A Comparison of Equity Portfolio Returns between Two Developing Markets

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DECLARATION

I, Deirdrè du Toit, declare that this research report is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other university.

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Date

DEDICATION

This research report is dedicated to my husband, Vladimir, without whose help, support, patience and advice none of this would have been possible.

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ABSTRACT

The purpose of the research is to assess whether the developing markets of the world provide the same return on equity investment as South Africa. Portfolio investments in these markets have increased from US$ 100 million in 1985 to US$ 47.9 billion in 2000. With globalisation and investors looking for lucrative investment opportunities to enhance their portfolio returns (Harvey, 1995b), the researcher compared the South African and Bulgarian stock market returns and their Sharpe ratios over the past five years (2003-2008), in order to provide some guidance for investors wishing to diversify their securities investment portfolios in emerging market economies.

The Sharpe ratio is one of the most widely used statistical measures in financial analysis and is an approach to evaluate the performance of a portfolio in a mean-variance framework. It is the ratio of the expected excess return of an investment to its expected volatility (standard deviation) (Hodges, Taylor & Yoder, 1997) and is useful because it is an indication of whether a portfolio's returns are due to smart investment allocations or merely a result of excess risk.

Portfolios were created with large and small cap stock, as well as value and growth stocks. The primary methodology employed was quantitative mathematical modelling, and the results of the research were explained using both descriptive and inferential statistics.

The research showed clearly that some benefit exists when investing in both the Bulgarian and the South African markets. The benefit seems to increase when an intelligent weighting system (Solver) is used to allocate the holding weights of the individual stocks included in the portfolios.

The comparison of whether an investment in both markets is strategically better than having money invested in the individual markets, based on a risk to return comparison (Sharpe ratio), indicates that there is no statistical significant difference other than the

South African large cap and value styles. A combined portfolio investment in these styles produced Sharpe ratios that were statistically significantly better indicating that the return per unit of risk taken was superior.

The research reveals that when funds are invested in both markets, according to the style mandates and a comparison made between Solver weighted and equal weighted portfolios, the Solver weighted portfolios render Sharpe ratios that are statistically significantly better in three of the four styles, thus indicating that the return per unit of risk taken is better following a Solver weighted approach.

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CHAPTER 1 INTRODUCTION

1.1 Purpose of study

The purpose of the research is to assess whether the developing markets of the world provide the same return on equity investment as South Africa. In the last 25 years one has seen the progress in regional markets such as Africa, South America, the Middle East and Eastern Europe. Portfolio investments in these markets have increased from US$ 100 million in 1985 to US$ 47.9 billion in 2000. Eastern Europe, in the process of joining, or after joining the European Union (EU), has fast tracked related markets which have shown significant returns, not withstanding that these markets are still underdeveloped and difficult to judge due to the lack of extensive historical data (Gilmore, Lucey, & McManus, 2006).

With globalisation and investors looking for lucrative investment opportunities to enhance their portfolio returns (Harvey, 1995b), the researcher would like to investigate the possibility of diversifying between the market of an Eastern European country, i.e. Bulgaria, and the South African market. Both markets are classified as developing markets, based on World Bank rankings.

1.2 Context of study

The basis of modern portfolio theory is that investors seek high return on their investment while at the same time seek to minimise risk. These expectations are contradictory and require a trade off between risk and return when selecting stocks for the construction of any portfolio (Horasanli & Fidan, 2007).

The idea of diversifying assets in order to reduce risk became a reality after the groundbreaking research of Markovitz (1952) showing that it is the covariance between assets that is the cause for risk and not so much the variance, and that returns can be

increased while reducing risk through widening the pool of potential assets. Given some careful planning, the risk of the portfolio could therefore be less than the sum of the individual component risks. The reduction of risk within a given portfolio does not cost any money, and investors should therefore not be compensated for risks that can be diversified (Rode, 2000).

Diversification has been used extensively by investors in developed countries to increase returns (Harvey, 1995a) and decrease risk by investing in emerging markets (De Bondt, 1998; Füss, 2002).

Diversification works by examining how assets contribute to the overall risk and return of a portfolio and not how they behave in isolation. International assets are not exposed to the same country-specific "shocks" as domestic assets, thus providing diversification benefits through their lower correlations with domestic stocks even after currency risk has been factored in (Solnik & McLeavey, 2004). In spite of these benefits, a so called "home-bias" still exists, as investors invest a substantial portion of their wealth in domestic securities (Lewis, 1996; Li, 2004).

Gooptu (1993) found that the flow of investments to developing countries over the period 1989 to 1991 had increased more than two and a half times. Füss (2002) found that cross-border investment had increased from 100 million to 46,9 billion US-$ from 1985 to 2000. Most of the literature discusses the diversifiable risk for developed markets, particularly for US investors (Bekaert & Urias, 1996; de Roon, Nijman & Werker, 2001; Li, Sarkar & Wang 2003) but few discuss the ability to diversify within developing markets. This paper will examine such possibilities within two distinctly different developing markets.

1.3 Problem statement

The researcher proposes to investigate whether diversification opportunities exist between equity portfolio investments in South Africa and Bulgaria, thus proving the investor with better returns.

The purpose of the research is to compare the South African and Bulgarian stock market returns and their Sharpe ratios over the past five years, and to recommend risk diversification strategies through the combination of various stocks of the two markets in order to maximise the return for the investors.

1.3.1 Sub-problems

The first sub-problem is to compare the returns of the JSE and the BSE with a combined portfolio of JSE and BSE stocks using an equal weighted strategy over the past five years and to identify whether diversification opportunities exist when examining the weekly Sharpe ratios.

The second sub-problem is to compare the returns of the JSE and the BSE with a combined portfolio of JSE and BSE stocks using an intelligent (Solver) weighted strategy over the past five years and to identify whether diversification opportunities exist when one compares Sharpe ratios.

The third sub-problem is to compare the results of the combined portfolios and identify whether an intelligent weighting strategy delivers superior weekly Sharpe ratios over an equal weighted strategy, thus increasing the return for the investor.

1.4 Significance of study

To date there have been many comparisons made regarding the financial benefit and risk diversification of securities portfolio investments in emerging markets, which by

themselves are completely different (Bruner, 2003). On the one hand one has a well established Stock Exchange, the Johannesburg Securities Exchange (JSE) with a history spanning over a 100 year period, and on the other hand one has an emerging market of a country that has emerged from communism, joined the EU, and is on a fast track to capitalism. Significant capital investments have been made in the economies of Eastern Europe to the amount of US Dollar 112 billion in 2006, up 45% from 2005 (Economist.com, 2007).

South Africa is fighting for its place in the sun for foreign investments. In Bulgaria there is a rapidly growing middle class, a decrease in tax rates from 15% in 2006 to 10% in 2007 (worldwidetax.com 2007), freer labour laws, decreasing unemployment from 18% in 2002 to 9.6% in 2006 (Central Intelligence Agency, 2007) and a stabilising political environment. South Africa, on other hand, also has a rapidly growing middle class, often referred to as “black diamonds” (Mail & Guardian online, 2007), but the country also faces restrictive labour laws, high unemployment rates (Statistics South Africa, 2007) and high crime rates (Institute for Security Studies, 2007).

The study provides some guidance to investors wishing to diversify their securities investment portfolios in emerging market economies.

1.5 Delimitations and limitations

1.5.1 Delimitations

- Exchange rate fluctuations will be taken into account and the portfolios will be run in Rand.
- For analysis purposes the South African risk free rate will be used as the adopted perspective is that of a South African investor.
- No short selling of stock will be considered as a long term investment strategy will be followed.
- Dividend pay-outs will not be reinvested in the portfolios.

- No inflationary adjustments will be made.
- Due to the relative short existence of the BSE some survivorship bias will exist within the portfolio.
- Transactional costs will be excluded from the calculation of portfolio returns as accurate historical transaction costs cannot be obtained.
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1.5.2 Limitations

- The amount of data available from the BSE will limit the sample data.
- External events like the 2010 FIFA World Cup in South Africa could influence the data.
- Stock selections will be from the BSE and the JSE and only stocks with a sufficient trading history as well as dividend pay-outs will be used.

1.6 Definition of terms

ALSI 40 Index	The JSE Actuaries All Share 40 Top Companies Index (ALSI 40 Index). The purpose of the equity index is to reflect the performance of the ordinary South African share market in totality. The companies that are included in the ALSI 40 Index are the larger companies with a sound financial history whose shares are widely traded.
BSE	Bulgarian Stock Exchange.
Correlation	The relationship between two variables.
Covariance	The correlation between two variables multiplied by the standard deviation of each.
JSE	JSE Securities Exchange.
Large Market Capitalisation	Large cap is the abbreviation of form and is calculated by multiplying the number of the company's shares outstanding by the stock price per share. One has to consider that the currency amounts used for the classifications "large cap", mid cap", or "small cap" are approximations that can change over time. Among market participants definitions can vary substantially.
Sharpe Ratio	Developed by William F. Sharpe and is a risk-adjusted measure. The ratio is calculated using the standard deviation and excess returns to determine the reward per unit of risk. A higher Sharpe ratio is indicative of a better historical, risk-adjusted performance.

