-P., & Jansen, W. J. (2005). Comovement in international equity markets: A sectoral view. *Journal of International Money and Finance*, *24*, 823–857. https://doi.org/10.1016/j.jimonfin.2005.04.001

Bikas, E. (2017). *Yield enhancement and risk management benefits of structured products from the perspective of mean-variance spanning test model*. Thesis. Utrecht University.

Bodie, Z., Kane, A., & Marcus, A. J. (2018a). Optimal risky portfolios. In *Investments* (11th ed., pp. 193–244). New York, United States: McGraw-Hill Education.

Bodie, Z., Kane, A., & Marcus, A. J. (2018b). Risk, return and the historical record. In *Investments* (11th ed., pp. 117–156). New York, United States: McGraw-Hill Education.

Celebuski, M. J., Hill, J. M., & Kilgannon, J. J. (1990). Managing Currency Exposures in International Portfolios. *Financial Analysts Journal*, *46*(1), 16–23. https://doi.org/10.2469/faj.v46.n1.16

Chen, W., Chung, H., Ho, K., & Hsu, T. (2010). Portfolio Optimization Models and Mean–Variance Spanning Tests. In C.-F. Lee & J. Lee (Eds.), *Handbook of Quantitative Finance and Risk Management* (1st ed., pp. 165–185). Berlin, Germany: Springer Science & Business Media. https://doi.org/10.1007/978-0-387-77117-5

Chuluun, T. (2017). Global portfolio investment network and stock market comovement. *Global Finance Journal*, *33*, 51–68. https://doi.org/10.1016/j.gfj.2016.08.002

Coeurdacier, N., & Guibaud, S. (2011). International portfolio diversification is better than

you think. *Journal of International Money and Finance*, *30*(2), 289–308. https://doi.org/10.1016/j.jimonfin.2010.10.003

de Roon, F. A., Nijman, T. E., & Werker, B. J. M. (2001). Testing for mean-variance spanning with short sales constraints and transaction costs: The case of emerging markets. *Journal of Finance*, *56*(2), 721–742. https://doi.org/10.1111/0022-1082.00343

De Santis, G., & Imrohoroğlu, S. (1997). Stock returns and volatility in emerging financial markets. *Journal of International Money and Finance*, *16*(4), 561–579. https://doi.org/10.1016/S0261-5606(97)00020-X

Driessen, J., & Laeven, L. (2007). International portfolio diversification benefits: Cross-country evidence from a local perspective. *Journal of Banking and Finance*, *31*, 1693–1712. https://doi.org/10.1016/j.jbankfin.2006.11.006

Eiling, E., Gerard, B., Hillion, P., & De Roon, F. A. (2012). International portfolio diversification: Currency, industry and country effects revisited. *Journal of International Money and Finance*, *31*(5), 1249–1278. https://doi.org/10.1016/j.jimonfin.2012.01.015

Elton, E., Gruber, M., Brown, S., & Gotzmann, W. (2014). *Modern Portfolio Theory and Investment Analysis* (9th ed.). New York, United States: John Whiley & Sons.

Farrell, G. N., & Todani, K. R. (2006). Capital flows, capital control regulations and foreign exchange policies in South Africa. *South African Journal of Economic History*, *21*(1–2), 84–123. https://doi.org/10.1080/10113430609511193

Federal Reserve Bank of St. Louis. (2020). Federal Reserve Economic Data . Retrieved June 10, 2020, from https://fred.stlouisfed.org/

French, K. R., & Poterba, J. M. (1991). Investor Diversification and International Equity Markets. *Behavioral Finance*, *81*(2), 222–226.

Gidlow, R. M. (2002). The history of exchange controls in South Africa. *South African Journal of Economic History*, *17*, 25–48. https://doi.org/10.1080/10113430209511143

Glabadanidis, P., Obaydin, I., & Zurbruegg, R. (2012). RAFI® replication: Easier done than said? *Journal of Asset Management*, *13*(3), 210–225. https://doi.org/10.1057/jam.2012.7

Goda, T., & Priewe, J. (2020). Determinants of real exchange rate movements in 15 emerging

market economies. *Brazilian Journal of Political Economy*, *40*(2), 214–237. https://doi.org/10.1590/0101-31572020-3072

Grubel, H. G., & Fadner, K. (1971). The Interdependence of International Equity Markets. *The Journal of Finance*, *26*(1), 89–94.

