1. INTRODUCTION

1.1 Background

W Goetzmann, Li & Rouwenhorst (2002) found that the diversification benefits from investing within major equity markets, such as U.S.A, U.K., Germany and France are now lower than they have even been.

The emergence of new equity markets may offer lower correlation than those of more developed markets. The reason being that these emerging equity markets are more "removed" from major markets and hence are not as affected by global movements as are developed markets. Research by Harvey (1995) has shown that many developing countries are not (well) integrated with world capital markets. This would suggest that there are benefits to international portfolio diversification for investors in less developed countries, such as South Africa. Investors could therefore obtain benefits through international diversification by choosing increased weightings in emerging equity markets.

Prior research by Patrick (1996) looked at the benefits of international diversification, from a South African perspective, over the period 1976 to 1994 (19 years). The current research was updated to incorporate the period 1994 to 2003 to see the effect, if any, this period has had on the benefits of international portfolio diversification as previously researched. Tests were undertaken to see whether the expected return and/or the standard deviation of the portfolio has increased or decreased noticeably since the research of Patrick (1996). The proposed project report should provide insight into whether the longer investment period or the rapid globalisation over the last decade has had any noticeable impact on the diversified portfolio return and/or risk.

1.2 Objective

The objective of this Project Report was to update the research by Patrick (1996) to establish empirical evidence of the benefits of international portfolio diversification.

1.3 Importance of the research

The project report provides up-to-date evidence of the benefits of international portfolio diversification from a South African perspective. The report considers the significance of emerging equity markets on these benefits.

The research would be relevant and of importance to individual investors, corporate investors and pension fund managers.

1.4 Limitations

The sample considered in this project report is necessarily restricted and does not include all possible opportunities for international portfolio diversification. The population definition utilised in the project report includes all listed shares in countries, which have a formal equity market in the form of a stock exchange. Therefore non-listed assets and fixed-income securities were excluded from the population, as it was impractical to obtain accurate data on all these assets and securities.

The focus of this project report will be on the risks and returns of international diversification for a South African investor without taking account of foreign currency hedging. The use of various foreign currency strategies may further enhance returns and/or reduce risk.

The effects of various constraints, such as an investors' ability to take short sale positions, were also not considered. Li, Sarkar and Wang (2001) show that the benefits of international diversification remain

substantial for U.S equity investors even when they are prohibited from short selling in emerging markets.

1.5 Structure of the research

Chapter 2 of this report reviews existing literature relevant to the research problem and addresses the second objective listed in Chapter 1.2. Chapter 3 summarises the research proposition, while Chapter 4 describes the appropriate methodology that has been used. The findings of the empirical research have been presented in Chapter 5, 6 and 7 and address the first objective listed in Chapter 1.2. Chapter 8 addresses the interpretation of the results which have been compared and contrasted to other research findings and existing theory. The concluding chapter, Chapter 9, describes important findings and conclusions that have developed from the research.

2. LITERATURE REVIEW

2.1 Risk and risk aversion

There are a number of methods of measuring risk. For the purposes of this research, standard deviation is deemed an appropriate measure.

Investors tend to avoid risk and demand a reward for engaging in risky investments. The reward is taken as a risk premium, which is the difference between the expected rate of return and the alternate return on risk free investments.

Investor portfolios are made up of diverse types of assets and it's important to understand the interaction between the various asset returns when assessing and managing the risk of the portfolio. One way of managing portfolio risk is through diversification whereby investments are made in a variety of diverse assets. By diversifying in a basket of

different assets the overall portfolio risk may be lower than the risk of any component making up the portfolio when considered in isolation.

The portfolio risk is a function of the weighted average of the individual variances plus the covariance between the returns of pairs of shares. Markowitz (1952) demonstrated that the covariance between assets in a portfolio is the most important element in determining the overall risk of the portfolio. The covariance measures how much the returns on two risky assets move in tandem. A positive covariance indicates that the asset returns are moving together while a negative covariance means that they are moving inversely.

The portfolio variance highlights the effect of the covariance on portfolio risk. A positive covariance increases portfolio variance and a negative covariance will reduce portfolio variance. In the case of a well-diversified portfolio, the variance will be equal to the covariance between the stocks.

The correlation coefficient is a simpler statistic to interpret the covariance as is scales the covariance to a value between –1 (perfect negative correlation) and +1 (perfect positive correlation). Portfolios of less than perfectly correlated assets always offer better risk-return opportunities than the individual component assets on their own. The lower the correlation between the assets, the greater the gain in efficiency.

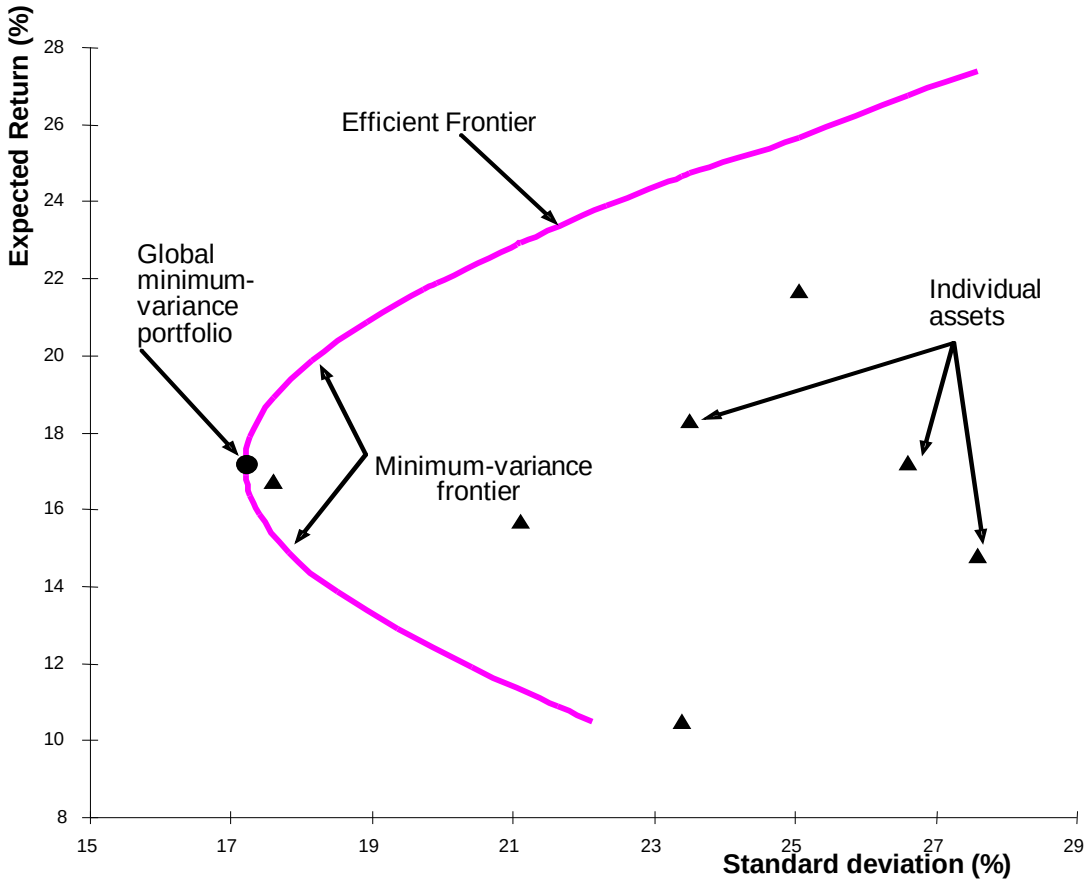
2.2 Portfolio Theory

Portfolio theory involves the determination of the best risk-return opportunities available from feasible investment portfolios and the choice of the best portfolio from the feasible set.

Markowitz (1952) developed the theory of the efficient frontier, which is the curve that encompasses all the best combinations of a number of available assets. The efficient frontier is the set of portfolios that indicates the highest expected return for each given level of risk, or the

minimum risk for each given level of return. Figure 2.1 shows the efficient frontier. The minimum-variance frontier shown on the graph is all the risk return opportunities available to the investor. This frontier is a graph of the lowest possible variance that can be attained for any given portfolio expected return. The part of the frontier that lies above the minimum-variance portfolio is the efficient frontier as they provide the best risk-return combinations. Assuming the investor is a mean-variance optimiser, then any portfolio below the minimum-variance portfolio is not optimal as there is a portfolio with the same standard deviation and a greater expected return positioned directly above it.

Figure 2.1 : The Efficient Frontier Of Risky Assets



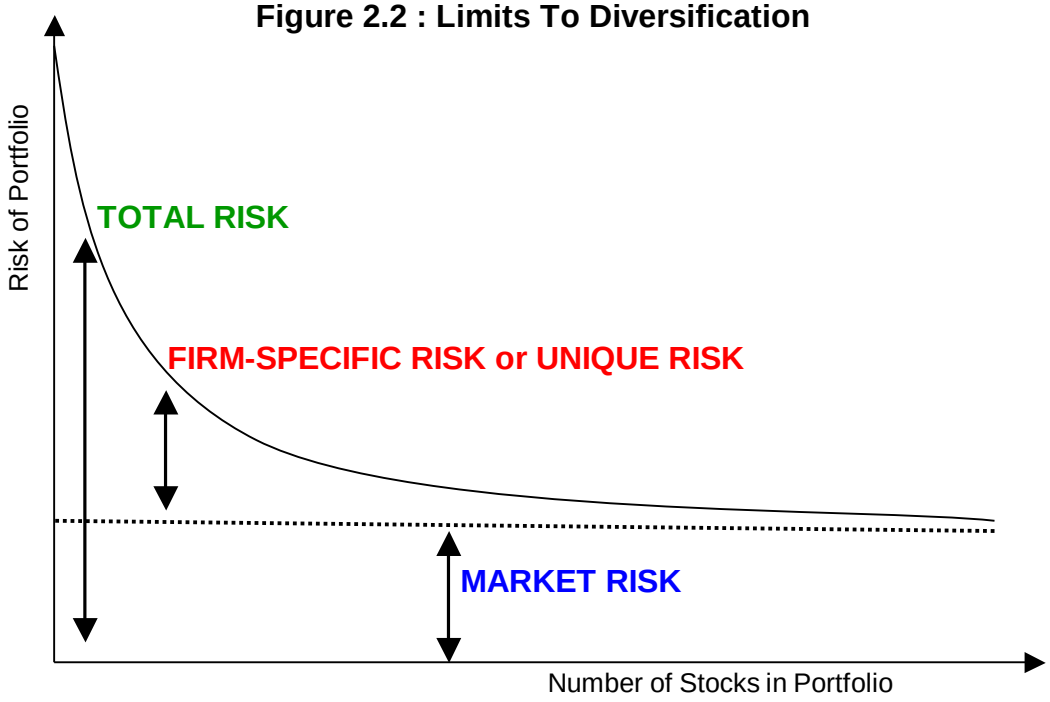
2.3 International Diversification

From the concept of portfolio theory as described in Chapter 2.2 it follows that global diversification offers opportunities for risk reduction and/or improved rates of return. By adding to a portfolio, assets that are not perfectly correlated, will improve the reward-to-volatility ratio and have similar returns.

The sequential addition of shares to a portfolio decreases the portfolio risk because the shares that experience less-than-expected returns will be offset to some degree by shares whose returns are greater than expected (Brigham & Gapenski, 1994). Initially, the portfolio variance decreases rapidly as the number of the securities increases, but the benefits diminish as the number of securities becomes large. Statman (1987) found that the bulk of variance reduction is achieved when the number of shares in a portfolio reaches 30.

The reason for the diminishing benefits is explained through the concept of total risk being made up of market risk and unique risk. Unique risks are risks faced by an individual company that are peculiar to its activity, its management, etc. These risks can be eliminated by diversification. The risk that remains even after extensive diversification is called market risk, risk that is attributable to market-wide risk sources. These market-wide risk sources such as business cycles and other common macroeconomic factors affect all companies and cannot be eliminated through diversification. Figure 2.2 illustrates the concept.

Figure 2.2 : Limits To Diversification



Increasing globalisation is one avenue of achieving international diversification. As companies adopt global investment and marketing strategies, they diversify their geographic source of income (Patrick, 1996). Investors who own shares in these multinational companies are effectively diversifying their portfolios internationally. The alternate to this indirect form of diversification is to purchase the assets of individual companies operating in various countries.

It should be borne in mind that international diversification does bring certain problems not encountered in domestic markets. Among these are exchange rate risks, political risk, government regulatory issues, differing accounting practices and restrictions on capital flows across international borders.

2.4 Empirical Studies Of International Diversification (South African Perspective)

From a South African perspective there is empirical evidence on the benefits of international diversification.