Short Sale	The sale of a share that is not owned by the seller at the date of the transaction.
Small Market Capitalisation	Small cap in abbreviated form, and refers to stocks with a relatively small market capitalisation. The definition can vary greatly and is merely an approximation that changes over time.
Standard Deviation	A statistical measure of the historical volatility of a portfolio and the extent to which returns are spread around their average (mean).
Thin Market and Thin Trading	A market with a low number of buyers and sellers. Due to the restricted number of transactions taking place in a thin market, the prices are often more volatile and the assets are less liquid. Due to the lower number of bids and asks, it results in a larger spread between the two quotations.
Variance	A measure of the average distance between each of set of data points and their mean value. It is equal to the sum of the squared values of the deviation from the mean value.
World Bank Atlas Method	The World Bank's official estimates of the size of economies of countries are based on Gross National Income (GNI) converted to current US dollars using the Atlas method. GNI takes into account all production in the domestic economy (i.e. GDP) plus the net flows of factor income (such as rents, profits, and labour income) from abroad. The Atlas method smoothes out exchange rate fluctuations by using a three year moving average with a price-adjusted conversion factor.

1.7 Assumptions

- The markets are sufficiently liquid. If this is not the case we can expect that the correlation and volatilities between stocks will increase as well as abnormal returns.
- All investors are fully invested without a portion of their portfolio in cash. Had a portion of funds been held in cash one would have to take into account the interest earned when calculating the return of a portfolio.
- Investors follow a buy and hold strategy. Should investors not follow a buy and hold strategy the transaction costs as well as changes in portfolio values and quantities will have to be taken into consideration in the calculations.
- Share data is correct. Should the share data not be correct some incorrect conclusions and results could be obtained.
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CHAPTER 2 LITERATURE REVIEW

The first part of the review will discuss the concepts of emerging and developing markets as these terms are used interchangeably in the literature and are not clearly defined. The second part of the review examines reasons for investing in developing markets, followed by part three and four that highlight the history and development of the Bulgarian Stock Exchange and the JSE Securities Exchange.

Part five will examine the literature concerning portfolio returns, diversification and risk reducing strategies, and the similarities and differences between the JSE and the BSE. Part six will look at asset allocation decisions, followed by the conclusion.

2.1 Emerging and developing markets

The term “emerging” or “developing” market was only introduced recently, however such markets have long been identified as alternative investments options by institutions and individuals. No universally accepted definition of an emerging market exists nor is there consensus regarding which markets merit the “emerging” term. The status of this global economy is dynamic where an emerging market today can become a vibrant economy tomorrow, hence the attractiveness and excitement of this market group (Barry, Peavy & Rodriguez, 1997).

An emerging or developing market economy is a term created by van Agmael of the International Finance Corporation (IFC), a subsidiary of the World Bank to define an economy with low-to-middle per capita income. These economies form the tier below the developed economies representing about 80% of the world population and 20% of the world’s economies. The economies are considered to be fast growing and are characterised by increases in both foreign and local investments (portfolio and direct) (Heakal. 2003).

There are, however, a number of different definitions for an emerging/developing market. Divecha, Drech and Stefek (1992) with a rather outdated definition define an emerging market as a market that:

- According to the Morgan Stanley Capital International or Financial Times indices is not developed;
- Global institutional investors find it of no interest;
- Data sources are reliable,
- Shares are traded publicly.

Authors that merely use income level to classify a market as "developing" are Richards and Berengaut (1996) who consider a country with a low or middle income as emerging, while Platt (1998) considers a country with a middle-income economy as developing.

Hess (1998) takes the definition one step further in that in addition to lower income levels, the investment community's general perception must be that the country is making progress in a favourable direction and that a lax/corrupt regulatory environment, greater perceived investment risk, and an inefficient banking system are all characteristics of a developing market.

The S&P/IFC indices broadly classify a market as "emerging" if one of the following two criteria is met:

- It is a low-, lower-middle, or upper-middle economy based on the World Bank definition.
- The investable market capitalisation is low compared with the GDP figures of the particular country.

In addition to these factors they also consider other criteria to categorise countries into developed, emerging, frontier and unclassified markets. The criteria addresses issues such as macroeconomic characteristics, market and company size, liquidity, competitiveness and levels of corruption (Bruner, 2003). These are the same issues that investors should consider when making investment decisions in emerging markets.

For the purpose of the research, the classification of the World Bank (which has a long history) will be used. The World Bank's categories of low, middle and high income are based on the bank's operational lending categories established three decades ago. The Gross National Income (GNI) per capita was considered the best indicator of economic capacity and progress. The original thresholds have been updated to incorporate inflationary effects ensuring that the thresholds remain constant.

The table below gives an indication of the classification and what the status of both the Bulgarian and South African economies are in terms of the World Bank classification (Gilmore *et al.*, 2006; The World Bank, 2007).

Table 1: World Bank Market Classification (2007)

Bank's fiscal year: Data for calendar year :	FY06 2004	FY07 2005	FY08 2006
Low income (L)	<= 825	<= 875	<= 905
Lower middle income (LM)	826-3,255	876-3,465	906-3,595
Upper middle income (UM)	3,256-10,065	3,466-10,725	3,596-11,115
High income (H)	> 10,065	> 10,725	> 11,115
Bulgaria	LM	LM	UM
South Africa	UM	UM	UM

2.2 Reasons for investing in developing markets

Solnik (1974), whilst merely looking at price variability and excluding exchange rate fluctuations, found that the gains from an international diversified portfolio were substantial and only half as risky as a well-diversified US stock portfolio.

In the early 1980s Errunza (1983) showed that the diversification benefits between developed markets had been eroded due to increased integration and interdependence, and that emerging markets held a promise for improved performance. Errunza and

Padmanabhan (1988) show that in spite of currency risk being an inhibiting factor for investment in developing markets, diversification still benefits the global investor.

The 1980s and 1990s saw rapid growth in emerging equity markets, much higher than the growth in some developed markets (Gill & Tropper, 1988). They suggest that in spite of being volatile, emerging markets provide an opportunity to diversify investment portfolios. Wilcox (1992) emphasises that the wealth created through the investment in emerging markets is high and the associated risk is reduced through diversification.

Gooptu (1993) identified six groups of investors in emerging markets with different motivations and each having a different tolerance for risk and return. The six groups identified are:

- Domestic residents of developing countries with overseas holdings and other private investors whose main motivation for investing is short-term high yields.
- Managed funds (closed-end country and mutual funds) – portfolio managers buy and sell shares and some holdings in high-yielding bonds.
- Foreign banks and brokerage firms – portfolios are allocated for inventory and trading purposes.
- Retail clients of Euro-bond houses – their purpose is diversification motivated by the high yield and risk that emerging markets offer.
- Institutional investors such as pension funds that focus on a longer-term time horizon expecting long term stable growth.
- Non-resident nationals of developing countries investing for long term growth.

Harvey (1995a) finds that emerging markets have low correlations with developed markets and that the inclusion of the emerging market stocks in a mean-variance efficient portfolio significantly reduces portfolio volatility and increases expected return. He also finds that the returns are more predictable than developed market returns.

De Fusco, Geppert and Tsetsekos (1996) find that the correlations between the emerging market regions are low, and in some cases negative, which provides a case for diversification between developing regions. Barry, Peavy and Rodriguez (1997) also refer to the low correlation between developing countries and, as a group, with developed markets as a means to enhance the return and reduce the risk of a total portfolio through the higher growth prospects of the developing markets. They identify three factors responsible for the dramatic growth in the emerging market stock values.

- Appreciation over time of the individual securities that compose the market.
- The inclusion of new countries in the emerging market grouping.
- Value growth due to new stocks becoming publicly available.

Rodriguez (2006) states that investing in developing markets by US institutional investors is relatively new due to the fact that countries have maintained restrictions on foreign investment in their market. As the barriers and costs of doing business in these countries have decreased, net capital flows to developing countries have increased from over $100 billion in the 1990's to over $270 billion in 2005. Due to the fact that developing markets having low return correlations with both US and international equity classes, they provide diversification benefits. Historically the returns of developing markets have on average been higher than developed markets, and over the period from 1988 to 2005, the out performance was 2.3% and 7.7% respectively.

Abidin (2006) shows that as long as the correlation coefficient between countries is less than +1.0 (closer to 0 and -1.0) some gain can still be made from international diversification.