Huberman, G., & Kandel, S. (1987). Mean-Variance Spanning. *The Journal of Finance*, *42*(4), 873. https://doi.org/10.2307/2328296

İlhan, M., Ding, J., & Meriç, G. (2016). Global Portfolio Diversification with Emerging Stock Markets. *Emerging Markets Journal*, *6*(1), 59–62. https://doi.org/10.5195/emaj.2016.88

Inaba, K. I. (2020). *A global look into stock market comovements*. *Review of World Economics* (Vol. 156). Springer Berlin Heidelberg. https://doi.org/10.1007/s10290-019-00370-1

Kan, R., & Zhou, G. (2012). Tests of Mean-Variance Spanning. *Annals of Economics and Finance*, *13*(1), 145–193. https://doi.org/https://dx.doi.org/10.2139/ssrn.231522

Kaplanis, E., & Schaefer, S. M. (1991). Exchange risk and international diversification in bond and equity portfolios. *Journal of Economics and Business*, *43*(4), 287–307. https://doi.org/10.1016/0148-6195(91)90027-T

Karoui, A. (2006). The Correlation between Fx Rate Volatility and Stock Exchange Returns Volatility: An Emerging Markets Overview. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.892086

Kellner, R., & Rösch, D. (2019). A country specific point of view on international diversification. *Journal of International Money and Finance*, *98*, 102064. https://doi.org/10.1016/j.jimonfin.2019.102064

Kodongo, O., & Ojah, K. (2012). A comparative examination of currency risk pricing and market integration in the stock markets of Nigeria and South Africa. *Review of Development Finance*, *2*(3–4), 118–129. https://doi.org/10.1016/j.rdf.2012.09.002

Kodongo, O., & Ojah, K. (2014). Conditional pricing of currency risk in Africa's equity markets. *Emerging Markets Review*, *21*, 133–155. https://doi.org/10.1016/j.ememar.2014.08.005

Levy, H., & Sarnat, M. (1970). International Diversification of Investment Portfolios. *The American Economic Review*, *60*(4), 668–675.

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance*, *7*(1), 77–91. https://doi.org/https://doi.org/10.1111/j.1540-6261.1952.tb01525.x

May, C., & Farrell, G. (2018). Modelling exchange rate volatility dynamics : empirical evidence from South Africa. *Journal for Studies in Economics and Econometrics*, *42*(3), 71–113. https://doi.org/https://doi.org/10.1080/10800379.2018.12097339

McDowell, S. (2018). The benefits of international diversification with weight constraints: A cross-country examination. *Quarterly Review of Economics and Finance*, *69*, 99–109. https://doi.org/10.1016/j.qref.2018.02.003

Meric, I., & Meric, G. (1989). Potential gains from international portfolio diversification and inter-temporal stability and seasonality in international stock market relationships. *Journal of Banking and Finance*, *13*(4–5), 627–640. https://doi.org/10.1016/0378-4266(89)90034-4

Mlambo, C., Maredza, A., & Sibanda, K. (2013). Effects of exchange rate volatility on the stock market: A case study of South Africa. *Mediterranean Journal of Social Sciences*, *4*(14), 561–570. https://doi.org/10.5901/mjss.2013.v4n14p561

Mpofu, T. (2016). *The Determinants of Exchange Rate Volatility in South Africa* (No. 604). Pretoria.

MSCI. (2020a, October 1). End of day index data search. Retrieved December 8, 2020, from https://www.msci.com/end-of-day-data-search

MSCI. (2020b, November 30). MSCI ACWI Index (USD). Retrieved December 7, 2020, from https://www.msci.com/documents/10199/8d97d244-4685-4200-a24c-3e2942e3adeb

MSCI. (2020c, November 30). MSCI Emerging Markets Index (USD). Retrieved December 7, 2020, from https://www.msci.com/documents/10199/c0db0a48-01f2-4ba9-ad01-226fd5678111