A study done by Bhana (1987), using an ex-ante “buy-the-market” strategy, found that an international portfolio of securities produced slightly higher annual returns on average than the portfolio comprising only South African securities. Furthermore, the international portfolio had a substantially lower risk over the period. This lead to the international portfolio having a standardised (risk adjusted) return of three times that of the South African portfolio.

This study was further supported by work done by Patrick (1996) where both ex-ante investment strategies and efficient portfolios based on ex-post data were examined. The study found that South African investors would historically have benefited from international portfolio diversification. Low correlation between the returns of world equity markets, and in particular between South African market returns and those of other markets were expected to continue.

Research undertaken by Wetton (2000) considered whether it was possible for a South African investor to increase returns and /or reduce risk by diversification on a country basis. This research found that, except for Sweden, portfolio diversification on a country basis did not provide opportunities for significant risk reduction or return maximisation. However, the sample chosen in the research only focused on a narrow six-year period and consequently the resilience and applicability of the conclusions reached are diminished. Furthermore the conclusions reached are contrary to work done by Errunza (1994) who found country selection to be the most important aspect of investing in emerging, as well as many developed markets.

Further South African research by Goldman (1999) used the Capital Asset Pricing Model to classify countries in a way that could aid investors in country allocation decisions. The research found that most emerging markets had low R^2 values while a positive relationship between returns and R^2 was shown. This suggested that investors should be

concentrating in developed markets with low correlations with the world market. Emerging markets with low correlations were also found to be effective in diversifying portfolios but there was little benefit in investing in emerging countries with high correlations.

2.5 Empirical Studies Of International Diversification (International Perspective

There is considerable academic research that documents the benefits of international diversification.

Grubel (1968) analysed the monthly rates of return (adjusted for changes in exchange rates) for eleven major countries between 1959 and 1966, and found that U.S. investors could have achieved better risk and return opportunities by investing part of their portfolio in foreign equity markets. Grubel found that the correlations between countries were less than one and sometimes negative for the period under review.

A study by Levy and Sarnat (1970) provided further empirical evidence supporting international diversification, particularly when diversifying portfolios through investment in developing countries. They found optimum portfolios that included high proportions of investments in countries like Japan, Mexico, New Zealand, South Africa and Venezuela.

Solnik (1974) analysed the difference between domestic diversification and international diversification as well as the impact of the number of securities held in an efficient portfolio. Solnik found that internationally diversified portfolios of more than thirty securities had half the risk of a well-diversified portfolio made up of only U.S.A securities.

2.6 Proponents Against International Portfolio Diversification

Despite the empirical research presented above, there appears to be little evidence of investors and fund managers actually applying international diversification strategies. A study by French and Poterba (1991) found that domestic share ownership was equivalent to 92% in

the USA and 96% in Japan as at December 1989. Wiandt (2000) reported at the end of 1999 that USA based mutual funds only invested 8.5% of their mutual fund total in international funds which comprise 51% of global capitalisation. This home-country bias continues to exist albeit that the obstacles to international investment, such as the costs of investing in a number of markets, securities taxes and capital controls, have been decreasing over the last decade.

The increasing globalisation of world capital markets could be a possible explanation for this home-country bias. When corporations adopt globalisation, they diversify their geographic source of income. Investors in these corporations are effectively diversifying their portfolios internationally without directly investing offshore. Other possible explanations offered by French & Poterba (1991) include exchange controls, penal taxation implications and transaction costs. Another possible explanation for this home-country bias is that the diversification benefits do not exist in practice because of the difficulty of taking short positions in many non-U.S. equity markets (Li, Sarkar and Wang, 2001). Therefore, it is important to understand whether investing primarily at home is optimal when market frictions such as short-sale constraints are taken into account.

It's plausible that greater globalisation will potentially reduce the benefits to be derived from international portfolio diversification. The benefits to international diversification have been diminished through increased international trade and the ability for communication to span the globe through ever increasing technological advancements.

2.7 Emerging Markets – The Current Debate

Recent developments in international investments have highlighted the benefits of increased investment in so-called "emerging markets". The term "emerging markets" was originally coined by the IFC to describe a fairly narrow list of middle-to-higher income economies among the developing countries, with stock markets in which foreigners could buy

securities. The term's meaning has since been expanded to include more or less all developing countries. Developing countries are classified by the World Bank as those with a Gross National Income per capita of $9265 or less.

The Standard and Poor website states that emerging markets are home to over 85% of the world's population, 75% of the world's national resources and account for nearly 25% of the world's Gross Domestic Product. Furthermore, their economies are growing at two to three times that of the G7 countries.

The case for investment in emerging markets is currently strong. Interest rates are falling globally, abandonment of fixed exchange rate regimes, domestic economic growth, strong Foreign Direct Investment, strong local currencies, improved standards of corporate governance and attractive levels of valuations are just a few of the arguments for increased investment in emerging markets.

A classic argument in favour of emerging markets has been diversification; however, the diversification benefits of emerging markets have shrunk in recent years. A study by Spiedell (2002) found that the three-year correlation of the Emerging Market Free Index (EMF) with the Standard and Poor 500 had risen from a low of 0.30 to 0.73.

Errunza (1994) noted the benefits of using emerging markets for international diversification purposes. Errunza found that the correlations between emerging markets and global portfolios remained, by and large, very low and at times negative. This despite the apparent increasing integration of emerging markets in the world economy.

Goldman (1999) found that the R^2 values of developed countries were significantly greater that the R^2 values of emerging countries. This indicates that emerging markets exhibit less co-movement with the world

market than developed markets do and therefore still offer good opportunities for international diversification.

However, there are still critics of increased investment in emerging markets. The negative results of the 1995 Latin America Tequila Crisis, the 1997 Asian Contagion, the 1998 Russian Crisis, the 1999 Brazil Crisis and the 2000 Argentina and Turkey Crisis still weigh heavy on investors minds.

2.8 Reliability and Validity of Time Series Data

Two common concerns regarding the reliability and validity of time series data are volatility contagion and inter-temporal stability.

Solnik (1996) found that the correlation between the local and foreign portfolio rates of return could be influenced by volatility contagion where increased (decreased) volatility in one market may lead to increased (decreased) volatility in another market. Therefore where it is expected that the contribution of a market may decrease overall portfolio volatility, the opposite may apply where volatility contagion actually causes increased portfolio volatility.

Research undertaken by Barber (2000) investigated the inter-temporal stability of correlation between the South African market and other markets. Inter-temporal stability relates to the movement of a particular variable or statistic through time. This was relevant because if correlation increased in periods of high volatility then it could indicate that the benefits from international diversification might be diminished. The research found that through time, the correlation between the South African market and other markets was not stationary. Contrary to the findings of Solnik (1996), the study found that the markets did not always become more synchronised when one market, or both, became more volatile. This could be good news for South African investors, as not only does South Africa have generally lower levels of correlation with other markets, but it also serves as a better hedge during volatile periods.

2.9 Conclusion

Strong theoretical arguments and empirical evidence, from a South African and an international perspective, exist for the benefits of international portfolio diversification.

The current research has been updated to incorporate the period 1994 to 2003 to see the effect, if any, this period has had on the benefits of international portfolio diversification as previously researched.

3. RESEARCH QUESTION

The following research questions have been distilled from a review of the literature:

Research Question 1:
South African investors could have benefited from international portfolio diversification, either by means of higher returns or lower levels of risk, or both, over the period 1976 to 2003, using an *ex-ante* investment strategy.

Research Question 2:
South African investors could have benefited from international portfolio diversification, either by means of higher returns or lower levels of risk, or both, over the period 1976 to 2003, using an *ex-post* investment strategy.

4. RESEARCH METHODOLOGY

4.1 Approach

To address Research Question 1, regarding the ex-ante benefits of international diversification, a naïve "buy-the-market" approach to ex-ante investment has been used.

An *ex-ante* investment strategy avoids the influence of historical events. A portfolio is constructed with a pre-determined approach, such as "buy-the-market" or naïve diversification.

A Mann-Whitney test was performed on the annual data from 1976 to 2003 to determine whether the standardised return of the various combinations differed significantly from the standardised returns of the three South African comparative portfolios at the 5% level. The null hypothesis used was that the two respective standardised returns were equal. The results were then compared to the previous research done by Patrick (1996).

To address Research Question 2, regarding the ex-post benefits of international diversification, the risk-reward optimisation principle of Markowitz (1952) was used to construct efficient international portfolios. The objective was to determine those portfolios of securities from different countries, which generated either the highest possible return for a given level of risk or the lowest possible risk for a given level of return. The return was obtained by calculating movements (monthly and annual) in the period-end values of the equity market indices. The risk was obtained by calculating the standard deviation of the period returns.

An *ex-post* investment strategy identifies the optimum international portfolio by analysing historical expected returns, variances and covariances. The use of past data to construct future internationally diversified portfolios contains estimation risk due to the uncertainty inherent in these parameter values. However Jorion (1985)

demonstrated that the estimation risk inherent in using *ex-post* data to illustrate *ex-ante* advantages of international diversification did not have a considerable impact on optimal portfolio selection.

A Mann-Whitney test was performed on the monthly data and the annual data from 1976 to 2003. The test was used to determine whether the standardised return of the minimum variance portfolio differed significantly from the standardised returns of the three South African comparative portfolios at a 5% significance level. The Mann-Whitney test provides evidence to either support or refute the observation that meaningful benefits have been derived from international portfolio diversification over the period of the research. The results were then compared to the previous research done by Patrick (1996) on data from 1976 to 1994 to see whether the benefits of international diversification for South African investors were diminishing as proposed in the preceding literature review.

The significance level is the chance of a Type 1 error occurring. That is the chance of concluding there is a relationship when there is not. Convention in the social sciences dictates the use of a 1% or 5% significance level. A 5% significance level was chosen as it was thought a 1% significance level was too stringent and would increase the chance of Type 2 errors. Type 2 errors are accepting a false null hypothesis. That is thinking you do not have a relationship when in fact you do.

The standardised return was developed by Bhana (1987) and is a simplified form of the Sharpe measure of portfolio performance. The standardised return has been used due to the difficulties in comparing the returns on various international portfolios, as the returns were generally measured at two different risk levels.

The prior research undertaken by Patrick (1996) made use of a Z test on the monthly data. It was felt that a Mann-Whitney test would be more appropriate for the project report as the assumption of normal

distribution, as required for a Z test, was questionable. Research undertaken by Harvey (1995) had found leptokurtosis in macroeconomic time series. This high kurtosis results in increased importance of "supposed" outliers and puts the assumption of normal distribution into question. The Mann-Whitney test does not require the assumption of normal distribution and hence was utilised over the Z test.

The three South African comparative portfolios that will be used as a "yardstick" to determine whether international portfolio diversification would have benefited a South African investor are:

i) a portfolio invested in the JSE All Gold Index ;
ii) a portfolio invested in the JSE Financial and Industrial Index ; and,
iii) a portfolio invested 30% in the JSE All Gold Index and 70% in the JSE Financial and Industrial Index. These proportions were taken to be representative of the portfolios of institutional investors in South Africa (Patrick, 1996).

4.2 The Research Population

The population was taken to be all countries which have a formal equity market and where there is an established market index representing relative price changes in that market.

Sharpe's (1964) definition of the market portfolio theoretically includes all risky assets. The population definition utilised in the project report includes all listed shares in countries, which have a formal equity market in the form of a stock exchange. Therefore non-listed assets and fixed-income securities were excluded from the population, as it was impractical to obtain accurate data on all these assets and securities.

4.3 Sample Selection

The selection of countries for the sample was obtained from the MSCI and IFC data series. The selection of countries was based on satisfying the following criteria:

- available data on returns and standard deviations of returns over a minimum twenty-year period.
- acceptable level of past political stability

Two segments of the JSE were included in the sample, the SA All Gold Index and the SA Financial and Industrial Index. The JSE was segmented into these two categories based on previous research by Gilbertson and Goldberg (1981) and Ward (1994) which demonstrated that the JSE is a segmented market. These two segments of the JSE have been used as the "yardstick" to determine whether a South African investor would have benefited from international portfolio diversification.

4.4 Data Collection

The following data is to be collected from the MSCI and IFC data series for the period 1974 to 2003:

- month-end value of the equity market indices
- month-end spot exchange rate between the SA Rand and the US dollar
- monthly dividends, adjusted for withholding tax, of the equity market indices.

The MSCI and IFC data series were used as they were both calculated similarly including monthly dividends, adjusted for withholding tax. These data series were used so as to facilitate the most accurate possible calculation of returns from foreign investments.

The SA Rand is not traded extensively on foreign currency markets and hence data was not available to convert the domestic currency returns

into SA Rand returns. To overcome this problem, the US dollar denominated MSCI and IFC data series were converted to SA Rand terms using the US Dollar / SA Rand exchange rate.