Driessen and Laeven (2007) found that when looking at investments from a local perspective, the benefit of diversification is largest for investors in developing countries when the investment is made outside their region. The benefit extends even in the scenario where currency effects are controlled, and the benefit seems to be largest for high risk countries. They also found that the diversification benefits varied over time as

the country risk changed and that there was a general decrease in diversification benefit over the past 20 years corresponding directly to improvements in country risk over the period.

They further state that “in case of no short sales constraints, the empirical results reveal economically large and statistically significant diversification benefits for investors in almost all countries, both when returns are measured in local currency and in US dollars. For example, the Sharpe ratio increases from 10% to 21% (averaged across countries), when allowing for global diversification. Global diversification benefits tend to be much larger than regional diversification benefits. Nevertheless, a fair amount of diversification can be obtained by investing only in a regional index. This within-region diversification is often neglected in the literature” (Driessen & Laeven, 2007:5). They found that global and regional diversification benefits appeared to be the largest for Eastern European countries.

2.3 The Bulgarian Stock Exchange

The Bulgarian equity market dates back a century where in 1907, the first provisional Stock Exchange Act was adopted which regulated the structure and functions of the stock and commodity exchanges. The first real stock exchange was established on April 15th, 1914 under the King's Decree №7. Twenty one companies were listed, with a total market capital of BGL 81 million. The Stock Exchange was reopened in 1920 after the World War I and transacted mainly in forex. After World War II the Stock Exchange ceased operations.

1991 saw the re-establishment of the equity markets with the introduction of the Commerce Act,: the result of the deep structural, economic and social changes in the country after the collapse of socialism in the late 1980s. During the period 1992–1994 the market was completely unregulated with a total of 20 regional markets functioning across the country (Bulgarian Stock Exchange - Sofia, 2005).

July 1995 saw the adoption of the Securities, Stock Exchanges and Investment Companies Act and a Securities and Stock Exchanges Commission (SSEC) was established. By the end of the year all the regional markets had merged and the Bulgarian Stock Exchange emerged. Legislation introduced in 1996 required that the prospectuses of all listed stocks had to be approved by the SSEC in order to trade on the BSE. Due to a lack of compliance by all companies, trading on the BSE was suspended on 23 October 1996.

Almost a year later, on 9 October 1997, the BSE-Sofia was officially licensed by the commission and the first trading session took place on October 21. The official floor was launched with the listing of "Elkabel", Bulgaria's largest cable producing company in January 1998.

By 2000, 32 companies were listed on the Official Market and another 1,000 companies were admitted for trading on the Free (OTC) Market, a direct result of the countries Mass Privatisation Program.

The BSE-Sofia launched its official price index, the SOFIX on 21 October 2000, consisting of a portfolio of the top domestic stocks (this could vary from five to 50 stocks), and market capitalisation weighted, with a base value of 100 points. The Free Market was replaced by the Unofficial Market on 6 December 2001, when the BSE-Sofia was officially licensed to organise the Unofficial Market, setting clear rules for the regulation of all companies trading on the exchange.

In 2003 a new electronic trading system was introduced called COBOS. The Client Order-Book Online System allows for the electronic trade of securities over the Internet in real-time, removing the need for brokers and opening up international trade possibilities to encourage further investment in the market.

A further drive towards international standard regulations on transparency was the introduction of International Accounting Standards to be adhered to by all companies as

from 2005 (Bulgarian Stock Exchange - Sofia, 2005). In order to get an insight into the market size and transaction volume, Table 2 presents some details on market activity and one can see that substantial progress has been made since 1998.

Table 2: Bulgarian Statistics (World Federation of Exchanges 2007)

Bulgaria	1998	1999	2000	2001	2002	2003	2004	2005	2006
Market capitalisation (%of GDP)	7.79	5.46	4.9	3.71	4.7	8.78	11.38	18.71	32.8
Market Capitalisation (Million US$)	992	706	617	505	733	1,755	2,804	5,086	10,325
Number of Listed Companies	18	28	23	404	350	326	332	331	347

2.4 The JSE Securities Exchange

Many towns in South Africa such as Barberton, Cape Town, Johannesburg, Kimberley, Klerksdorp, Pietermaritzburg, Potchefstroom and Pretoria, had stock exchanges during the 19th century, taking advantage of the country's mineral resources. The only exception to the rule was Pietermaritzburg who used the exchange for the exploitation of the ostrich feather boom. The only exchange that survived the 20th century was the JSE, and since that time it has been synonymous with gold (Borkum, 2007).

The JSE was founded by Benjamin Woollan in 1887 and provided a facility for investors to buy and sell shares after the discovery of gold on the Witwatersrand and the subsequent establishment of the mining and investment companies. In 1963 the JSE became a member of the World Federation of Exchanges, and by 1978 had reached a market capitalisation of R51 billion.

By 1995 the South African Institute of Stockbrokers was formed, setting standards for training and the qualification of brokers. The open trading floor was closed in 1996, and replaced with the Johannesburg Equities Trading system (JET).

The Securities Exchange News Service (SENS) was introduced in 1997 which ensured real time transfer of company announcements and price information, and in 1999 the

JSE introduced an electronic settlement system, STRATE, in collaboration with the four largest commercial banks.

The year 2000 saw the listing of the Satrix 40, an exchange traded fund covering the top 40 companies on the Main Board of the JSE and the acquisition of the SAFEX, the South African Futures Exchange, in 2001.

All listed securities functioned according to the STRATE electronic settlement environment ensuring the JSE of a zero fail trade record which enhanced local and international investor confidence. A new free float indexing system was introduced, the FTSE/JSE African Index Series, which provided foreign investors with an indexing system that they were familiar with. This was all in place by the end of 2002.

During 2005 the JSE de-mutualised, adopting a corporate structure and separating the ownership and trading rights of the exchange. The existing rights holders became the first shareholders (JSE Securities Exchange 2007).

Table 3 below gives us a glance at the development of the exchange over a nine year period and it is clear that the development has been substantial. A point to be noted is that the market cap in 2006 was 280% of GDP compared to the market cap of the Bulgarian stock exchange at 32.8% of GDP in the same period.

Table 3: JSE Statistics (World Federation of Exchanges, 2007)

South Africa	1998	1999	2000	2001	2002	2003	2004	2005	2006
Market capitalisation (%of GDP)	126.77	197.08	154.24	117.95	166.5	160.66	210.46	233.58	280.41
Market Capitalisation (Million US$)	170,252	264,478	204,952	139,750	184,622	267,745	455,536	565,408	715,025
Number of Listed Companies	669	658	606	532	451	411	389	373	389

2.5 Comparison of returns, JSE and BSE

The researcher examined the similarities and differences of the two markets and compared the Sharpe ratios of the JSE and the BSE over the period 2003 to 2008.

2.5.1 Portfolio selection – number of stocks

There have been numerous debates about the number of stocks that should be included in a portfolio. Evans and Archer (1968) argued that the majority of unsystematic variation is eliminated by the addition of the 8th stock to a portfolio, and that a total number of ten are more than adequate to diversify a portfolio. They take into account that the cost of acquiring a portfolio is a function of the number of shares and the number of securities held.

Fisher and Lorie (1970:117) concluded that the "opportunity to reduce dispersion by increasing the number of stocks in the portfolio is rapidly exhausted. Roughly 40% of achievable reduction is obtained by holding two stocks; 80% by holding eight stocks; 90% by holding 16 stocks;…"

Upson, Jessup and Mutsumoto (1975) found that when examining data for the period 1926 to 1965, holding eight stocks rather than one reduced the standard deviation by 65%. A portfolio of 128 stocks compared with eight stocks saw a reduction in the standard deviation of 77%, indicating that increasing the number of stocks in a portfolio increases the confidence of obtaining the same return as the market.

Statman (1987) argued that a well diversified, randomly selected portfolio should include at least 30 stocks and that all the benefit of diversification will be exhausted beyond this point. Sears and Trennepohl (1993), as well as Bodie, Cane and Marcus (2005), appeared to suggest that the correct number lies somewhere between eight and 30.

It is worth mentioning that despite all the debate about diversification Blume, Crockett and Friend (1974) found in their test sample that 34.1% of investors only had one dividend paying stock in their stock portfolio, 50% had no more than two, and only 10.7% of investors held more than 10.

Kelly (1995) confirmed the results using data from the 1983 Survey of Consumer Finances. He found that the median number of stocks in a portfolio was a mere two and that less than 30% of households held more than 10 stocks. Kumar and Goetzmann (2002) investigated more than40 000 equity investment accounts for the period 1991 to 1996 and found that the vast majority of investors were under-diversified. Portfolios containing only one stock occurred more than 25% of the time, less than three stocks occurred more than 50% of the time, and portfolios with more than 10 stocks were observed less than 10% of the time. They did, however, find that over the investigation period (1991-1996) the average number of stocks in a portfolio increased from four to seven.