MSCI. (2020d, November 30). MSCI South Africa Index (USD) . Retrieved December 7, 2020, from https://www.msci.com/documents/10199/d2021dc7-efe2-4389-981a-

f2e2eb5c25f6

MSCI. (2020e, November 30). MSCI World Index (USD). Retrieved December 7, 2020, from https://www.msci.com/documents/10199/149ed7bc-316e-4b4c-8ea4-43fcb5bd6523

Odei Mensah, J., & Premaratne, G. (2019). Exploring Diversification Benefits in Asian Equity Markets. *The Singapore Economic Review*, *64*(3), 517–542. https://doi.org/10.1142/S0217590816500284

Odier, P., & Solnik, B. (1993). Lessons for International Asset Allocation. *Financial Analysts Journal*, *49*(2), 63–77. https://doi.org/https://doi.org/10.2469/faj.v49.n2.63

RandReview. (2018). South African Exchange Control. Retrieved August 3, 2020, from https://www.randreview.co.za/south-african-exchange-control/

Rubinstein, M. (2002). Markowitz's "Portfolio Selection": A Fifty-Year Retrospective. *The Journal of Finance*, *57*(3), 1041–1045.

Sharpe, W. F. (1966). Mutual Fund Performance. *The Journal of Business*, *39*(1), 119–138.

Shawky, H. A., Kuenzel, R., & Mikhail, A. D. (1997). International portfolio diversification: a synthesis and an update. *The Journal of International Financial Markets, Institutions & Money*, *7*, 303–327. https://doi.org/https://doi.org/10.1016/S1042-4431(97)00025-5

Singh, S. K., & Singh, K. B. (2017). International Portfolio Diversification Strategy: Analysis of Last Decade Strategy. *The Indian Journal of Commerce*, *70*(2), 38–44.

Solnik, B. H. (1974). Why Not Diversify Internationally Rather Than Domestically? *Financial Analysts Journal*, *30*(4), 48–54. https://doi.org/10.2469/faj.v30.n4.48

South African Reserve Bank. Exchange Control Circular No. 37/2010 (2010). Pretoria: National Treasury.

South African Reserve Bank. Exchange Control Circular No. 44/2010 (2010). Pretoria: National Treasury.

South African Reserve Bank. Exchange Control Circular No. 5/2017 (2017). Pretoria: National Treasury.

South African Reserve Bank. Exchange Control Circular No. 6/2017 (2017). Pretoria: National Treasury.

South African Reserve Bank. Exchange Control Circular No. 3/2018 (2018). Pretoria: National Treasury.

South African Reserve Bank. (2020). *Currency and Exchanges guidelines for individuals*. Pretoria: National Treasury.

Steinberg, J. B. (2018). International portfolio diversification and the structure of global production. *Review of Economic Dynamics*, *29*, 195–215. https://doi.org/10.1016/j.red.2018.01.001

Thomas, L. (2017). *Ownership of JSE-listed companies Research Report for National Treasury*. Pretoria: National Treasury.

Viceira, L. M., & Wang, Z. (2018). *Global Portfolio Diversification for Long-Horizon Investors* (No. 24646). Cambridge: National Bureau of Economic Research.

Appendix A: Mean-variance spanning test

The detailed mean-variance spanning test results are given in Table 7 where the P-values are shown. It is also important to note that the residuals of the regressions used in the spanning test were tested and found to be homoscedastic with mean zero as required by the test.

Table 7: Mean-variance spanning test

Year	World index		Developed market index		Emerging market index	
	F1	F2	F1	F2	F1	F2
March 1995	1.33	107.73	1.37	106.15	0.26	22.81
	P - 0.26	P – 0.00	P - 0.26	P – 0.00	P - 0.62	P – 0.00
March 1997	6.86	112.51	6.89	109.70	1.76	36.21
	P - 0.01	P – 0.00	P - 0.01	P – 0.00	P - 0.19	P – 0.00
February 2000	12.04	147.70	12.69	149.37	0.66	26.87
	P - 0.00	P – 0.00	P - 0.00	P – 0.00	P - 0.42	P – 0.00
March 2008	4.06	232.91	4.11	239.28	0.98	47.02
	P - 0.04	P – 0.00	P - 0.04	P – 0.00	P - 0.32	P – 0.00
December 2010	1.24	239.29	1.23	247.34	0.21	48.54
	P - 0.27	P – 0.00	P - 0.2686	P – 0.00	P - 0.65	P – 0.00
March 2015	3.73	278.48	4.06	287.17	0.26	60.31
	P - 0.05	P – 0.00	P - 0.04	P – 0.00	P - 0.61	P – 0.00
March 2018	4.37	309.42	4.67	318.61	0.55	71.83
(Current regulations)	P - 0.0373	P – 0.0000	P - 0.0315	P – 0.0000	P - 0.4582	P – 0.0000