This should not be considered a limitation as any difference between the exchange rate of the local currency to the US Dollar, and of the US Dollar to the SA Rand, relative to the direct exchange rate of the local currency to the SA Rand would represent an arbitrage opportunity and is likely to be traded away fairly quickly. Furthermore, prior research by Bhana (1986), Jorion (1989) and Patrick (1996) has shown a low correlation between stock returns and exchange rates. Solnik (1996) argues that even though the impact of currency returns on the investment may exceed the capital gain in the short run, in the long run, currency fluctuation has never been a major component of total return on a diversified stock portfolio.

4.5 Data Analysis

The data collected in Chapter 4.4 was utilized to obtain the following monthly returns:

Rate of return for the period = $$\left(\frac{P_1 + D_1}{P_0} * \frac{ER_1}{ER_0}\right) - 1$$

Where : D_1 = Dividend for the period

P_0 = Index value at beginning of the period

P_1 = Index value at end of the period

ER_0 = Exchange rate between US Dollar and SA Rand at beginning of the period

ER_1 = Exchange rate between US Dollar and SA Rand at end of the period.

Comparison of returns at two different risk levels requires the returns to be standardised to account for the different risk levels in comparing returns on the various international portfolios. The measure used was developed by Bhana (1987) and is a simplified form of the Sharpe measure of portfolio performance:

$$\text{Standardised return of portfolio a} = \frac{\overline{R_{a,t}}}{\sigma_a}$$

where the bar denotes the arithmetic average of the expression below it, and:

$R_{a,t}$ = Actual return on portfolio a during period t

σ_a = Standard deviation of the return of portfolio a

A Mann-Whitney test at the 5% level was used to determine significant differences in average standardised returns.

The various combinations of inter-country correlation coefficients were also calculated and tested to determine if they were significantly different, at the 5% level, from one. One indicates perfect correlation, and a less than perfect correlation between two equity markets would indicate potential benefits from international portfolio diversification as a movement in one equity market would be fully or partially offset by an opposite movement in another equity market.

Correlation coefficients were tested to determine if they were significantly different from one (1), at the 5% level. Tests were also performed to determine if correlation coefficients based on monthly returns differed significantly from those based on annual returns at the 5% level. The

Fisher r-to-z Transformation was used to conduct these tests. The Fisher r-to-z Transformation converts Pearson's r's to the normally distributed variable z which can be applied to assess the significance of the difference between the observed correlation coefficient and the correlation hypothesized to exist within the population of bi-variable values from which the sample is randomly drawn. The formula for the transformation is:

$$Z = 0.5[\ln(1+r)-\ln(1-r)]$$

Where: $\ln$ = Natural logarithm

r = Sample estimate

5. PRELIMINARY INDICATION OF THE POSSIBLE BENEFITS OF INTERNATIONAL DIVERSIFICATION

5.1 Descriptive Statistics

The mean monthly return and standard deviation of return was calculated for each of the 27 countries for the period January 1976 to December 2003 (28 years). Table 5.1 summarises the calculations and compares the results with the prior research from January 1976 to December 1994.

TABLE 5.1 : DESCRIPTIVE STATISTICS - MONTHLY RAND RETURN				
COUNTRY	CURRENT RESEARCH (1976 TO 2003)		PATRICK RESEARCH (1976 TO 1994)	
	MEAN	STANDARD DEV.	MEAN	STANDARD DEV.
SA All Gold Index	1.71%	10.45%	2.06%	10.30%
SA Financial & Industrial Index	1.64%	5.81%	2.09%	5.35%
Australia	1.70%	7.35%	1.85%	7.94%
Austria	1.53%	6.73%	1.75%	7.06%
Belgium	1.79%	6.47%	2.03%	6.42%
Canada	1.62%	6.54%	1.56%	6.50%
Denmark	1.70%	6.05%	1.70%	5.86%
France	1.80%	7.26%	1.91%	7.52%
Germany	1.67%	7.10%	1.78%	6.87%
Hong Kong	2.25%	9.69%	2.68%	10.07%
Italy	1.72%	8.21%	1.79%	8.52%
Japan	1.63%	7.07%	2.19%	7.18%
Netherlands	1.90%	6.12%	2.11%	5.83%
Norway	1.75%	8.27%	1.97%	8.69%
Singapore	1.73%	8.38%	2.19%	8.31%
Spain	1.54%	7.45%	1.31%	7.57%
Sweden	2.05%	7.98%	2.12%	7.62%
Switzerland	1.77%	6.11%	1.84%	6.04%
United Kingdom	1.84%	6.50%	2.03%	6.90%
United States	1.70%	5.78%	1.71%	5.66%
Argentina	4.33%	25.50%	6.03%	29.75%
Brazil	2.09%	16.25%	3.03%	17.87%
Chile	2.45%	10.43%	3.75%	11.65%
Greece	1.27%	11.14%	1.32%	10.36%
India	1.74%	8.60%	2.31%	8.35%
Korea	1.85%	11.87%	2.48%	10.06%
Mexico	2.19%	12.40%	3.01%	13.44%
Thailand	1.59%	10.47%	2.66%	8.49%

It is apparent from Table 5.1 that the longer 28-year period still has a dispersion of returns amongst the various countries and differences in risk, as measured by the standard deviation of returns. Hence there appears to be intuitive justification for international portfolio diversification. However, comparison of the two periods shows a slightly

lower mean return for the developed countries (i.e. Australia though to United States) than seen in the earlier research. In particular, some of the larger developed countries, such as United Kingdom, Japan and Hong Kong have had fairly large decreases in their mean returns. This could provide intuitive support for the proposition that the benefits of international diversification have been diminishing over the last decade. As the global economy becomes more integrated, there are fewer opportunities to reduce risk by diversifying overseas as the correlation coefficients between these developed countries become draw closer to 1 (perfect correlation).

Analysing the emerging markets (i.e. Argentina through to Thailand) it can be seen that they have relatively high mean returns when compared to the developed countries. However they also had relatively high standard deviation of returns indicating a different risk-return profile to the developed countries. Comparison of the emerging markets for the two periods showed that the average mean return had decreased from 3.07% to 2.19% while the average standard deviation had also decreased from 13.75% to 13.34%. Again this could provide intuitive support for the proposition that the benefits of international diversification have been diminishing over time.

Each of the pairs of mean monthly returns (19 year and 28 year periods) were tested for a significant difference between the mean returns, using a Mann Whitney test, at a 5% significance level. The test concluded that the 2 periods were significantly different at a 5% significance level. The rejection of the null hypothesis indicated that the mean monthly returns from the Patrick research (19 year period) were superior to the mean monthly returns of the current research (28 year period). This could provide intuitive support to the literature review that the expected return of the portfolio had decreased noticeably since the research of Patrick (1996).

Each of the pairs of standard deviations of monthly returns (19 year and 28 year periods) were tested for a significant difference between the standard deviations of monthly returns, using a Mann-Whitney test, at a significance level of 5%. None of the differences were found to be statistically different at the 5% level.

The mean return and standard deviation of returns were also calculated in respect of the compound annual returns on the various MSCI and IFC equity indices. Table 5.2 summarises the calculations for the period 1976 to 2003. The comparative values from Patrick's (1996) study, for the period 1976 to 1994, are also shown.

Each of the pairs of mean annual returns (19 year and 28 year periods) were tested for a significant difference between the mean returns, using a Mann Whitney test, at a significance level of 5%. The test concluded that the 2 periods were significantly different at a 5% significance level. The rejection of the null hypothesis indicated that the mean annual returns from the Patrick research (19 year period) were superior to the mean annual returns of the current research (28 year period).

Each of the pairs of standard deviations of annual returns (19 year and 28 year returns) were tested for a significant difference between the standard deviations of annual returns, using a Mann-Whitney test, at a significance level of 5%. None of the differences were found to be statistically different at the 5% level.

TABLE 5.2 : DESCRIPTIVE STATISTICS - ANNUAL RAND RETURNS				
COUNTRY	CURRENT RESEARCH (1976 TO 2003)		PATRICK RESEARCH (1976 TO 1994)	
	MEAN	STANDARD DEV.	MEAN	STANDARD DEV.
SA All Gold Index	21.15%	44.27%	29.83%	55.66%
SA Financial & Industrial Index	18.17%	19.46%	27.32%	18.65%
Australia	21.47%	27.86%	22.90%	28.79%
Austria	24.24%	58.96%	29.60%	70.22%
Belgium	26.16%	39.63%	29.37%	40.40%
Canada	20.79%	24.25%	19.30%	21.92%
Denmark	24.60%	36.34%	25.47%	40.78%
France	25.87%	40.02%	27.55%	44.01%
Germany	25.26%	48.58%	27.87%	55.65%
Hong Kong	31.33%	46.89%	37.75%	50.72%
Italy	25.51%	50.83%	27.70%	58.12%
Japan	22.66%	34.39%	30.42%	34.29%
Netherlands	26.11%	30.73%	28.94%	31.24%
Norway	26.31%	49.75%	30.95%	57.03%
Singapore	21.78%	32.51%	27.06%	26.77%
Spain	23.06%	42.33%	20.23%	45.21%
Sweden	28.64%	38.28%	29.30%	38.07%
Switzerland	25.35%	39.64%	26.91%	44.49%
United Kingdom	24.48%	28.31%	26.44%	28.60%
United States	23.23%	27.15%	22.52%	24.99%
Argentina	59.13%	131.28%	84.73%	155.46%
Brazil	28.26%	68.45%	44.14%	84.01%
Chile	34.20%	45.61%	55.11%	52.80%
Greece	25.59%	82.92%	18.48%	46.97%
India	23.62%	42.26%	32.06%	45.43%
Korea	29.41%	61.19%	35.77%	50.23%
Mexico	31.27%	55.96%	43.32%	62.53%
Thailand	24.98%	49.85%	39.19%	48.13%

5.2 Effects Of Currency Movements

Table 5.3 summarises the movement of the Rand exchange rate (commercial) relative to the US Dollar and the UK Pound Sterling over various time periods.

TABLE 5.3: ANNUAL CURRENCY MOVEMENTS		
PERIOD	RAND / UK STERLING	RAND / US DOLLAR
1976 TO 1994		
Mean currency movement	7.70%	9.01%
Standard Deviation	19.81%	18.21%
1976 TO 2003		
Mean currency movement	8.84%	9.36%
Standard Deviation	21.45%	20.76%
1994 TO 2003		
Mean currency movement	11.06%	9.52%
Standard Deviation	23.37%	25.14%

It is evident that the South African Rand was depreciating to both the US Dollar and the UK Pound. The Rand depreciation to both currencies has been increasing over recent years. The Rand / US Dollar depreciated 9.01% during the period of Patrick's (1996) study while it has depreciated by 9.52% in the last 9 years from 1994 to 2003. The Rand / UK Sterling depreciated 7.70% during the period of Patrick's (1996) study while it has depreciated by 11.06% in the last 9 years from 1994 to 2003. Furthermore the exchange rate volatility has increased as evidenced by the increasing standard deviation of annual currency movements. The depreciating Rand to foreign currencies enhances the benefits of

international diversification for South African investors as the foreign currency returns result in higher Rand returns.

Table 5.4 represents the effect of currency movements, from the perspective of a South African investor, on the mean monthly returns, which was taken to be the difference between the mean monthly returns in South African terms, and the mean monthly returns measured in local currency terms.

TABLE 5.4 : THE EFFECT OF CURRENCY MOVEMENTS ON MEAN RETURNS (MONTHLY)

COUNTRY	Mean (Rands)	Mean (Local)	Currency Effect	Patrick's prior Research (1976 to 1994)
Australia	1.70%	1.11%	0.58%	0.55%
Austria	1.53%	0.71%	0.82%	0.92%
Belgium	1.79%	1.04%	0.75%	0.86%
Canada	1.62%	1.00%	0.63%	0.57%
Denmark	1.70%	1.03%	0.67%	0.67%
France	1.80%	1.17%	0.64%	0.64%
Germany	1.67%	0.83%	0.84%	0.95%
Hong Kong	2.25%	1.70%	0.55%	0.53%
Italy	1.72%	1.28%	0.44%	0.32%
Japan	1.63%	0.60%	1.03%	1.23%
Netherlands	1.90%	1.11%	0.79%	0.87%
Norway	1.75%	1.12%	0.63%	0.61%
Singapore	1.73%	0.92%	0.81%	0.94%
Spain	1.54%	1.10%	0.44%	0.36%
Sweden	2.05%	1.52%	0.53%	0.46%
Switzerland	1.77%	0.86%	0.91%	1.01%
United Kingdom	1.84%	1.19%	0.66%	0.60%
United States	1.70%	1.02%	0.68%	0.69%

Each of the pairs of mean monthly returns (19 year and 28 year periods) were tested for a significant difference between the mean returns, using

a Mann-Whitney test, at a significance level of 5%. None of the differences were found to be statistically different at the 5% level.