Elton and Gruber (1977) investigated the relationship between the number of stocks and their risk and found that increasing the number of securities held from one to 10 eliminates 51% of a portfolio's standard deviation. The addition of 10 more securities only eliminates an additional 5% of the standard deviation, and increasing the number of securities to 30 only reduces the standard deviation by an additional 2%.

From the literature it is clear that some benefit exists in holding more than one stock in a portfolio. The benefits, however, seem to decrease as additional stocks are added to the portfolio. The size of the portfolios selected for the research will be 15 stocks as it lies within the range suggested by the above authors.

2.5.2 Portfolio selection – style

Another important consideration is the specific style mandate for the portfolio. Banz (1981) found that smaller firms had higher risk adjusted returns than their larger

counterparts over a 40 year period, indicating that there exists a size effect. Matteev (2004) found that in the Bulgarian market the size effect is positive compared with evidence from other markets where a negative or no relationship exists between average return and size.

Sharpe (1992) also refers to different equity classes; namely value, growth, small and medium, and proposes the use of an asset class factor model to effectively allocate assets. Organisations with high book-to-market (B/M), earnings-to-price (E/P) and cash flow to price (C/P) ratios are considered to be value stocks that consistently show low earnings while stocks with low B/M, E/P and C/P tend to show persistent strong growth and high earnings (Fama & French, 1998). They found that value stocks outperformed growth stocks around the world and that 12 out of 13 major markets during the period 1975 to 1995 confirmed this, based on book-to-market ratios. They confirmed that a value premium also exists in emerging markets.

Basu (1977) found that when the effects of taxation on dividends and capital gains is ignored portfolios with low price-to earnings P/E (value) ratios perform between 2 and 4½% better than the portfolio's with high ratios (growth) on an annual basis. The P/E ratio is a comparison between two information sets, the information about current and future earnings, summarised in price, and the information about current earnings alone, while the interpretation of the ratio is that prices provide indications of future earnings relative to current earnings (Ou & Penman, 1989).

Claessens, Dasgupta and Glen (1995) examined cross-sectional returns from 19 emerging markets and found that size, dividend yield, and price-to-book value had significant explanatory power but that the signs of the coefficients were contrary to those of developed markets and that the price-earnings effect was limited. Robertson and Van Rensburg (2001) found that a two factor model was appropriate for the JSE, namely size and price-to-earnings (P/E) to capture international evidence of style effects.

Coaker (2006) found that during the period 2001-2002 the S&P 500 sank 9 and 11.9% respectively, while small value stocks gained 22.8 and 14%, clearly indicating the out performance of value stocks. Rodriguez (2006) confirmed that the returns of emerging stock markets also reveal strong size and value effects. Over the period 1988 to 2005 the return on value stocks was 22.39% compared with 14.47% on growth stocks, and that the return on small caps was 21.88% compared with 16.99% on large cap stocks.

For the purpose of the research, portfolios will be created with large and small cap as well as value and growth stocks.

2.5.3 Thin trading

Estimated returns in developing markets often differ from actual returns due to frictions in the trading process, and some periods can show no returns as a result of the stocks not having traded. Fischer (1966) was one of the first individuals to identify the occurrence of thin trading, with particular reference to the fact that recorded prices of securities were not always equal to their underlying theoretical value. A “trade-to-trade” approach was suggested by Schwert (1977) and Marsh (1979) in which case the intervals over which the returns are measured would vary in length.

Cohen, Hawawini, Maier, Schwartz and Whitcomb (1983) suggested that adjustments need to be made as soon as there is evidence of thin trading. Shanken (1987) controlled thin trading by merely eliminating thin trading stock, while other authors (Maynes and Rumsey, 1993; Kallunki & Martikainen, 1997) used a method of estimating returns for missing days and assigned them to the day on which trade took place thus setting the returns of all the no-trade days to zero. This method is prone to false autocorrelation which is caused by the zero values of non-traded periods.

Bowie and Bradfield (1993) suggested that the trade-to-trade methodology for thinly traded JSE stocks, rather than the Cohen estimator, produced results with significantly lower standard deviations indicating that it is more efficient.

Both the JSE and the BSE are plagued by thin trading (Robertson & van Rensburg, 2001; Matteev, 2004). Thin trading is due to the existence of a low number of buyers and sellers; few transactions take place, and prices are more volatile and assets are less liquid. The low number of bids and asks would make it difficult for potential buyers and sellers to transact in the market.

The BSE is more affected by this phenomenon than the JSE purely because the BSE is so much smaller and less sophisticated. Dockery and Vergari (2001) found that the efficiency of a market is related to its size and that small markets have supply and demand limitations that in turn prevent the investor forming a well balanced portfolio.

Yakimova Bhaumik and Shivarov (2002) explained further, in that many of the companies that had been privatised in Bulgaria were sold to foreign investors who do not have to raise capital from the BSE, thus adversely affecting the width of the market and the dilemma of potential owners in limiting the effect on the liquidity of the market.

In spite of the effect of thin trading, Rodriguez (2006) found that emerging markets appear to be efficient and that stock prices reflect fair values even though many imperfections exist in the markets resulting in active fund managers not being able to consistently beat the market. He also finds that despite the fact that higher turnover rates provide better stock picking opportunities they are not associated with higher returns.

For the purpose of the research the last known trading price was be used in the event of non-trading days.

2.5.4 Dual market effect

The JSE differs from other stock markets in the sense that mining companies, in particular precious metal mining, comprise a major portion of the overall market capitalisation. The prices of these commodities are influenced by international political

and economic events and are not always due to developments in the South African economy, as is the case for the industrial sector, and that the performance of these two sectors at any one time can vary significantly (Gilbertson & Goldberg, 1981). They argue that any returns-generating model would be enhanced by taking the dual nature of the market into consideration.

Carter (1983), through the use of a multi-dimensional scaling technique, demonstrated that a single index model was inappropriate for the JSE Securities Exchange and identified that the market can be split into a financial and industrial sector, and a mining sector. Achour, Harvey, Hopkins and Lang (1999), in a study conducted on investing in South Africa, noted that the economy is influenced by large mining and commodities, cyclical influences which are very sensitive to changes in international commodity prices, particularly the gold price. Bradfield (2002) confirmed that the that the JSE is composed of two types of shares, namely Financial and Industrial, and Resources shares.

Resources make up 40% of the market capitalisation of the JSE and the mining sector which is included in Resources, represents 35% of the market capitalisation on its own (Correia & Uliana, 2004). Research conducted by Barr, Kantor and Holdsworth (2007) estimated the contribution of mining and resources to be closer to 50% of the market value of the JSE, and that these respond differently to Rand weaknesses and strengths thus indicating that the All Share Index (ALSI) is heavily weighted towards Resources. They concluded that the short term movements in the JSE Securities Exchange will continue to be dominated by the direction in which the Rand moves.

Mining and energy companies earn dollars but pay costs in Rand, and a weaker Rand boosts the earnings of commodities companies (Theunissen, 2008). Correia and Uliana (2004) found that the cost of equity for the All Share Index (ALSI) and the Financial and Industrial Index (FINDI) were significantly different, and that the FINDI figures were above the ALSI figures 90% of the time, indicating that care must be taken when selecting a market proxy.

Bulgaria, on the other hand, is a small country with few resources and is considered obsolete by West European standards (Yakimova *et al*., 2002). Research conducted by Bechev and Gechev (2007), regarding the reason why developing markets are inefficient in the early periods of existence, found that when looking at the Bulgarian Stock Exchange the market had shown segmented market efficiency in the early days.

For the purpose of the research basic Resources will be excluded from the JSE population in an attempt to eliminate the exchange rate influence and ensure a better comparison between the market returns.

2.5.5 Taxes and currency

Investing in developing markets causes the investor to be exposed to the market's currency values (exchange risk) which in turn are exposed to political risk and a number of economic influences. Currency values are an important factor when examining the equity performance of different markets as results can be misleading when making performance comparisons not taking these differences into account (Barry *et al*., 1997). In order to reduce currency risk Solnik (1974) suggests that one buys a forward exchange contract and that not doing so implies speculating on currencies which in turn has its own risks and rewards.

The corporate tax rate in Bulgaria is 10%, and combined with the absence of capital gains tax, the country is supporting real business growth and equity investing. The fixed exchange rate, pegged at 1.95583 BGN (Lev) per EUR (Euro) 1 (Karoll Weekly Newsletter, 2008) as well as International Accounting Standards being practised in Bulgaria, further encourage foreign investors interested in the Bulgarian capital market (Stefanova, 2007).

South Africa, on the other hand, has an effective tax rate in the region of 36.89% (corporate rate 29% and a secondary tax on dividends 12.5%) (KPMG, 2007).