Appendix B: Mean-variance frontiers over time

The mean-variance frontiers of the possible portfolios are given in the figures below. Figure 7 shows the different mean-variance frontiers for combinations of the South African market with World markets. Figure 8 shows the different mean-variance frontiers of combinations of the South African market and Developed markets. Figure 9 shows the different mean-variance frontiers of combinations of the South African market and Emerging markets.

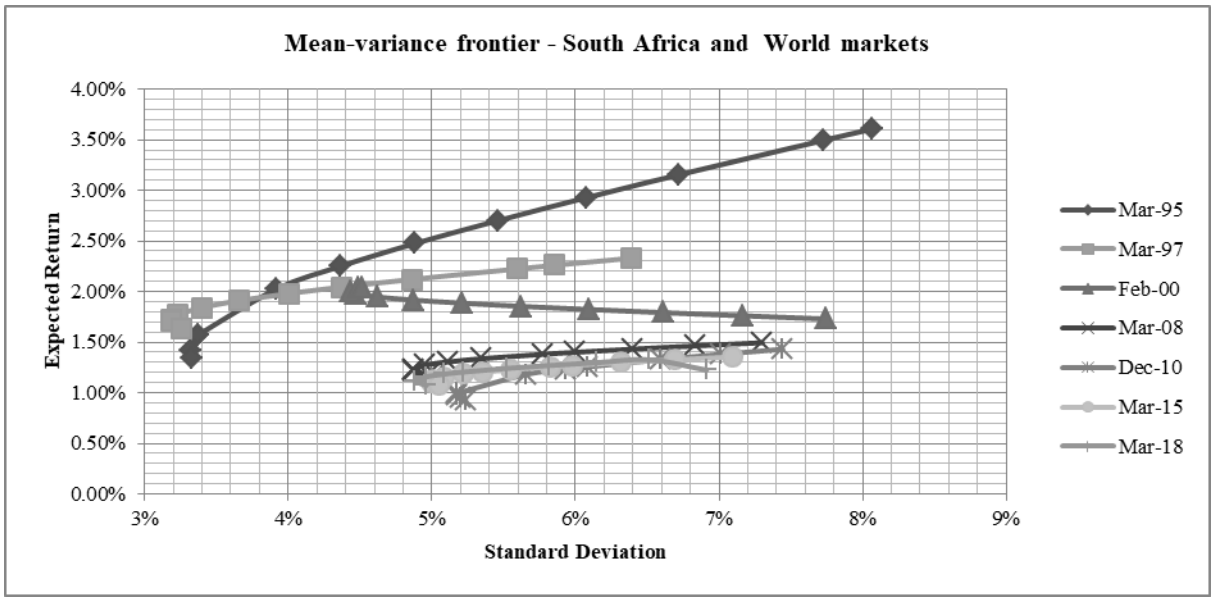

Figure 7: Mean-variance frontier - South Africa and World markets

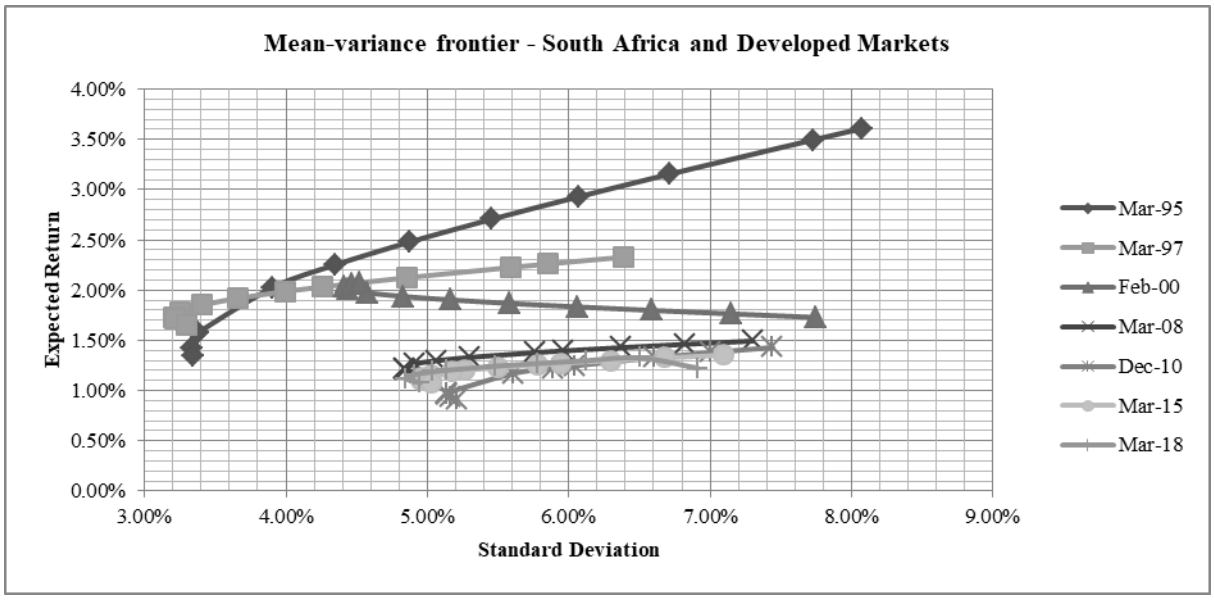

Figure 8: Mean-variance frontier - South Africa and Developed markets

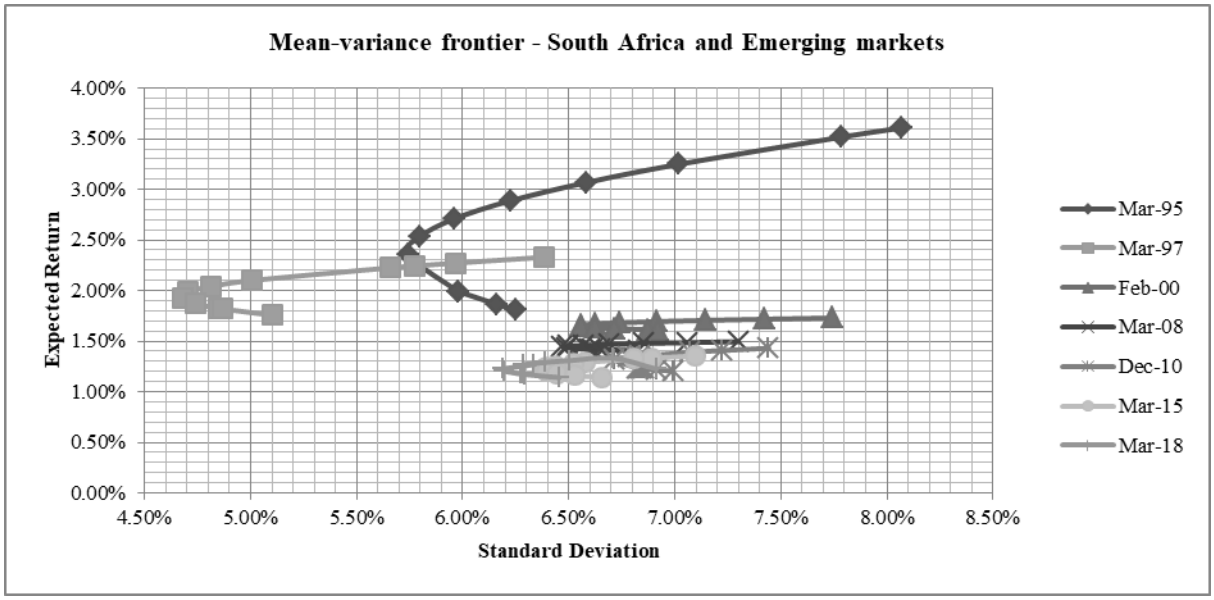

Figure 9: Mean-variance frontier - South Africa and Emerging markets