Table 5.5 represents the effect of currency movements, from the perspective of a South African investor, on the standard deviation of monthly returns, which was taken to be the difference between the standard deviation of monthly returns in South African terms, and the standard deviation of monthly returns measured in local currency terms.

TABLE 5.5 : THE EFFECT OF CURRENCY MOVEMENTS ON STANDARD DEVIATIONS OF RETURNS (MONTHLY)

COUNTRY	Std. Dev. (Rands)	Std. Dev. (Local)	Currency Effect	Patrick's prior Research (1976 to 1994)
Australia	7.35%	5.44%	1.91%	1.81%
Austria	6.73%	5.82%	0.91%	0.95%
Belgium	6.47%	5.14%	1.34%	1.34%
Canada	6.54%	4.97%	1.57%	1.56%
Denmark	6.05%	5.23%	0.82%	0.87%
France	7.26%	6.13%	1.13%	1.30%
Germany	7.10%	5.92%	1.18%	1.68%
Hong Kong	9.69%	8.93%	0.76%	0.96%
Italy	8.21%	7.32%	0.90%	0.98%
Japan	7.07%	5.26%	1.81%	1.85%
Netherlands	6.12%	5.18%	0.94%	1.08%
Norway	8.27%	7.24%	1.03%	1.01%
Singapore	8.38%	7.29%	1.09%	1.04%
Spain	7.45%	6.43%	1.02%	1.28%
Sweden	7.98%	7.16%	0.82%	0.77%
Switzerland	6.11%	4.72%	1.40%	1.60%
United Kingdom	6.50%	5.03%	1.47%	1.50%
United States	5.78%	4.41%	1.37%	1.41%

Each of the pairs of standard deviations of monthly returns (19 year and 28 year periods) were tested for a significant difference between the standard deviations of returns, using a Mann-Whitney test, at a

significance level of 5%. None of the differences were found to be statistically different at the 5% level.

Similar descriptive statistics to those in Table 5.4 and 5.5 were calculated in respect of compound annual returns, for comparison with Patrick's (1996) study. These are summarised in Table 5.6 and 5.7.

TABLE 5.6 : THE EFFECT OF CURRENCY MOVEMENTS ON MEAN RETURNS (ANNUAL)

COUNTRY	Mean (Rands)	Mean (Local)	Currency Effect	Patrick's prior Research (1976 to 1994)
Australia	21.47%	14.06%	7.41%	6.13%
Austria	24.24%	9.62%	14.62%	17.60%
Belgium	26.16%	13.88%	12.28%	13.82%
Canada	20.79%	12.17%	8.62%	7.37%
Denmark	24.60%	14.96%	9.64%	9.84%
France	25.87%	15.61%	10.25%	10.51%
Germany	25.26%	11.55%	13.71%	16.14%
Hong Kong	31.33%	22.13%	9.21%	9.15%
Italy	25.51%	17.60%	7.91%	6.93%
Japan	22.66%	7.95%	14.72%	18.08%
Netherlands	26.11%	14.16%	11.96%	13.25%
Norway	26.31%	16.63%	9.68%	10.38%
Singapore	21.78%	11.99%	9.79%	11.57%
Spain	23.06%	14.98%	8.08%	6.89%
Sweden	28.64%	20.93%	7.71%	6.82%
Switzerland	25.35%	11.57%	13.78%	15.84%
United Kingdom	24.48%	14.56%	9.93%	9.04%
United States	23.23%	12.89%	10.35%	10.15%

Each of the pairs of mean annual returns (19 year and 28 year periods) were tested for a significant difference between the mean returns, using a Mann-Whitney test, at a significance level of 5%. None of the differences were found to be statistically different at the 5% level.

TABLE 5.7 : THE EFFECT OF CURRENCY MOVEMENTS ON STANDARD DEVIATIONS OF RETURNS (ANNUAL)				
COUNTRY	Std. Dev. (Rands)	Std. Dev. (Local)	Currency Effect	Patrick's prior Research (1976 to 1994)
Australia	27.86%	21.92%	5.94%	2.88%
Austria	58.96%	30.06%	28.90%	34.83%
Belgium	39.63%	24.03%	15.60%	16.30%
Canada	24.25%	16.84%	7.42%	6.22%
Denmark	36.34%	30.65%	5.69%	7.21%
France	40.02%	27.07%	12.95%	16.09%
Germany	48.58%	27.79%	20.79%	28.05%
Hong Kong	46.89%	37.61%	9.28%	11.04%
Italy	50.83%	35.02%	15.81%	19.43%
Japan	34.39%	22.15%	12.25%	13.23%
Netherlands	30.73%	20.41%	10.32%	12.77%
Norway	49.75%	43.37%	6.38%	7.58%
Singapore	32.51%	31.67%	0.84%	-0.43%
Spain	42.33%	29.91%	12.41%	13.64%
Sweden	38.28%	33.21%	5.07%	6.87%
Switzerland	39.64%	22.89%	16.75%	21.67%
United Kingdom	28.31%	15.37%	12.94%	14.70%
United States	27.15%	16.34%	10.81%	12.35%

Each of the pairs of standard deviations of annual returns (19 year and 28 year periods) were tested for a significant difference between the standard deviations of returns, using a Mann-Whitney test, at a significance level of 5%. None of the differences were found to be statistically different at the 5% level.

5.3 Correlation Coefficients

Appendix 1 details the correlation coefficients of the monthly returns of each pair of equity markets considered in the research. Appendix 1 indicates a marked increase in the correlation coefficients when compared to the prior research of Patrick (1996). In the prior research of Patrick (1996) the average correlation coefficient for all of the equity markets considered was 0.3411 and had now increased to 0.3794. This could provide further intuitive support for the proposition that the benefits of international diversification have been diminishing. When the average

correlation coefficient was further segmented into the 18 developed equity markets and the 8 emerging equity markets it was found that the average correlation coefficient of the developed equity markets had increased 25% from 0.3577 to 0.4735 between the Patrick (1996) study and the current research. The average correlation coefficient of the emerging equity markets had increased 13% from 0.2095 to 0.2416 for the same period. The lower correlation coefficient and smaller decline between the two studies could be an indication of the increasing importance of emerging equity markets for international portfolio diversification.

Table 5.8 details the correlation coefficients for the monthly returns between the South African All Gold Index and the South African Financial and Industrial Index, and each of the foreign equity markets considered in the research.

It was apparent from Table 5.8 that the correlation coefficients between the South African All Gold Index and each of the foreign equity markets considered in the research, had decreased from Patrick's research (average Correlation Coefficient of 0.134) to the current research (average Correlation Coefficient of 0.082). This was contrary to the general findings shown in Appendix 1 which indicated a marked increase in the correlation coefficients between the two different research periods. There was no noticeable change in the correlation coefficients between the South African Financial and Industrial Index and each of the foreign equity markets over the two different research periods.

TABLE 5.8 : CORRELATION COEFFICIENTS (MONTHLY, RANDS)				
COUNTRY	Current Research (1976 to 2003) Corr. Coefficient with		Patrick's Research (1976 to 1994) Corr. Coefficient with	
	SA All Gold	SA Fin & Ind	SA All Gold	SA Fin & Ind
SA All Gold Index	1.000	0.307	1.000	0.421
SA Financial & Industrial Index	0.307	1.000	0.421	1.000
Australia	0.159	0.322	0.154	0.291
Austria	0.137	0.259	0.153	0.238
Belgium	0.085	0.204	0.151	0.194
Canada	0.164	0.338	0.218	0.235
Denmark	0.015	0.168	0.065	0.110
France	0.096	0.277	0.023	0.084
Germany	0.073	0.264	0.174	0.209
Hong Kong	0.056	0.265	0.153	0.149
Italy	0.064	0.197	0.048	0.170
Japan	0.134	0.215	0.134	0.145
Netherlands	0.059	0.248	0.135	0.123
Norway	0.154	0.324	0.152	0.159
Singapore	0.055	0.362	0.191	0.242
Spain	-0.019	0.202	0.045	0.299
Sweden	0.014	0.312	0.075	0.226
Switzerland	0.065	0.237	0.185	0.195
United Kingdom	0.063	0.262	0.105	0.258
United States	-0.009	0.251	0.022	0.178
Argentina	-0.070	0.057	-0.087	-0.009
Brazil	-0.031	0.149	-0.036	0.013
Chile	-0.049	0.198	0.027	0.105
Greece	-0.014	0.032	0.116	0.071
India	0.000	0.135	-0.025	0.062
Korea	0.005	0.187	-0.036	-0.027
Mexico	0.057	0.344	0.081	0.278
Thailand	0.072	0.338	0.111	0.180

Table 5.9 details the correlation coefficients for the annual returns between the South African All Gold Index and the South African Financial and Industrial Index, and each of the foreign equity markets considered in the research.

It was apparent from Table 5.9 that the correlation coefficients for the annual returns between the South African All Gold Index and the South African Financial and Industrial Index, and each of the foreign equity markets considered in the research, had increased from Patrick's research to the current research . This was in line with the findings of Appendix 1

TABLE 5.9 : CORRELATION COEFFICIENTS (ANNUAL, RANDS)

COUNTRY	Current Research (1976 to 2003) Corr. Coefficient with		Patrick's Research (1976 to 1994) Corr. Coefficient with	
	SA All Gold	SA Fin & Ind	SA All Gold	SA Fin & Ind
SA All Gold Index	1.000	0.303	1.000	0.448
SA Financial & Industrial Index	0.303	1.000	0.448	1.000
Australia	0.346	0.320	0.217	0.517
Austria	0.218	0.207	0.138	0.122
Belgium	0.140	0.076	0.041	0.079
Canada	0.170	0.266	0.247	0.386
Denmark	0.047	0.245	-0.034	0.218
France	0.156	0.266	0.130	-0.026
Germany	0.149	0.250	0.147	0.290
Hong Kong	0.359	0.255	0.115	0.110
Italy	0.203	0.236	0.366	0.122
Japan	0.204	0.289	0.213	0.228
Netherlands	0.183	0.166	0.030	-0.117
Norway	0.272	0.368	0.180	0.070
Singapore	0.350	0.453	0.252	0.488
Spain	0.104	-0.002	0.344	0.444
Sweden	0.100	0.340	0.090	0.193
Switzerland	0.136	0.219	0.149	0.099
United Kingdom	0.218	0.155	0.158	0.061
United States	0.054	0.054	-0.002	-0.006
Argentina	0.050	0.319	0.024	0.231
Brazil	0.089	0.322	0.000	0.106
Chile	0.281	0.503	0.320	0.387
Greece	-0.165	-0.510	-0.001	-0.315
India	0.025	0.287	-0.054	0.003
Korea	0.146	-0.152	-0.170	-0.288
Mexico	0.101	0.352	0.102	0.475
Thailand	0.416	0.085	0.274	-0.044

The various combinations of inter-country correlation coefficients of both monthly and annual returns, as per Table 5.8 and Table 5.9 respectively, were tested using the test statistic described in 4.6 to determine if they were significantly different, at the 5% level, from one. One indicates perfect correlation, and a less than perfect correlation between two equity markets would indicate potential benefits from international portfolio diversification as a movement in one equity market would be fully or partially offset by an opposite movement in another equity market.

The hypothesis used in these tests was as follows:

$$Ho : \rho > 0.9$$
$$Ha : \rho \leq 0.9$$

A test value of 0.9 was used due to the nature of the test statistic, and its relative sensitivity at values of ρ close to one (1).

The value of the test statistic and the result of the test are shown in Table 5.10 (Monthly returns) and Table 5.11 (Annual returns). Consideration of Table 5.10 and Table 5.11 highlighted that the correlation coefficients between the two South African market sectors and the 26 foreign equity markets were significantly less than perfect in all cases. This result provided further intuitive support for the benefits of international portfolio diversification.