The South African Rand (ZAR) is often used for carry trade (Galati, Heath & McGuire, 2007). Currency carry trade can be defined as:

"…a leveraged cross-currency position designed to take advantage of interest rate differentials and low volatility. The strategy involves borrowing funds at a low interest rate in one currency (the funding currency) and buying a higher-yielding asset in another (the target currency). Ex ante, the strategy is only profitable as long as the gains from interest rate differentials are not expected to be overwhelmed by exchange rate movements in the short to medium term….. The use of leverage makes these positions particularly sensitive to changes in exchange rates or interest differentials" (Galati *et al*., 2007:28)

or borrowing a given amount in the funding (low interest rate) currency, converting the funds to a target (high interest rate) currency and lending the resulting amount in target currency out at a higher interest rate (Cavallo, 2006).

As long as there is a disparity between the interest rates of two currencies carry trade is appealing, and when constructing such a portfolio it is advisable to select currency pairs not based only on their interest rate differentials but rather on inflation considerations (Confas, 2008). Burnside, Eichenbaum and Rebelo (2007) pointed out that the inclusion of emerging market currencies in a carry trade portfolio substantially increases the Sharpe ratio of the carry trade providing that the bid-ask spread is taken into account.

De Wet (2006) stated that the Rand exhibits many characteristics and that stability is not one of them. Campbell (2007) confirmed this by showing that the annual volatility of the Rand over the year was 14.8% (volatility has been seen at 30%), higher than any of the currencies of major emerging markets such as Brazil, India, Indonesia and Turkey, and that the unwinding of existing carry trade positions can weaken the Rand depending on the speed that the positions are closed.

Theunissen (2007) estimated that as much as 30 to 50% of the strengthening of the Rand was due to carry trade. A currency is only considered a true carry trade if the investors takes at least a one-year position, which for the Rand tends to be more of a short term bet, and that despite the higher interest rates traders shy away from the Rand due to the patches of extreme currency volatility that the Rand exhibits (a loss of 30c to 50c against the US dollar). Much of carry trade flow is invested in government bonds, and news such as the US economic crisis has seen the outflows from the bond market at 20 billion Rand (Bonorchis, 2008).

Lim (2007) points out that many speculators use the funds to invest in foreign equity markets on a leveraged basis, forcing them to liquidate their equity positions to meet marginal calls when the price of equities fall. The consequences of carry trade activity on world-wide financial stability are enormous because of the scale in which it is done and its negative effect on liquidity.

From the literature it is clear that the South African Rand is much more volatile than the Bulgarian Lev and that the volatility is often caused by factors other than in-country political and economical factors. The Lev on the other hand is stable (pegged to the Euro) and potentially offers conservative investors an alternative to the exposure of the volatility of the Rand.

2.5.6 Conclusion

The literature suggests that when selecting a portfolio it important to acquire a sufficient number of stocks in order to diversify a portfolio adequately. The number seems to lie somewhere between eight and 30.

Another important consideration is the style mandate of the portfolio. Historically value stocks seem to outperform growth stocks, and small caps seem to outperform large caps.

Knowing the market and understanding what the effects of thin trading is on the volatility and liquidity of the market is important for any investor to take into consideration when making an investment. The methodology selected for dealing with thin trading will have a significant influence on the calculated standard deviations.

Another aspect of knowing the market, and particularly in the case of South Africa, is the fact that the market acts as two distinctly different markets, namely Resources and Financials and Industrials. This knowledge is important when comparing different markets as the influence of Resources and its dependence on the value of the Rand will skew the results.

A clear understanding of the taxes and the underlying influences on the currency of a country in which one potentially seeks to invest will allow one not to be surprised if the results of an investment are not what one had calculated. It will also allow one to seek other investment horizons in the case that the estimated currency volatilities are beyond the investor's appetite for risk.

2.6 Asset allocations decisions: A combined BSE - JSE portfolio

The researcher will examine combining assets from the BSE and the JSE in order to reduce risk and maximise returns.

2.6.1 Risk and return

Risk can be seen as the uncertainty of what a share price – and its return – will be at a particular point in the future. Another term to describe risk is volatility, which is often represented by a standard deviation in statistical terms. Return can be seen as the rate of change in value of an asset defined over a specific time interval.

2.6.2 Correlation and covariance

Low correlations (close to 0 and greater than -1) between developing and developed markets have led to developed markets taking advantage of the benefit of diversification and the increased returns (Harvey, 1995b).

Correlation is a rather abstract concept for most investors, yet it is the basis of portfolio theory. Correlation is the measurement of the direction and degree of a linear relationship that exists between two assets, and investing in assets that are not well correlated will help limit portfolio volatility and reduce risk. A perfectly positive relationship has a correlation of +1, implying that the assets move in tandem and that there is no diversification benefit. A decreasing correlation, moving towards -1 indicates that the assets are negatively related and that substantial benefits can be derived from diversification as well as reducing risk while maintaining the same returns. A correlation of 0 is merely an indication that no linear relationship exists between the assets and that some benefit can be derived from diversification (Coaker, 2006).

It is a well know fact that correlations between assets change over time. Coaker (2007) indicated that the only effective way of consistently reducing portfolio risk is by combining assets with consistently low correlations.

Markowitz (1952) stated that selecting many securities in an attempt to make the variances small is not enough, and that the investor should avoid securities with high covariance among themselves as covariance often determines the majority of the total risk. Covariance is a measure of the degree to which risky assets move together. A positive covariance indicates that returns move together while a negative covariance indicates that returns move inversely. When the covariance increases the riskiness of the investment should also increase, increasing the required rate of return and decreasing the desirability of the security.

Solnik (1974) pointed out that the total risk of a portfolio does not only depend on the number of stocks included in the portfolio but also on the riskiness of the individual stocks and the degree of independence of the risks. He expounded with an example of having a portfolio of 10 electronic securities which will benefit less from diversification than having a portfolio made up of stocks from 10 different industries.

The greater the covariance in returns, the smaller the incentive becomes to invest for diversification benefits (Leahy & Whited, 1996).

2.6.3 Sharpe ratio

The Sharpe ratio is one of the most widely used statistical measures in financial analysis and is an approach to evaluate the performance of a portfolio in a mean-variance framework. It is the ratio of the expected excess return of an investment to its expected volatility (standard deviation) (Hodges, Taylor & Yoder, 1997) and is useful because it is an indication of whether a portfolio's returns are due to smart investment allocations or merely a result of excess risk.

Dowd (2000) expanded on the concept, stating that the Sharpe ratio captures both risk and return. An increasing return and a decreasing standard deviation (both good for investors) leads to an increase in the Sharpe ratio. Opdyke (2007) expanded the concept and stated that the Sharpe ratio will be higher when there are higher returns but it will also have a higher value, everything being equal, under less volatile conditions.

When choosing between alternatives, the one with the higher Sharpe ratio will be the best alternative. Historically the Sharpe ratio has been used to rank the performance of funds and the fund with the highest value is considered the best option without one really knowing whether the difference is statistically significant or just a reflection of market volatility.

The work done by (Opdyke, 2007) developed ways in which two Sharpe ratios can statistically be tested, accompanied by p-ratios to determine whether their differences are significant. By statistically measuring the differences the Sharpe ratio can now be used more extensively than merely as a ranking tool. This method of statistically testing the differences in Sharpe Ratios will be used to determine whether the returns of the BSE and JSE are indeed different and whether diversification benefits exist between the markets. A note of caution is that the ratio takes it as a given that a return is uncorrelated with the rest of the portfolio. The Sharpe ratio is also independent of the extent of leverage that is used as long as the standard deviation remains small.

Research conducted by Eling and Schumacher (2007), comparing 13 different performance measures found that they all produced rankings that are largely the same as those obtained from methods using the Sharpe ratio, thus confirming that the Sharpe ratio is as good a risk-adjusted performance measure as the other more complex methods available.

The mathematical formulation for the Sharpe ratio is as follows:

$$SharpeRatio = \frac{\bar{r}_p - r_f}{\sigma_p}$$

Where:

$\bar{r}_p$ = Expected Portfolio return

r_f = Risk free rate

σ_p = Portfolio Standard deviation

2.6.4 Conclusion

In summary, the literature suggests that care must be taken in the selection of stocks to make up a diversified portfolio and that it would be advisable to calculate and consider correlation coefficients as well as the covariance of the stocks during the selection process. The Sharpe ratio is a valuable tool that can be used to identify a superior performing portfolio and result in increased returns on investment.

2.7 Conclusion of literature review

From the literature it is clear that a well developed portfolio strategy can result in optimal diversification of risk with excellent returns. Care must be taken that the portfolio includes sufficient numbers of stocks and that their variances and covariance are relatively low. A specific style of investment is advisable, and history has indicated that small cap and value stocks will most likely outperform growth and large cap stocks. Calculating the Sharpe ratio of different investment options can be a valuable tool in selecting the best performer.

CHAPTER 3 HYPOTHESES

Three hypotheses were tested to find the answer to the research problem at significance levels of α equal to 0.1, 0.05, and 0.01 respectively.

Hypothesis 1

These hypotheses were tested for the individual, equal weighted, BSE and JSE portfolio styles in order to determine firstly whether their Sharpe ratios are different from zero, indicating that these investments are worthwhile and that the markets are worth investing in, and secondly whether a diversification benefit exists when investing in a combined equal weighted portfolio by testing the differences in the Sharpe ratios, where the difference will be noted as $SR_{Combined}$ - SR_{BSE} and $SR_{Combined}$ – SR_{JSE}.

Table 4: Hypothesis 1

Hypothesis 1

Sharpe Ratio (SR)

	South Africa	Bulgaria	Combined SA - Bulgaria	
	Equal Weighted			
Large Cap	SR	SR	SR	Compare SR
Small Cap	SR	SR	SR	Compare SR
Value	SR	SR	SR	Compare SR
Growth	SR	SR	SR	Compare SR

Hypothesis 1a

The null hypothesis states that the equal weighted Sharpe ratio is not significantly different from zero.

The alternative hypothesis states that the equal weighted Sharpe ratio is significantly different from zero.

$H_A : SR_X \neq 0$

Where

SR_x = the Sharpe ratio of the different stock exchanges and investment styles.

Hypothesis 1b

The null hypothesis states that the difference between the combined and the individual South African and Bulgarian equal weighted Sharpe ratios is not significantly different from zero.

The alternative hypothesis states that the difference between the combined and the individual South African and Bulgarian equal weighted Sharpe ratio is significantly different from zero.

$H_0 : SR_X = 0$

$H_A : SR_X \neq 0$

Hypothesis 2

These hypotheses were tested for the individual intelligent weighted, or Solver weighted, BSE and JSE portfolio styles in order to determine firstly whether their Sharpe ratios are different from zero indicating that these investments are worth while and that the markets are worth investing in, and secondly whether a diversification benefit exists when investing in a combined Solver weighted portfolio by testing the differences in the Sharpe ratios, where the difference will be noted as $SR_{Combined}$ - SR_{BSE} and $SR_{Combined}$ – SR_{JSE}.

Solver is a what-if analysis tool. Solver automatically finds optimal values for identified input cells, called decision variables, which drive a spreadsheet model. Solver ensures

that these values satisfy identified limits, called constraints, on other cells calculated by formulas in the model. A designated formula cell, called the objective, is maximised or minimised at the optimal solution.

Table 5: Hypothesis 2

Hypothesis 2

Sharpe Ratio (SR)

	South Africa	Bulgaria	Combined SA - Bulgaria	
	Solver Weighted			
Large Cap	SR	SR	SR	Compare SR
Small Cap	SR	SR	SR	Compare SR
Value	SR	SR	SR	Compare SR
Growth	SR	SR	SR	Compare SR

Hypothesis 2a

The null hypothesis states that the Solver weighted Sharpe ratio is not significantly different from zero.

The alternative hypothesis states that the Solver weighted Sharpe ratio is significantly different from zero.

$H_0 : SR_X = 0$

$H_A : SR_X \neq 0$

Hypothesis 2b

The null hypothesis states that the difference between the combined and the individual Bulgarian and South African Solver weighted Sharpe ratios is not significantly different from zero.

The alternative hypothesis states that the difference between the combined and the individual Bulgarian and South African Solver weighted Sharpe ratio is significantly different from zero.

$H_0 : SR_X = 0$

$H_A : SR_X \neq 0$

Hypothesis 3

These hypotheses were tested for the combined portfolio styles in order to determine whether an intelligent optimisation strategy (Solver weighted) would indeed result in statistically significant returns over that of an equal weighted portfolio, where the difference in Sharpe ratio will be noted as $SR_{Solver\ weighted} - SR_{Equal\ weighted.}$

Table 6: Hypothesis 3

Hypothesis 3

Sharpe Ratio (SR)

	Combined SA - Bulgaria		
	Equal Weighted	Solver Weighted	
Large Cap	SR	SR	Compare SR
Small Cap	SR	SR	Compare SR
Value	SR	SR	Compare SR
Growth	SR	SR	Compare SR

Hypothesis 3

The null hypothesis states that the difference in Sharpe ratio is not significantly different from zero.

The alternative hypothesis states that the difference in Sharpe ratio is significantly different from zero.

$H_0 : SR_X = 0$

$H_A : SR_X \neq 0$

CHAPTER 4 RESEARCH METHODOLOGY

4.1 Introduction

The primary methodology employed was quantitative mathematical modelling, and it was applied to the problems identified. What follows is a more detailed description of the processes.

4.2 Research methodology

The method of research employed was quantitative mathematical modelling. The aim of quantitative research is to determine the relationships between independent and dependent, or outcome variables, taken from a population (Hopkins, 2000).

Quantitative research is the collection of numerical and statistical data which can be sorted, classified and measured in an objective way. The prescribed procedures ensure the validity and reliability of results and allow for broader study, enhancing the ability to make generalisations about data. The method only deals with data and issues known at the inception of the project (O'Neill, 2005).

Variables from a sample are measured and the relationships are expressed using statistical measures such as correlation, relative frequencies, covariance and the difference between means, to name but a few (Hopkins, 2000).

4.3 Research design

The scope of the share selection for the hypotheses was both the BSE and the JSE. The selection was further limited by a sufficient period of historical returns for the two indices. There were no restrictions pertaining to sectors and shares for the BSE. Because of the identified dual market effect of the JSE and the substantial influence of

exchange rates on basic Resources, this sector was excluded from the population in order to make the comparison as fair as possible. Shares were limited to ordinary, dividend paying shares.

A random sampling technique was used to select the shares to be included in the portfolios, from the identified population, based on the different style mandates. Due to the fact that a retrospective sample was taken the population was most likely a victim of survivorship bias as shares that did not have a sufficiently long history were disregarded.

As discussed in the literature review, the benefit of diversification increases as more stocks are added to a portfolio. Evans and Archer (1968) found that 10 stocks are more than adequate to diversify a portfolio while Statman (1987) argued that the benefit of diversification is exhausted beyond 30 stocks. The size of each portfolio was restricted to 15 shares, a reasonable number for a private investor taking into account cost vs. diversification benefits.

Shares in the portfolios tested in Hypothesis 1 were purchased on an equal-value weighted basis ensuring that the initial holding of the shares were the same in value terms.

The daily returns for each stock were calculated by taking the log of the share price of week two divided by the share price of week one and continued until the last data point is included. The mean and standard deviation of each mandate were calculated and these in turn were used to calculate the Sharpe ratio:

$$SharpeRatio = \frac{\bar{r}_p - r_f}{\sigma_p}$$

Where:

$\bar{r}_p$ = Expected Portfolio return

r_f = Risk free rate

σ_p = Portfolio Standard deviation

The share selection for Hypothesis 2 made use of Solver to allocate optimal weights based on the maximisation of the Sharpe ratio. A detailed description of the process followed can be found in Appendix A.

The scope of the share selection in Hypothesis 3 was merely the two combined portfolios that were created in Hypothesis 1 and 2, based on the style selection.

In order to determine whether the differences in Sharpe ratios of the portfolios were statistically significant, the following two-sample statistic for comparing Sharpe ratios, as described by Opdyke (2007), was used as well as the MS Excel spreadsheets obtained from the author.[1]

The Sharpe ratio has significant limitations that are well known and documented. The limitations include inappropriateness when returns are non-normal, non-comparability when the investment horizons differ, the "inputs", expected return and standard deviations are measured with error resulting in the Sharpe ratio being subject to estimation error (Christie 2005). He continued to say that in order to determine whether the Sharpe ratios are statistically significantly different from zero, one has to take into account the correlation between the estimators of the means and the standard deviations, as well as the Sharpe ratio itself. Because the Sharpe ratio is a convex

[1] The article published by Opdyke (2007) makes reference to the author's website, www.DataMineIt.com, where the Excel spreadsheets are obtainable. It was downloaded by the researcher but only after personally contacting the author by email was a password obtained that unlocked the spreadsheets.

function, and given Jensen's inequality, it is known that the expected value of the estimator of the Sharpe ratio will be bias and therefore needs to be corrected.

Opdyke (2007) built on and combined the work of Lo (2002) and Christie (2005) and derived a one and two sample estimator that delivers a reasonably good power of control in real world conditions that include concurrent leptokurtosis, asymmetry and in the case of two samples, strong correlation between inputs. What follows is the corrected formula required for the correction of the estimates in order to produce valid results regarding the statistical significance of the differences in Sharpe ratio.