TABLE 5.10 : CORRELATION COEFFICIENT TESTS (MONTHLY, RANDS)				
COUNTRY	Z-test statistic for $\rho > 0.9$		Test result at 5% level	
	SA All Gold	SA Fin & Ind	SA All Gold	SA Fin & Ind
SA All Gold Index	N/A	-21.08	N/A	Reject
SA Financial & Industrial Index	-21.08	N/A	Reject	N/A
Australia	-23.94	-20.77	Reject	Reject
Austria	-24.35	-22.03	Reject	Reject
Belgium	-25.31	-23.09	Reject	Reject
Canada	-23.85	-20.45	Reject	Reject
Denmark	-26.59	-23.77	Reject	Reject
France	-25.11	-21.68	Reject	Reject
Germany	-25.53	-21.93	Reject	Reject
Hong Kong	-25.84	-21.91	Reject	Reject
Italy	-25.70	-23.22	Reject	Reject
Japan	-24.41	-22.88	Reject	Reject
Netherlands	-25.79	-22.24	Reject	Reject
Norway	-24.03	-20.73	Reject	Reject
Singapore	-25.86	-19.95	Reject	Reject
Spain	-27.21	-23.13	Reject	Reject
Sweden	-26.61	-20.98	Reject	Reject
Switzerland	-25.68	-22.46	Reject	Reject
United Kingdom	-25.71	-21.97	Reject	Reject
United States	-27.03	-22.19	Reject	Reject
Argentina	-28.14	-25.82	Reject	Reject
Brazil	-27.36	-28.31	Reject	Reject
Chile	-27.54	-28.53	Reject	Reject
Greece	-29.16	-28.42	Reject	Reject
India	-27.49	-28.38	Reject	Reject
Korea	-27.34	-27.47	Reject	Reject
Mexico	-26.81	-28.42	Reject	Reject
Thailand	-27.74	-26.83	Reject	Reject

TABLE 5.11 : CORRELATION COEFFICIENT TESTS (ANNUAL, RANDS)				
COUNTRY	Z-test statistic for $\rho > 0.9$		Test result at 5% level	
	SA All Gold	SA Fin & Ind	SA All Gold	SA Fin & Ind
SA All Gold Index	N/A	-5.80	N/A	Reject
SA Financial & Industrial Index	-5.80	N/A	Reject	N/A
Australia	-5.56	-5.70	Reject	Reject
Austria	-6.25	-6.31	Reject	Reject
Belgium	-6.66	-6.98	Reject	Reject
Canada	-6.50	-6.00	Reject	Reject
Denmark	-7.13	-6.11	Reject	Reject
France	-6.57	-6.00	Reject	Reject
Germany	-6.61	-6.08	Reject	Reject
Hong Kong	-5.48	-6.06	Reject	Reject
Italy	-6.33	-6.16	Reject	Reject
Japan	-6.33	-5.87	Reject	Reject
Netherlands	-6.44	-6.52	Reject	Reject
Norway	-5.97	-5.43	Reject	Reject
Singapore	-5.53	-4.92	Reject	Reject
Spain	-6.84	-7.37	Reject	Reject
Sweden	-6.86	-5.59	Reject	Reject
Switzerland	-6.68	-6.25	Reject	Reject
United Kingdom	-6.25	-6.58	Reject	Reject
United States	-7.09	-7.09	Reject	Reject
Argentina	-7.11	-5.71	Reject	Reject
Brazil	-6.91	-5.69	Reject	Reject
Chile	-5.92	-4.59	Reject	Reject
Greece	-8.19	-10.17	Reject	Reject
India	-7.24	-5.88	Reject	Reject
Korea	-6.63	-8.13	Reject	Reject
Mexico	-6.85	-5.52	Reject	Reject
Thailand	-5.15	-6.94	Reject	Reject

Consideration of Tables 5.8 to 5.11 highlighted apparent differences between the correlation coefficients based on annual return data and those based on monthly return data. These apparent differences were tested using the test statistic described in 4.6 at a significance level of 5%. The results are shown in Table 5.12. There were only four emerging market equity indices where significant differences were found between the correlation coefficients derived from monthly returns and those derived from compound annual returns. The results contrasted the findings of the research done by Patrick (1996), over the 19-year period 1976 to 1994, which found a number of cases of significant differences between the monthly and annual correlation coefficients. The results did highlight numerous negative z-test statistics which could indicate that the monthly correlation coefficients were lower than the annual correlation coefficients, albeit the differences were not significantly different at the 5% level. The lower monthly correlation coefficients could be more beneficial for international portfolio diversification.

The correlation coefficients using 28-year monthly data were tested against the correlation coefficients derived from the Patrick research using 19-year monthly data, to determine if there were any significant differences between the two periods, at the 5% level. The results are shown in Table 5.13. The results indicated significant differences between the SA Financial & Industrial market sector and 7 foreign market indices while no significant differences were found between the SA All Gold market sector and the various foreign equity markets. Consideration of Table 5.13 highlighted a large number of positive z-test statistics which could indicate that the 28-year period had lower correlation coefficients than the research of Patrick over the 19-year period. Therefore while the differences between the 19-year and 28 year were not statistically different at the 5% level, the longer period could result in more favourable international portfolio diversification. No tests were done on the annual data as the Fisher r-to-z Transformation was not suitable for small samples of less than 50.

TABLE 5.12 : TESTS COMPARING MONTHLY AND ANNUAL CORRELATION COEFFICIENTS (28 YEARS)				
COUNTRY	Z-test statistic		Test result at 5% level	
	SA All Gold	SA Fin & Ind	SA All Gold	SA Fin & Ind
SA All Gold Index	N/A	0.02	N/A	Accept
SA Financial & Industrial Index	0.02	N/A	Accept	N/A
Australia	-0.97	-0.13	Accept	Accept
Austria	-0.40	0.27	Accept	Accept
Belgium	-0.27	0.63	Accept	Accept
Canada	-0.03	0.38	Accept	Accept
Denmark	-0.15	-0.39	Accept	Accept
France	-0.29	0.06	Accept	Accept
Germany	-0.37	0.07	Accept	Accept
Hong Kong	-1.54	0.05	Accept	Accept
Italy	-0.68	-0.20	Accept	Accept
Japan	-0.35	-0.38	Accept	Accept
Netherlands	-0.61	0.41	Accept	Accept
Norway	-0.60	-0.24	Accept	Accept
Singapore	-1.50	-0.53	Accept	Accept
Spain	-0.59	1.00	Accept	Accept
Sweden	-0.42	-0.15	Accept	Accept
Switzerland	-0.35	0.09	Accept	Accept
United Kingdom	-0.76	0.54	Accept	Accept
United States	-0.30	0.98	Accept	Accept
Argentina	-0.58	-1.32	Accept	Accept
Brazil	-0.58	-0.89	Accept	Accept
Chile	-1.63	-1.70	Accept	**Reject**
Greece	0.74	2.87	Accept	**Reject**
India	-0.12	-0.77	Accept	Accept
Korea	-0.69	1.65	Accept	**Reject**
Mexico	-0.21	-0.04	Accept	Accept
Thailand	-1.79	1.29	**Reject**	Accept

TABLE 5.13 : TESTS COMPARING 28 YEAR AND 19 YEAR CORRELATION COEFFICIENTS				
COUNTRY	Z-test statistic		Test result at 5% level	
	SA All Gold	SA Fin & Ind	SA All Gold	SA Fin & Ind
SA All Gold Index	N/A	1.53	N/A	Accept
SA Financial & Industrial Index	1.53	N/A	Accept	N/A
Australia	-0.06	-0.40	Accept	Accept
Austria	0.19	1.21	Accept	Accept
Belgium	0.78	1.29	Accept	Accept
Canada	0.65	0.86	Accept	Accept
Denmark	0.58	1.11	Accept	Accept
France	-0.85	-0.14	Accept	Accept
Germany	1.19	1.61	Accept	Accept
Hong Kong	1.14	1.09	Accept	Accept
Italy	-0.19	1.25	Accept	Accept
Japan	0.00	0.13	Accept	Accept
Netherlands	0.89	0.75	Accept	Accept
Norway	-0.02	0.06	Accept	Accept
Singapore	1.60	2.22	Accept	**Reject**
Spain	0.74	3.79	Accept	**Reject**
Sweden	0.71	2.50	Accept	**Reject**
Switzerland	1.41	1.53	Accept	Accept
United Kingdom	0.49	2.33	Accept	**Reject**
United States	0.36	2.19	Accept	**Reject**
Argentina	-0.20	0.71	Accept	Accept
Brazil	-0.06	0.51	Accept	Accept
Chile	0.88	1.79	Accept	**Reject**
Greece	1.51	0.99	Accept	Accept
India	-0.29	0.72	Accept	Accept
Korea	-0.48	-0.37	Accept	Accept
Mexico	0.28	2.65	Accept	**Reject**
Thailand	0.46	1.27	Accept	Accept

6. RESULTS OF EX-ANTE INVESTMENT STRATEGY

6.1 "Buy-The-Market" Approach

A portfolio was constructed representing equal proportions (i.e. 3,571%) of investment in each of the 27 countries (two sectors for South Africa being the Financial & Industrial Index and the All Gold Index) in the sample over the 28 years.

Table 6.1 summarises the calculations and compares the results with the prior research from January 1976 to December 1994.

TABLE 6.1 : "BUY-THE-MARKET" PORTFOLIOS

	Current Research (1976 to 2003)		Patrick's Research (1976 to 1994)	
	Mean Return	Standard Deviation	Mean Return	Standard Deviation
BUY-THE-MARKET PORTFOLIOS				
Monthly, Commercial Rand	1.877%	6.741%	2.259%	4.824%
Annual, Commercial Rand	26.524%	24.675%	32.152%	30.263%
SOUTH AFRICA ONLY PORTFOLIO				
100% All Gold, Monthly, Commercial Rand	1.709%	10.451%	2.060%	10.300%
100% All Gold, Annual, Commercial Rand	21.152%	44.273%	29.830%	55.660%
100% Fin&Ind, Monthly, Commercial Rand	1.642%	5.814%	2.090%	5.350%
100% Fin%Ind, Annual, Commercial Rand	18.166%	19.456%	27.320%	18.650%
30% Gold / 70% Fin&Ind, Monthly, Commercial Rand	1.662%	5.060%	2.081%	4.527%
30% Gold / 70% Fin&Ind, Annual, Commercial Rand	19.062%	21.711%	28.073%	25.196%

The "buy-the-market" portfolio would have had a monthly mean return of 1,877% and a standard deviation of 6,741% over the period 1976 to 2003. Over the period 1976 to 1994 the "buy-the-market" portfolio would

have had a monthly mean return of 2,259% and a standard deviation of 4,824%. The monthly mean return had decreased while the standard deviation had increased over the longer period of the current research which is indicative of reduced benefits of international diversification based on a buy-the-market approach.

The “buy-the-market” portfolio would have had an annual mean return of 26,524% and a standard deviation of 24,675% over the period 1976 to 2003. Over the period 1976 to 1994 the “buy-the-market” portfolio would have had an annual mean return of 32,152% and a standard deviation of 30,263%.

Each of the pairs of mean monthly and annual “buy-the-market” returns (19 year and 28 year periods) were tested for a significant difference between the mean returns, using a Mann Whitney test, at a significance level of 5%. The test concluded that the 2 periods are significantly different at a 5% significance level. The rejection of the null hypothesis indicated that both the mean monthly and annual “buy-the-market” returns from the Patrick research (19 year period) were superior to the mean monthly and annual “buy-the-market” returns of the current research (28 year period).

The “buy-the-market” monthly and annual returns were contrasted with the three comparative South African portfolio monthly and annual returns set out in Table 6.1. Consideration of Table 6.1 indicated that the “buy-the-market” monthly and annual returns were higher than the comparative South African portfolio monthly and annual returns. However, with the exception of the 100% All Gold South African portfolio, the standard deviation of the “buy-the-market” portfolio was higher than the other two South African portfolios indicating potentially more volatile returns.

Table 6.2 details the standardised returns as used by Bhana (1987) which allowed for a comparison of portfolios with different risk levels in each period.

TABLE 6.2 : BHANA RATIO OF STANDARDISED RETURN		
PORTFOLIO CHARACTERISTICS	Current Research (1976 to 2003)	Patrick's Research (1976 to 1994)
Buy-The-Market, Monthly, Commercial Rand	0.278	0.468
Buy-The-Market, Annual, Commercial Rand	1.075	1.062
100% All Gold, Monthly, Commercial Rand	0.164	0.200
100% All Gold, Annual, Commercial Rand	0.478	0.536
100% Financial & Industrial, Monthly, Commercial Rand	0.282	0.391
100% Financial & Industrial, Annual, Commercial Rand	0.934	1.465
30% Gold / 70% Financial & Industrial, Monthly, Commercial Rand	0.329	0.460
30% Gold / 70% Financial & Industrial, Annual, Commercial Rand	0.878	1.114

The Mann-Whitney test at a 5% level of significance, using the Bhana ratio of standardised return, was used to ascertain whether there were significant differences between the “buy-the-market” portfolio and the three South African portfolios. The null hypothesis used was that the two respective standardised returns were equal.

The acceptance of the null hypothesis indicated no differences between the various monthly and annual “buy-the-market” portfolios and the three South African portfolios.

7. RESULTS OF EX-POST INVESTMENT STRATEGY

7.1 Investment Horizon

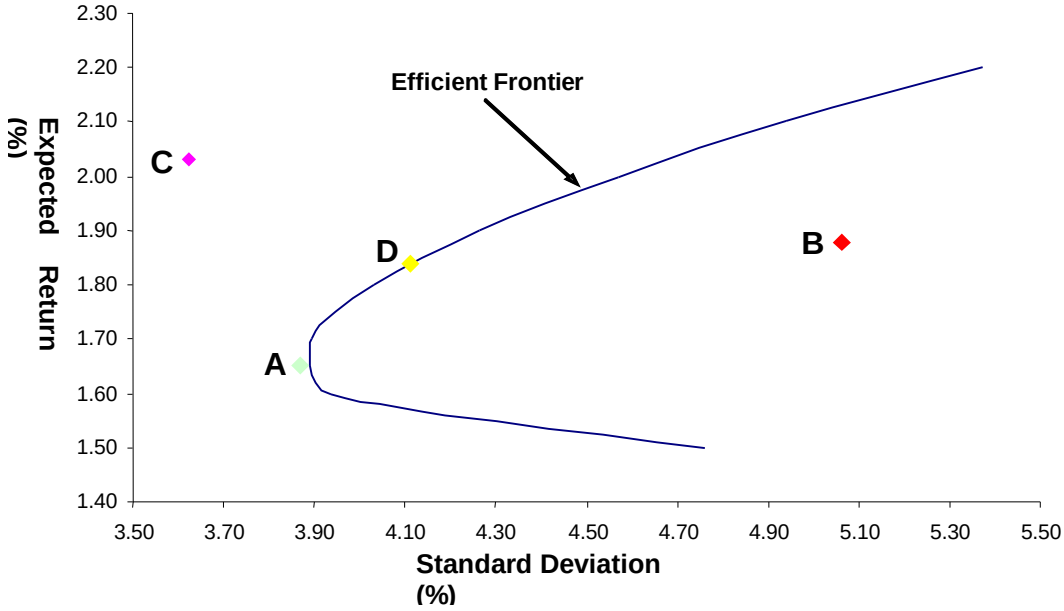
The investment horizon of the investor should be considered when undertaking international portfolio diversification. The literature review of chapter 2 and the descriptive statistics of chapter 5.1 have indicated that the correlation coefficients between various countries differ when different investment horizons are selected. This project report examined efficient portfolios using both monthly and annual return data.

Efficient portfolios represent the best risk-return trade-off amongst all the possible portfolios that could be derived from the population of securities. The objective was to identify portfolios that generated either the highest possible return for a given level of risk or the lowest possible risk for a given level of return. If the investor's objective was to minimise the monthly standard deviation of a portfolio for a given level of return, then monthly data should be used. Conversely, if the investor has a slightly longer time horizon and wishes to minimise portfolio standard deviation over a period of a year, then annual data should be used. However, monthly data could be used in the longer time horizon if it was shown to be a good forecast of annual returns.

7.2 Monthly Returns

Efficient portfolios were complied using monthly return data of the 27 countries. Figure 7.1 shows the efficient frontier developed from the 28-year monthly data.

Figure 7.1 Efficient Frontier (Monthly Returns, 28 Years)



The expected monthly return of the minimum-variance portfolio over the 28-year period, as shown by Point A on Figure 7.1, was 1,653% and the standard deviation was 3.871%. Point B shows the buy-the-market portfolio, which was detailed in Chapter 6.1, with equal proportions (i.e. 3,571%) of investment in each of the 27 countries. The expected monthly return of this portfolio was 1,877% with a standard deviation of 5,063%. Figure 7.1 highlights the superiority of the minimum-variance portfolio over the buy-the-market portfolio. Even though the buy-the-market portfolio has a higher monthly return, it lies below the efficient frontier and hence the reward to risk trade-off was higher than the minimum variance portfolio. The research results of Patrick (1996), for the period 1976 to 1994, are shown by Point C and had an expected return of 2,032% per month and a standard deviation of 3,625%. Point C with both a higher monthly mean and a lower standard deviation was superior to the results of the period 1976 to 2003 and this was reflected by Point C lying above the efficient frontier of the 28 year period. This was further evidence of the diminishing benefits of international portfolio diversification over the last decade. Point D shows the tangency portfolio which had an expected return of 1,838% per month and a standard

deviation of 4,111% per month. The tangency portfolio is the point where the efficient frontier is tangent to the Capital Market Line and has the highest Sharpe ratio along the efficient frontier. It differs to Point A in that while Point A reflects the lowest variance for a given return, Point B reflects the highest possible return for a given variance. Any point along the efficient frontier to the right of Point D would incorporate a higher level of risk for each unit of return. Conversely, any point along the efficient frontier to the left of Point D would have lower returns for each unit of risk.

The composition of the minimum-variance portfolio (Point A), and the comparative for the research of Patrick (Point C), in Figure 7.1 is shown in Table 7.1.

TABLE 7.1 : MINIMUM VARIANCE PORTFOLIOS (MONTHLY RETURNS, 28 YEARS)

COUNTRY	Current Research (1976 to 2003) Proportion of portfolio	Patrick Research (1976 to 1994) Proportion of portfolio
SA All Gold Index	8.091%	4.485%
SA Financial & Industrial Index	26.791%	34.263%
Austria	4.574%	1.343%
Denmark	19.974%	16.190%
Italy	5.526%	0.000%
Japan	5.485%	6.600%
Netherlands	0.000%	0.117%
Spain	0.000%	1.292%
United States	7.654%	11.749%
Brazil	0.000%	0.377%
Chile	2.412%	1.916%
Greece	10.236%	4.046%
India	9.257%	10.902%
Korea	0.000%	4.824%
Thailand	0.000%	1.896%
Expected Return	1.652%	2.032%
Standard Deviation	3.871%	3.625%
Bhana Standardised Return	0.427	0.561

Contrary to the suppositions made in the literature review of Chapter 2, analysis of the monthly data over the period 1976 to 2003 showed no increase in the proportion of emerging market indices making up the minimum-variance portfolio. The proportion of emerging markets making up the minimum-variance portfolio had decreased from 23,96% to 21,91% over the extended period 1976 to 2003. One possible explanation could be supported by the results of the descriptive statistics in Chapter 5.1 which found that the variances of the monthly returns on the emerging market indices had increased proportionately more over the 28 year period than the variances of the developed country indices over the same period. This finding would result in emerging markets being "penalised" more in the composition of the minimum-variance portfolio. The composition of the tangency portfolio had a different result. The proportion of emerging markets making up the tangency portfolio was higher at 26,86%. This would be expected as emerging markets would be "rewarded" for higher variance if supported by proportionately higher returns.

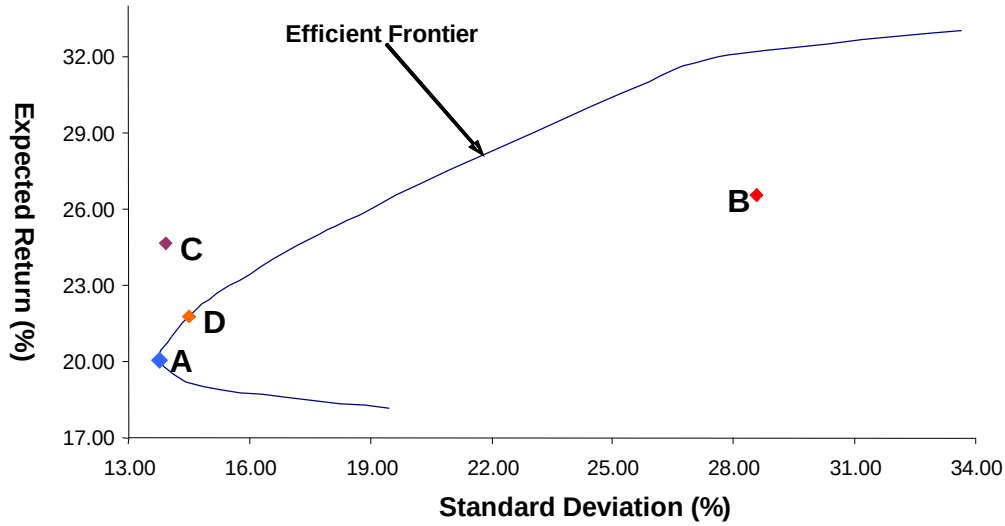
The composition of South African indices in the minimum-variance portfolio had decreased from 38,75% to 34.88% with the SA Financial and Industrial index making up a large portion of the portfolio. The Gold Mining Index only featured to a limited extent in the portfolio.

The minimum-variance portfolio had a noticeably higher monthly Bhana standardised return of 0,427 than any of the three South African "yardstick" portfolios (Table 6.2). The monthly standardised return of the minimum-variance portfolio was significantly different (see Table 7.5) from the standardised returns of all three South African portfolios on the basis of a one-tail test at a 5% significance level. This provided support for the supposition that meaningful benefits could have been obtained by investors from international portfolio diversification through investment in the minimum-variance portfolio.

7.3 Annual Returns

Efficient portfolios were compiled using annual return data of the 27 countries. Figure 7.2 shows the efficient frontier developed from the 28 year annual data.

Figure 7.2 Efficient Frontier (Annual Returns, 28 Years)



The expected annual return of the minimum-variance portfolio over the 28 year period, as shown by Point A on Figure 7.2, was 20,057% and the standard deviation was 13,786%. The expected annual return of the buy-the-market portfolio (Point B) was 26,524% with a standard deviation of 28,586%. Figure 7.2 highlighted the superiority of the minimum-variance portfolio over the buy-the-market portfolio which lies below the efficient frontier. The minimum-variance portfolio from the earlier research by Patrick (1996), as shown by Point C, had an expected return of 24,643% per month and a standard deviation of 13,928% per month. This was superior to the results of the period 1976 to 2003 and this was reflected by Point C lying above the efficient frontier of the 28 year period. This was further evidence of the diminishing benefits of international portfolio

diversification over the last decade. The tangency portfolio (Point D) had an expected annual return of 21,778% and a standard deviation of 14,519%.

The composition of the minimum-variance portfolio (Point A), and the comparative for the research of Patrick (Point C), in Figure 7.2, is shown in Table 7.2.

TABLE 7.2 : MINIMUM VARIANCE PORTFOLIOS (ANNUAL RETURNS, 28 YEARS)		
COUNTRY	Current Research (1976 to 2003) Proportion of portfolio	Patrick Research (1976 to 1994) Proportion of portfolio
SA All Gold Index	1.403%	0.000%
SA Financial & Industrial Index	73.922%	37.587%
Australia	0.000%	6.426%
Austria	0.000%	0.000%
Belgium	0.000%	0.000%
Canada	0.000%	22.008%
Denmark	0.123%	0.000%
France	0.000%	0.000%
Germany	0.000%	0.000%
Hong Kong	0.000%	0.000%
Italy	0.000%	0.000%
Japan	0.000%	0.964%
Netherlands	0.000%	3.546%
Norway	0.000%	0.000%
Singapore	0.000%	9.593%
Spain	0.000%	0.000%
Sweden	0.000%	0.000%
Switzerland	0.000%	0.000%
United Kingdom	0.000%	6.696%
United States	7.818%	13.180%
Argentina	0.000%	0.000%
Brazil	0.000%	0.000%
Chile	0.000%	0.000%
Greece	10.530%	0.000%
India	0.000%	0.000%
Korea	5.423%	0.000%
Mexico	0.000%	0.000%
Thailand	0.781%	0.000%
Expected Return	20.066%	24.643%
Standard Deviation	13.786%	13.928%
Bhana Standardised Return	1.455	1.769

The efficient international portfolios derived using annual return data of 28 years, differed noticeably from those derived using monthly data over the same period and from the research of Patrick (1996) over the lesser period of 19 years. The proportion of emerging markets making up the annual minimum-variance portfolio had increased from 0% to 16.7% and the proportion of SA Financial & Industrial Index (classified by MSCI as an emerging market) had increased from 37.59% to 75.33%, to the detriment of developed market indices, over the extended period 1976 to 2003. This data provided support for the suppositions made in the literature review of Chapter 2, that investors could have obtained benefits through international diversification by choosing increased weightings in emerging equity markets.

It was expected that the efficient portfolios developed using monthly return data would differ from those developed using annual return data. The literature review of Chapter 2 highlighted the fact that the standard deviation of a given portfolio is influenced by the covariances between the various indices. The results of the Descriptive Statistics in Chapter 5.3 demonstrated that the correlation coefficients between the various countries differed according to the length of the investment horizon chosen.

The minimum-variance portfolio had a noticeably higher annual Bhana standardised return of 1,455 than any of the three South African “yardstick” portfolios (Table 6.2). The annual standardised return of the minimum-variance portfolio was significantly different (see Table 7.5) from the annual standardised returns of the South African All Gold portfolio on the basis of a one-tail test at a 5% significance level. It was not significantly different to the South African Financial & Industrial portfolio nor the combined All Gold (30%) and Financial & Industrial (70%) portfolio.