The calculation of the point estimates of the differences in Sharpe Ratio (SR_{diff}) was bias corrected for skewness and kurtosis by using the following formula.

Skewness correction

$$\sqrt{b_1} = \left[\frac{n-2}{\sqrt{n(n-1)}}\right] \times \left[\frac{\left(n\sum_{i=1}^{n} x_i^3 - 3\sum_{i=1}^{n} x_i \sum_{i=1}^{n} x_i^2 + 2\left(\sum_{i=1}^{n} x_i\right)/n\right)}{s^3 \times [n-1][n-2]}\right]$$

Where $\sqrt{b_2}$ is the estimator used for skewness

Kurtosis correction

$$b_2 = 3\frac{(n-1)}{(n+1)} + \frac{(n-2)(n-3)}{(n+1)(n-1)} \times$$

$$\frac{\left[(n^3+n_2)\sum_{i=1}^{n} x_i^4 - 4(n^2+n)\sum_{i=1}^{n} x_i^3 \sum_{i=1}^{n} x - 3(n^2-n)\left(\sum_{i=1}^{n} x_i^2\right)^2 + 12n\sum_{i=1}^{n} x_i^2\left(\sum_{i=1}^{n} x\right)^2 - 6\left(\sum_{i=1}^{n} x\right)^4\right]}{s^4 \times 4(n-1)(n-2)(n-3)}$$

Where b_2 is the estimator used for kurtosis and

the difference in variance is calculated by

$$Var_{diff} = 2 - 2\rho_{a,b} + \frac{1}{2}\left(SR_a^2 + SR_b^2 - 2SR_aSR_b\rho_{a,b}^2\right)$$

and the standard error of the Sharpe ratio calculated by

$$SE(\widehat{SR}) = \sqrt{\left[1 + \frac{SR^2}{4}\left(\frac{\mu_4}{\sigma^4} - 1\right) - SR\frac{\mu_3}{\sigma^3}\right]/T}$$

The formula for the estimated Standard error being

$$\widehat{SE(\widehat{SR})} = \sqrt{\left[1 + \frac{\widehat{SR^2}}{4}\left(\frac{\hat{\mu}_4}{\hat{\sigma}^4} - 1\right) - \widehat{SR}\,\frac{\hat{\mu}_3}{\hat{\sigma}^3}\right]/(T-1)}$$

And the confidence bounds are determined by

$$\widehat{SR} \pm z_{crit} \times \widehat{SE(\widehat{SR})}$$

Where the z_{crit} is the critical value of the standard normal distribution that corresponds to the desired confidence level.

The bias adjustment formula is

$$= SR(\mu, \sigma) \times \left(1 + \frac{1}{4} \frac{\left[\frac{\mu_4}{\sigma^4} - 1 \right]}{T} \right)$$

4.4 Population and sample

4.4.1 Population

The population for the research included stocks of the BSE and JSE with a history spanning at least five years. Basic Resources were excluded from the JSE, and the top stocks of the JSE and the BSE, which have a dividend and sufficient trading history, were selected for the population.

4.4.2 Sample

A stratified sampling technique was used to select the stocks from the population bases on selected style mandates, namely Large Cap, Small Cap, Value and Growth. Large cap included all stocks that make up 90% of the population market capitalisation while value and growth was differentiated by the 50th -percentile of accumulated P/E values, where value stretches from 0 to 50% and growth is represented by values over 50 and up to 100%.

A total of 15 stocks per portfolio for all the different investment style mandates were selected from the respective populations.

4.5 Data collection

Historical, closing price data was obtained for the JSE and the BSE. Bulgarian share prices were obtained from the Bulgarian Stock Exchange official website (www.bse-sofia.bg) which is available to the public.

South African share prices were obtained from the share trading website of Standard Bank.

The period used for the analysis stretched from 4 April 2003 to 14 July 2008.

4.6 Data analysis and interpretation

The returns, and ultimately the Sharpe ratios, of the different portfolios were compared individually and then combined, examining the growth, total returns and whether the data were statistically different from zero, thus indicating that diversification opportunities exist between the two developing markets.

4.7 Validity and reliability

High levels of validity and reliability are important in research. Validity refers to the accuracy of the study; and reliability can be defined as "the consistency with which a measuring instrument yields a certain result when the entity being measured hasn't changed" (Leedy, 2001:31).

4.7.1 External validity

External validity is the extent to which generalisations from the results of a specific study can be made into other areas (Leedy & Ormrod, 2001). The result obtained from the research might be a valuable tool to use in making inferences regarding the similarities and dissimilarities of other stock exchanges and whether diversification opportunities exist.

4.7.2 Internal validity

Internal validity refers to the extent of accurate conclusions being made from the study (Leedy & Ormrod 2001). This implies that the possibilities of the research results coming

about from reasons other than the results from the study have been reduced. The results from the study will be based purely on the returns, and care will be taken that the selection techniques will be random ensuring unbiased.

4.7.3 Reliability

According to Leedy and Ormrod (2001), reliability examines the consistency of results within the study. Reliability in this study will be determined through the consistent and correct application of the models used.

CHAPTER 5 PRESENTATION OF RESULTS

5.1 Introduction

The Bulgarian population in the study comprised 64 companies listed on the Bulgarian Stock Exchange. All the companies had a share trading history and paid dividends during the period of consideration, i.e. 2003-2008.

The South African population in the study comprised 140 companies listed on the JSE Securities Exchange. All the companies had a share trading history and paid dividends during the period of consideration, i.e. 2003-2008.

Data were gathered from the Bulgarian Stock Exchange and the Standard Bank web sites.

The data were adjusted for currency fluctuations by converting the Bulgarian stock prices from Lev to Rand, using daily exchange rate data from the web site of the Bulgarian National Bank.

5.2 Large cap

The 15 large cap stocks in both the Bulgarian and South African portfolios were randomly selected from the sample of stocks that combined make up 90% of the population market capitalisation.

In the case of South Africa, the stocks in the large cap portfolio comprised the following:

Table 7: Large Cap - South Africa

Large Cap		
	Code	**Name**
1	LGL	Liberty Group
2	SUI	Sun International Ltd
3	RLO	Reunert
4	INL	Investec Ltd
5	NPK	Nampak
6	SHF	Steinhoff International Holdings
7	SLM	Sanlam
8	TKG	Telkom
9	MSM	Massmart Holdings
10	PPC	Pretoria Portland Cement
11	SBK	Standard Bank Group
12	INP	Investec PLC
13	REM	Remgro
14	ACL	ArcelorMittal
15	FSR	Firstrand Limited

The Bulgarian large cap portfolio included the following stocks:

Table 8: Large Cap Bulgaria

Large Cap		
	Code	**Name**
1	ELTOS	Sparky Eltos
2	TOPL	Toplivo
3	CCB	CB Central Cooperative Bank
4	ELHIM	Elhim Iskra
5	HVAR	Holding Varna
6	OTZK	Le and Zinc Complex
7	SKELN	SS Konstantine And Elena Holding
8	IHLBL	Industrial Holding Bulgaria
9	DOVUHL	Doverie United Holding
10	ALBHL	Albena Invest Holding
11	NEOH	Neochim
12	HIKA	Industrial Capital Holding
13	MCH	M+S Hydraulic
14	SFARM	Sopharma
15	KAU	Kauchuk

The combined large cap portfolio was merely a combination of the South Africa and Bulgarian large cap portfolios.

5.3 Small cap

The small cap Bulgarian and South African portfolios were made up of 15 stocks that were randomly selected from the sample remaining after the exclusion of large cap stocks. The South African portfolio contained the following stocks:

Table 9: Small Cap South Africa

Small Cap		
	Code	**Name**
1	ARL	Astral Foods Ltd
2	GDF	Gold Reef Resorts
3	NCL	New Clicks Holdings
4	CAT	Caxton & CTP
5	BAT	Brait SA
6	HDC	Hudaco Industries
7	OCT	Octodec Investments
8	ZSA	Zurich Insurance Co S A
9	MAF	Mutual & Federal Insurance Company
10	CPL	Capital Property Fund
11	KGM	Kagiso Media Ltd
12	EOH	EOH Holdings Ltd.
13	SFN	Sasfin Holdings
14	DCT	Datacentrix Holdings
15	AVI	AVI

While the Bulgarian portfolio included the following:

Table 10: Small Cap Bulgaria

Small Cap

	Code	Name
1	MOSTS	Moststroy
2	RAZHL	Razvitie Industry Holding
3	ELKA	Elektronika
4	YAVOV	Yavor
5	DUPBT	Dupnitsa-BT
6	MSTRY	Mashstroy
7	HANKR	Han Krum
8	AKUMP	Akumplast
9	DOBRO	Dobrotitsa-BSK
10	PKAR	Petar Karaminchev
11	AFH	Favorit Hold
12	BULVI	Bulgaria-29
13	GAMZA	Severcoop Gamza Holding
14	HFSI	FS Holding
15	SEVTO	Bulgarska Roza-Sevtopolis

The combined small cap portfolio was made up of the combination of the South Africa and Bulgarian small cap portfolios.