7.4 **"Passive" Diversification**

The preceding chapters have focused on active portfolio management. Proponents of the efficient market hypothesis believe that active management is largely wasted effort and unlikely to justify the expenses incurred. The expenses are the costs of obtaining information and of managing the particular portfolio. Efficient market hypothesis states that stocks already reflect all available information and that competition among market analysts leads naturally to market efficiency.

The alternative to active portfolio management is a passive investment strategy that makes no attempt to outsmart the market by looking for over- or undervalued stocks. One common passive investment strategy is to create an index fund, which is designed to replicate the performance of a broad range of stocks. The MSCI World Index is a well used index fund for such purposes. The shortfall with utilising the MSCI World Index is that it's a market value weighted index and is therefore heavily weighted towards certain equity markets such as the Japanese Nikkei and the United States Dow Jones and S&P500. The various weightings of the individual countries making up the MSCI World Index as at 31 December 2003 are shown in Appendix 4.

Efficient portfolios were developed using the MSCI World Index and the two South African indices, namely the All Gold Index and the Financial and Industrial Index. The resultant efficient frontier which was based on 28 years of monthly data is shown in figure 7.3.

The expected monthly return of the minimum-variance portfolio, using passive diversification, over the 28 year period, as shown by Point A on Figure 7.3, was 1,638% and the standard deviation was 4,354%. These results compare favourable when analysed against the various efficient portfolios developed in the preceding chapters.

Figure 7.3 Efficient Frontier Assuming Passive Diversification (Monthly Returns, 28 Years)

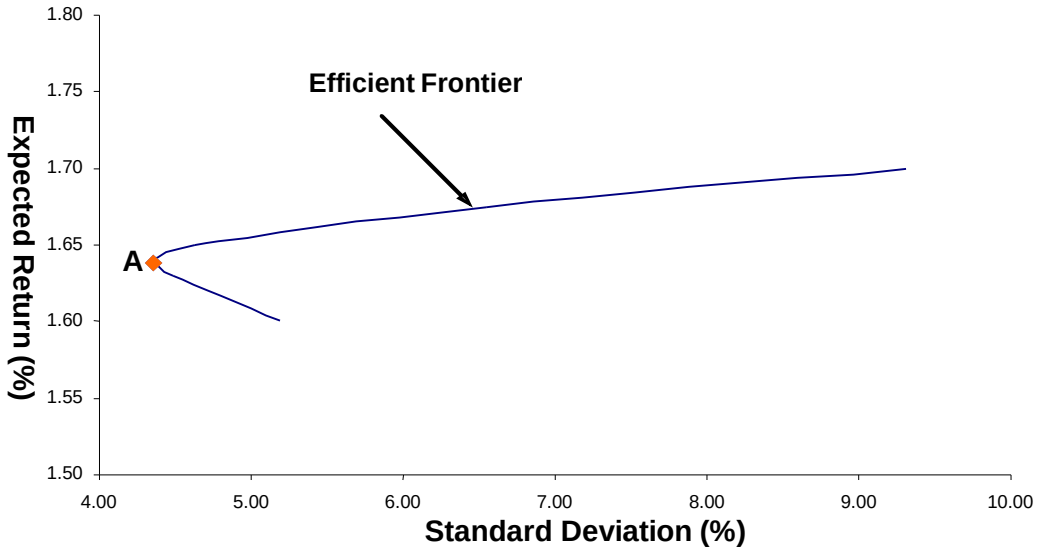


Table 7.3 summarises the results of the various comparative portfolio investments which have been ranked from lowest to highest standardised return.

TABLE 7.3 : RESULTS OF COMPARATIVE PORTFOLIO INVESTMENTS (MONTHLY)

	Mean	Standard Deviation	Bhana Standardised Return
SOUTH AFRICA ONLY PORTFOLIOS			
100% All Gold Index	1.709%	10.451%	0.164
100% Financial & Industrial Index	1.642%	5.814%	0.282
30% All Gold Index / 70% Financial & Industrial Index	1.662%	5.060%	0.328
BUY-THE-MARKET PORTFOLIOS			
Equal Weightings of all 27 countries	1.877%	5.063%	0.371
PASSIVE DIVERSIFICATION PORTFOLIO			
MSCI World Index / SA All Gold / SA Fin & Ind Index	**1.638%**	**4.354%**	**0.376**
MINIMUM-VARIANCE PORTOLIOS			
Optimum minimum-variance	1.652%	3.871%	0.427
TANGENCY PORTOLIOS			
Highest Sharpe Ratio	1.838%	4.111%	0.447

Table 7.4 shows the composition of the passive diversification portfolio for the 19 year and the 28 year periods. The two periods had very similar results with regard to the split between South African shares and MSCI shares. The allocations to the South African shares were higher than those derived from the earlier efficient portfolios. However this could be due to the absence of the emerging market indices from the passive diversification.

TABLE 7.4 : PASSIVE DIVERSIFICATION PORTFOLIOS (MONTHLY, 28 YEARS)

COUNTRY	Current Research (1976 to 2003) Proportion of portfolio	Patrick Research (1976 to 1994) Proportion of portfolio
SA All Gold Index	8.994%	2.060%
SA Financial & Industrial Index	36.163%	44.914%
MSCI World Index	54.842%	53.026%
Expected Return	1.638%	1.915%
Standard Deviation	4.354%	4.053%
Bhana Standardised Return	0.376	0.472

7.5 **Tests Of Significance On Standardised Returns**

A Mann-Whitney test was performed on the monthly and the annual data from 1976 to 2003 to determine if the standardised return of the various efficient portfolios, developed in the preceding chapters, differed significantly, at the 5% level of significance, from the standardised returns of the three South African comparative portfolios. The null hypothesis used was that the two respective standardised returns were equal. Table 7.5 summarises the results.

TABLE 7.5 : SIGNIFICANCE TESTS OF STANDARDISED RETURNS OF VARIOUS EFFICIENT PORTFOLIOS RELATIVE TO STANDARDISED RETURNS ON COMPARATIVE SOUTH AFRICAN PORTFOLIOS			
PORTFOLIO CHARACTERISTICS	Result of One-Tail Test at the 5% significance level		
	SA Fin & Ind	SA All Gold	SA Combination
BUY-THE-MARKET PORTFOLIOS			
Monthly, 28 year	Reject	Reject	Reject
Annual, 28 year	Accept	Reject	Accept
MINIMUM-VARIANCE PORTOLIOS			
Monthly, 28 year	Reject	Reject	Reject
Annual, 28 year	Accept	Reject	Accept
PASSIVE DIVERSIFICATION PORTFOLIO			
Monthly, 28 year	Accept	Reject	Accept
Annual, 28 year	Accept	Reject	Accept

The various efficient frontiers had significantly different standardised returns, at the 5% level, against most of the comparative South African portfolios on a monthly and annual basis. However, no significant differences were found between the various efficient frontiers and the SA Financial & Industrial portfolio and the SA Combination portfolio, on the annual data.

8. INTERPRETATION OF RESULTS

The objective of the Project Report was to update the research of Patrick (1996) to establish empirical evidence of the benefits of international portfolio diversification.

In the descriptive statistics of Chapter 5, the mean returns and standard deviations of 27 country indices were analysed over the period 1976 to 2003. The key observations were:

- There is still a dispersion of returns (monthly and annual) amongst various countries and differences in risk, as

measured by the standard deviation of returns. Hence, there appears to be intuitive justification for the use of international portfolio diversification.

- The mean returns (monthly and annual) of the various country indices are lower than seen in the earlier research of Patrick (19 year period). A Mann-Whitney test, at a significance level of 5%, concluded that the mean returns for the period 1976 to 1994 were significantly higher when compared to the period 1976 to 2003. This could provide intuitive support for the proposition that the benefits of international diversification have been diminishing over the last decade.
- The impact of currency movements on the returns of foreign equity markets had increased relative to the previous study by Patrick (1996). The South African Rand continues to depreciate both in terms of higher mean currency movement and through increased exchange rate volatility as evidenced by higher standard deviation of currency movements. These factors enhance the benefits of international diversification for South African investors as the foreign currency returns result in higher rand returns.

The descriptive statistics analysed the correlation coefficient of returns (monthly and annual) of each pair of equity markets over the period 1976 to 2003 and the comparative period of 1976 to 1994. The results showed an increase in the correlation coefficients over the extended period which could provide further intuitive support for the proposition that the benefits of international diversification have been diminishing. However, the emerging market indices reflected lower correlation coefficients than those of developed countries, and had smaller declines from the 19 year period to the 28 year period which could be an indication of increasing importance of emerging equity markets for international portfolio diversification.

The various “buy-the-market” portfolios (monthly and annual) were subjected to a Mann-Whitney test at a significance level of 5% and led to the following observations:

- The mean return (monthly and annual) had decreased from the 19 year period to the 28 year period. The rejection of the null hypothesis indicated that the mean “buy-the-market” returns from the Patrick research (19 year period) were significantly superior, at a 5% significance level, than the mean “buy-the-market” returns of the current research (28 year period). This could be indicative of reduced benefits of international diversification based on a “buy-the-market” approach.
- When the “buy-the-market” standardised returns (monthly and annual) were compared to the three comparative South African portfolio returns, no significant differences were found using a Mann-Whitney test at a significance level of 5%. Nevertheless, the higher “buy-the-market” returns (annual) would have benefited investors in absolute terms by favouring the “buy-the-market” portfolio over any of the three South African portfolios.

In Chapter 7, various minimum-variance portfolios were constructed and highlighted a number of issues

- The research results of Patrick (1996), for the period 1976 to 1994 had a higher mean return (monthly and annual) than the results for the period 1976 to 2003. This was further evidence of the diminishing benefits of international portfolio diversification over the last decade.
- The monthly standardised return of the minimum-variance portfolio was significantly different from the standardised returns of all three South African portfolios on the basis of a one-tail test at a 5% significance level. This provided support

for the supposition that meaningful benefits could have been obtained by investors from international portfolio diversification through investment in the minimum-variance portfolio.

- The annual standardised return of the minimum-variance portfolio was significantly different from the standardised returns of the South African All Gold portfolio on the basis of a one-tail test at a 5% significance level. It was not significantly different to the South African Financial & Industrial portfolio nor the combined All Gold (30%) and Financial & Industrial (70%) portfolio.
- Contrary to the results of the descriptive statistics, analysis of the monthly data over the period 1976 to 2003, showed no increase in the proportion of emerging market indices making up the minimum-variance portfolio. However, the composition of the tangency portfolio, with the highest Sharpe ratio, had a different result. The proportion of emerging markets making up the tangency portfolio was higher at 26,86%.
- The proportion of emerging markets making up the annual minimum-variance portfolio had increased over the extended period 1976 to 2003. This data provided support for the suppositions that investors could obtain benefits through international diversification by choosing increased weightings in emerging equity markets.
- The four points above highlight the importance of the investment horizon. The results have shown that different efficient international portfolios can result from the use of monthly as opposed to annual returns.
- The standardised return (monthly and annual) of the efficient portfolios using passive diversification were significantly different from the standardised returns of the South African All Gold portfolio on the basis of a one-tail test at a 5% significance level. It was not significantly different to the South African Financial & Industrial portfolio nor the

combined All Gold (30%) and Financial & Industrial (70%) portfolio. Nevertheless, a passive approach to country index selection had results that were not significantly different from those using active diversification methods.

9. CONCLUSIONS

The descriptive statistics and results of the ex-post and ex-ante investment strategies have highlighted that South African investors would have benefited historically from international portfolio diversification. This confirms the suppositions made in the literature review and the results of previous empirical studies. The dispersion of returns amongst various countries, differences in risk and low correlation coefficients between the various world equity markets indicates that the benefits to international portfolio diversification will continue to exist for South African investors.

However the benefits of international portfolio diversification have been diminishing significantly over the last decade since the research of Patrick (1996). This was supported by the increase in the correlation coefficients, the higher mean “buy-the-market” returns (monthly and annual) and the higher ex-post mean returns (monthly and annual) for the period 1976 to 1994 when compared to the results for the period 1976 to 2003.

The importance of emerging equity markets for international portfolio diversification was evidenced when comparing the Patrick (1996) research to the extended period (1976 to 2003). The benefits were less pronounced for the monthly data, unless the tangency portfolio was used. However, the annual data of minimum-variance portfolios supported increased weightings in emerging equity markets.

The investment period of the investor must be identified at an early stage of the investment strategy as it was shown that different efficient

international portfolios can result from the use of monthly as opposed to annual returns.

A passive investment strategy can yield a minimum-variance portfolio that is not significantly different from an active strategy, thereby providing a cheaper alternative to active country allocation methods.

The impact of currency movements on the returns of foreign equity markets had increased when compared to the previous study by Patrick (1996). These currency movements can either enhance foreign equity returns when the rand is depreciating or it could reduce the benefits when the rand is appreciating to the foreign currency. Therefore the effects of exchange rate stability should be assessed when undertaking international portfolio diversification.

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APPENDIX 1

Full Correlation Matrices (28 year monthly returns)

-YEAR CORRELATION COEFFICIENTS (MONTHLY, RANDS)

	1	2	3	4	5	6	7	8	9	10	11	12	13
	SA All Gold	SA Fin & Ind	Australia	Austria	Belgium	Canada	Denmark	France	Germany	Hong Kong	Italy	Japan	Netherland
All Gold	1.0000	0.3069	0.1594	0.1371	0.0850	0.1643	0.0152	0.0963	0.0729	0.0564	0.0642	0.1340	0.058
Fin & Ind		1.0000	0.3223	0.2587	0.2044	0.3377	0.1682	0.2766	0.2644	0.2655	0.1966	0.2155	0.247
stralia			1.0000	0.3235	0.4300	0.6722	0.4251	0.4773	0.4461	0.4917	0.3733	0.4223	0.535
stria				1.0000	0.5360	0.3811	0.4390	0.5234	0.6407	0.3465	0.3921	0.3050	0.554
gium					1.0000	0.5035	0.6109	0.7080	0.7238	0.3833	0.5126	0.4792	0.752
nada						1.0000	0.5329	0.5782	0.5272	0.5112	0.4663	0.4462	0.672
nmark							1.0000	0.5558	0.6383	0.3585	0.5011	0.4511	0.655
nce								1.0000	0.7279	0.3926	0.5758	0.4999	0.710
rmany									1.0000	0.4399	0.5399	0.4376	0.793
ng Kong										1.0000	0.3639	0.3681	0.533
y											1.0000	0.4474	0.533
pan												1.0000	0.517
therlands													1.000
rway													
gapore													
ain													
eden													
itzerland													
ited Kingdom													
ited States													
entina													
zil													
le													
ece													
ia													
ea													
xico													
iland													

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Norway	Singapore	Spain	Sweden	Switzerland	United Kingdor	United States	Argentina	Brazil	Chile	Greece	India	Korea	Mexico	Thailand
0.1545	0.0551	-0.0190	0.0141	0.0647	0.0633	-0.0089	-0.0701	-0.0305	-0.0486	-0.0137	0.0005	0.0050	0.0571	0.07
0.3238	0.3617	0.2025	0.3120	0.2372	0.2625	0.2513	0.0575	0.1495	0.1981	0.0317	0.1348	0.1869	0.3441	0.33
0.5494	0.5400	0.4848	0.5200	0.5040	0.5848	0.5826	0.2437	0.2555	0.2871	0.1229	0.2897	0.3040	0.3575	0.37
0.4561	0.3310	0.4371	0.3965	0.5960	0.4538	0.3737	0.1431	0.2150	0.2633	0.1003	0.2847	0.2077	0.1908	0.28
0.6062	0.4281	0.5324	0.5249	0.7184	0.6398	0.6063	0.0870	0.2373	0.2707	0.1735	0.2318	0.2882	0.3390	0.27
0.6039	0.5599	0.4941	0.5706	0.5895	0.6464	0.8051	0.2327	0.2609	0.3005	0.1646	0.2771	0.3822	0.3997	0.33
0.5624	0.4152	0.5306	0.5576	0.6399	0.5636	0.5797	0.1446	0.2437	0.2310	0.0226	0.2893	0.2805	0.2015	0.21
0.5884	0.3876	0.5596	0.5532	0.6795	0.6503	0.6127	0.1743	0.2471	0.2134	0.0769	0.2949	0.2521	0.3033	0.23
0.5682	0.4189	0.5689	0.6350	0.7483	0.6071	0.6060	0.1554	0.2960	0.2633	0.1644	0.2710	0.2907	0.3055	0.31
0.4618	0.6436	0.4060	0.4532	0.4446	0.5069	0.4873	0.1174	0.2605	0.2729	0.1800	0.1967	0.2777	0.3434	0.41
0.4276	0.3270	0.5403	0.4980	0.4930	0.4943	0.4538	0.1840	0.2555	0.2220	-0.0015	0.1990	0.2708	0.2560	0.21
0.3820	0.4115	0.4734	0.4754	0.5216	0.5061	0.4563	0.1006	0.2198	0.2042	0.0515	0.1603	0.4433	0.2512	0.26
0.6693	0.5263	0.5865	0.6521	0.7826	0.7438	0.7461	0.1513	0.2967	0.2695	0.1875	0.2941	0.3349	0.3517	0.30
1.0000	0.4977	0.4786	0.5669	0.5999	0.6063	0.6115	0.1449	0.3036	0.2568	0.1685	0.2585	0.2720	0.3758	0.24
	1.0000	0.3981	0.4877	0.4550	0.5213	0.5896	0.1493	0.2535	0.2995	0.1349	0.2773	0.3487	0.4260	0.55
		1.0000	0.6031	0.5414	0.5558	0.5428	0.1625	0.3036	0.2793	0.1447	0.2439	0.3050	0.3336	0.26
			1.0000	0.5952	0.5751	0.6180	0.1573	0.3121	0.2614	0.1138	0.2885	0.3691	0.3649	0.29
				1.0000	0.6798	0.6554	0.1753	0.2906	0.2325	0.1455	0.2978	0.3358	0.3031	0.29
					1.0000	0.6757	0.1050	0.2782	0.2192	0.0541	0.2390	0.3303	0.3562	0.27
						1.0000	0.1898	0.3118	0.2956	0.2358	0.2791	0.4116	0.4438	0.34
							1.0000	0.1013	0.2081	0.1190	0.1857	0.0438	0.2634	0.11
								1.0000	0.2036	0.1404	0.1993	0.1814	0.1945	0.16
									1.0000	0.0464	0.2432	0.2298	0.2980	0.26
										1.0000	-0.0347	0.0511	0.2120	0.15
											1.0000	0.2228	0.1957	0.22
												1.0000	0.2530	0.42
													1.0000	0.31
														1.00

APPENDIX 2

Full Correlation Matrices (28 year annual returns)

-YEAR CORRELATION COEFFICIENTS (ANNUAL, RANDS)

	1	2	3	4	5	6	7	8	9	10	11	12	13
	SA All Gold	SA Fin & Ind	Australia	Austria	Belgium	Canada	Denmark	France	Germany	Hong Kong	Italy	Japan	Netherland
All Gold	1.0000	0.3026	0.3462	0.2176	0.1396	0.1702	0.0471	0.1556	0.1485	0.3592	0.2027	0.2038	0.182
Fin & Ind		1.0000	0.3205	0.2073	0.0758	0.2664	0.2454	0.2665	0.2499	0.2549	0.2355	0.2889	0.166
stralia			1.0000	0.4407	0.6291	0.7352	0.6678	0.7013	0.5633	0.6386	0.5708	0.5358	0.665
stria				1.0000	0.7124	0.4793	0.6443	0.7505	0.9079	0.4461	0.7891	0.4681	0.769
lgium					1.0000	0.5253	0.6686	0.8909	0.8472	0.4842	0.7941	0.6365	0.875
nada						1.0000	0.6976	0.6851	0.6152	0.6184	0.4890	0.4975	0.727
nmark							1.0000	0.6674	0.7760	0.3193	0.5966	0.4811	0.754
ance								1.0000	0.8759	0.5652	0.8488	0.6641	0.872
rmany									1.0000	0.4900	0.8474	0.6124	0.900
ng Kong										1.0000	0.5279	0.5216	0.604
y											1.0000	0.6171	0.783
pan												1.0000	0.598
therlands													1.000
rway													
gapore													
ain													
eden													
itzerland													
ited Kingdom													
ited States													
entina													
zil													
ile													
eece													
ia													
rea													
xico													
ailand													

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Norway	Singapore	Spain	Sweden	Switzerland	nited Kingdo	United States	Argentina	Brazil	Chile	Greece	India	Korea	Mexico	Thailand
0.2717	0.3502	0.1044	0.0998	0.1355	0.2178	0.0537	0.0502	0.0894	0.2811	-0.1652	0.0248	0.1458	0.1008	0.41
0.3680	0.4533	-0.0016	0.3397	0.2189	0.1550	0.0541	0.3194	0.3218	0.5032	-0.5101	0.2869	-0.1524	0.3516	0.08
0.6456	0.5287	0.5411	0.6154	0.5032	0.6429	0.6002	0.2261	0.6282	0.2969	0.1648	0.4439	0.3546	0.6741	0.28
0.5665	0.0544	0.5540	0.5343	0.8556	0.7162	0.5799	0.2018	0.4608	0.2648	-0.0352	0.7054	0.2618	0.2399	0.23
0.4807	0.1046	0.7873	0.6474	0.8180	0.7531	0.7709	0.1208	0.5268	0.1201	0.2248	0.5263	0.5684	0.3378	0.27
0.7667	0.5280	0.5070	0.7563	0.5257	0.6468	0.7392	0.2915	0.6213	0.1025	0.3001	0.5648	0.2343	0.5397	0.09
0.5791	0.3479	0.4878	0.8175	0.7199	0.6587	0.7058	0.1525	0.6391	-0.0301	-0.1034	0.5965	0.2927	0.4020	0.13
0.5685	0.2954	0.7336	0.7134	0.8136	0.7673	0.7281	0.1673	0.5609	0.2062	0.1218	0.6285	0.4213	0.5469	0.25
0.5391	0.1839	0.6471	0.7372	0.9428	0.8246	0.7485	0.1732	0.6109	0.2069	-0.0099	0.7700	0.3820	0.3028	0.28
0.5468	0.5383	0.5727	0.4576	0.4824	0.5536	0.5433	0.3655	0.5866	0.3922	0.3515	0.5493	0.2652	0.4957	0.23
0.4388	0.1263	0.7667	0.6228	0.8088	0.7367	0.6402	0.0386	0.4532	0.1994	0.0178	0.6377	0.2635	0.2418	0.03
0.3146	0.5371	0.6118	0.7173	0.4698	0.5268	0.4835	0.1199	0.5570	0.2091	0.2267	0.6199	0.6365	0.3393	0.35
0.5978	0.2160	0.7257	0.7181	0.8828	0.8786	0.8837	0.1988	0.6302	0.1144	0.3104	0.5836	0.3165	0.3652	0.20
1.0000	0.3083	0.3617	0.5027	0.5002	0.4771	0.4610	0.3251	0.4513	0.2398	0.1587	0.4788	0.1039	0.4895	-0.01
	1.0000	0.1280	0.5858	0.0600	0.1550	0.2505	0.2218	0.4679	0.2237	-0.1425	0.3905	0.3945	0.5445	0.43
		1.0000	0.6103	0.6074	0.6855	0.6793	-0.0398	0.4878	0.0105	0.5105	0.4149	0.3813	0.2851	0.11
			1.0000	0.6066	0.5799	0.7174	0.1032	0.6593	-0.0277	0.0447	0.6760	0.4314	0.3609	0.19
				1.0000	0.7982	0.7237	0.1643	0.5392	0.1871	-0.0441	0.6442	0.2526	0.2466	0.16
					1.0000	0.7699	0.0067	0.5081	0.2045	0.2593	0.5745	0.3031	0.3268	0.25
						1.0000	0.2367	0.6100	-0.0153	0.3197	0.5374	0.3647	0.3174	0.09
							1.0000	0.3412	0.5284	-0.1230	0.2199	-0.0062	0.3616	0.00
								1.0000	0.2101	0.2052	0.6626	0.3030	0.5310	0.29
									1.0000	-0.2940	0.2668	0.1185	0.3975	0.23
										1.0000	-0.0825	0.1004	0.0313	-0.01
											1.0000	0.4179	0.3357	0.20
												1.0000	0.2098	0.57
													1.0000	0.25
														1.00

APPENDIX 3

Weighting of Equity Markets Comprising the MSCI World Index as at 31 December 2003

Country	Weight In Index
Australia	1,5%
Austria	0,1%
Belgium	0,4%
Canada	2,1%
Denmark	0,3%
Finland	1,0%
France	3,7%
Germany	2,7%
Greece	0,2%
Hong Kong	0,7%
Ireland	0,4%
Italy	1,4%
Japan	7,6%
Netherlands	2,3%
New Zealand	0,1%
Norway	0,2%
Portugal	0,2%
Singapore/Malaysia	0,3%
Spain	1,2%
Sweden	0,9%
Switzerland	2,7%
United Kingdom	10,9%
United States of America	59,1%