5.4 Value and growth

The value and growth populations ware differentiated by the 50^{th} percentile of the accumulated P/E values, where value stocks are classified as the stocks from 0 to the 50% and growth stocks are represented by the stocks with values over 50 and up to 100%.

The 15 stocks representing the value portfolio were randomly selected from the sample making up the 0 to 50^{th} percentile. In the case of Bulgaria the stocks are represented in table 11.

Table 11: Value Portfolio Bulgaria

Value		
	Code	**Name**
1	ELKA	Elektronika
2	DOBRO	Dobrotitsa-BSK
3	RAZHL	Razvitie Industry Holding
4	FAZAN	Fazan
5	NEOH	Neochim
6	BULSTH	Yutex Holding
7	ALBHL	Albena Invest Holding
8	BCH	Bulgar Czech Invest Holding
9	TCH	TK-Hold
10	ALB	Albena
11	DUPBT	Dupnitsa-BT
12	TOPL	Toplivo
13	VPLOD	Varna-Plod
14	HVAR	Holding Varna
15	YAVOV	Yavor

The South African value portfolio included the following stocks:

Table 12: Value Portfolio South Africa

Value		
	Code	**Name**
1	SNT	Santam
2	UCS	UCS Group
3	OMN	Omnia Holdings Ltd
4	KAP	KAP International Ltd
5	NED	Nedbank Group.
6	DCT	Datacentrix Holdings
7	MET	Metropolitan Holdings
8	DAW	Distribution and Warehousing Network
9	SUR	Spur Corp
10	SHF	Steinhoff International Holdings
11	KGM	Kagiso Media Ltd
12	CRM	Ceramic Industries
13	ASA	Absa Group
14	ILA	Iliad Africa
15	ADW	African Dawn Capital

The Bulgarian and South African growth portfolios were randomly selected from the population samples of the over 50th to the 100th percentile of accumulated P/E values.

The stocks included in the Bulgarian Growth portfolio are represented in Table 13 below.

Table 13: Growth Portfolio Bulgaria

Growth	Code	Name
1	ALUM	Alcomet
2	HFSI	FS Holding
3	KMH	Belovo Paper Mill
4	FORM	Formoplast
5	DSPED	Despred
6	SEVTO	Bulgarska Roza-Sevtopolis
7	BULVI	Bulgaria-29
8	CCB	CB Central Cooperative Bank
9	AFH	Favorit Hold
10	ROZA	Bulgarska Roza
11	MELHL	Mel Invest Holding
12	KAU	Kauchuk
13	OTZK	Le and Zinc Complex
14	IHLBL	Industrial Holding Bulgaria
15	ELMET	Elektrometal

The 15 stocks included in the South African Growth portfolio are listed in Table 14 below:

Table 14: Growth Portfolio South Africa

Growth	Code	Name
1	ADR	Adcorp Holdings
2	TRE	Trencor Ltd
3	APK	Astrapak Ltd
4	CPI	Capitec Bank Hldgs Ltd
5	ACP	Acucap Properties Limited
6	ADH	Advtech
7	ENV	Enviroserv Holdings
8	RES	Resilient Prop Inc Fd
9	GRF	Group Five/South Africa
10	MSM	Massmart Holdings
11	DGC	Digicore Holdings
12	RAH	Real Africa Holdings
13	HDC	Hudaco Industries
14	TRU	Truworths International
15	FBR	Famous Brands

The combined value and growth portfolios are a combination of the Bulgarian and South African value and growth portfolios.

5.5 Equal weighted portfolio descriptive results

The equal weighted portfolios period returns, standard deviation and Sharpe ratios are summarised in Table 16 below. Looking at the Sharpe ratios, and following the general guidelines that the portfolio with the highest Sharpe ratio is the best investment based on risk and return, the large cap combined portfolio, with a Sharpe ratio of 0.2785 would have been the first choice. What one notes, however, is that the large cap Bulgarian portfolio produced the highest period return of 35.86. The period return is the final value of one Rand invested into each portfolio at the beginning of the period. This portfolio had the second largest Sharpe ratio of 0.2557, and compared with the large cap combined portfolio, had higher standard deviation and mean return values, confirming that having taken more risk the return would have been better.

Table 15: Descriptive statistics for all equal weighted portfolios

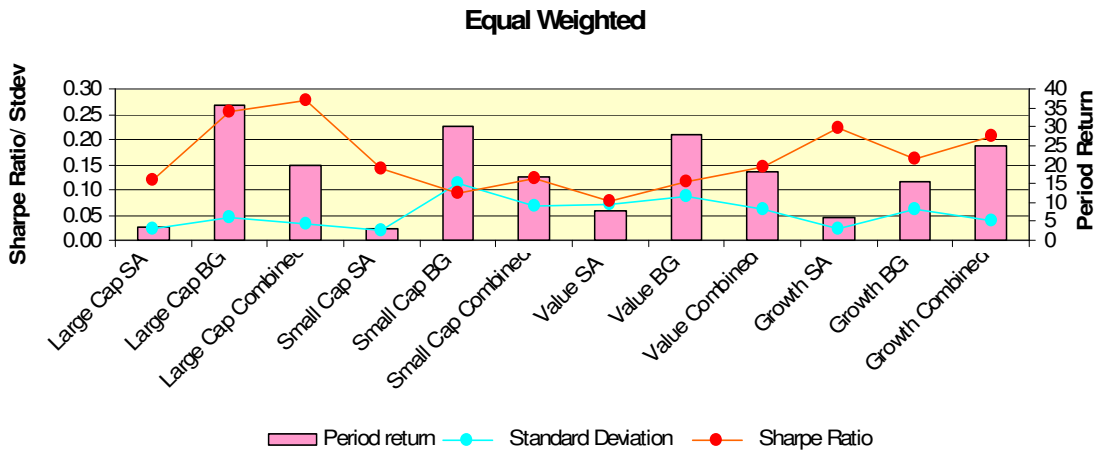
Equal Weighted
South Africa & Bulgaria individually vs. Combined portfolio

Sharpe Ratio and Descriptive Statistics	Mean Return	Standard Deviation	Sharpe Ratio	Period return
Large Cap SA	0.0044	0.0232	0.1202	3.32
Large Cap BG	0.0130	0.0447	0.2557	35.86
Large Cap Combined	0.0108	0.0331	0.2785	19.59
Small Cap SA	0.0042	0.0185	0.1427	3.19
Small Cap BG	0.0124	0.1124	0.0932	29.95
Small Cap Combined	0.0102	0.0681	0.1236	16.57
Value SA	0.0075	0.0695	0.0772	7.87
Value BG	0.0121	0.0871	0.1157	27.83
Value Combined	0.0105	0.0600	0.1439	17.85
Growth SA	0.0064	0.0215	0.2237	6.00
Growth BG	0.0117	0.0622	0.1600	15.34
Growth Combined	0.0099	0.0401	0.2059	24.87

* Sharpe ratio has been bias corrected

Figure 1 below is a graphic representation of the period returns (the pink bars with the scale on the right of the graph) compared with the standard deviation (blue line) and Sharpe ratio (red line) values (scale on the left of the graph). One can clearly see that the differences are substantial and one would expect that there would be statistically significant differences in the Sharpe ratios.

Figure 1: Equal weighted portfolios risk, return and standard deviation



5.6 Equal weighted portfolio inferential results

The single asterisk (*) next to the p value in Table 16, 18 and 20 indicates rejection of the null hypothesis, that the Sharpe ratio is equal to zero at a 10% significance level (90% confidence), two (**) indicates rejection of the null hypothesis at a 5% significance level (95% confidence), and three (***) indicates rejection of the null hypothesis at a 1% significance (99% confidence).

Table 16 below represents the results of the equal weighted, individual portfolios compared with the equal weighted combined portfolios for each style mandate.

The p-values indicate whether the individual Sharpe ratios of either fund are statistically significantly larger than zero, and whether the Sharpe ratio of one fund B, in this case the

combined equal weighted portfolios is larger than that of the other A (equal weighted South African and Bulgarian individual portfolios) with statistical significance.

From the data one can see that the Sharpe ratios of the combined equal weighted portfolios (SR-B) are all statistically significantly different from zero at a significance level of 1% except in the case of the equal weighted combined portfolio which is significant at the 5% level. The individual equal weighted portfolios of South Africa and Bulgaria (SR-A) have mixed results. The large cap Bulgarian and both the growth portfolios for South Africa and Bulgaria are statistically significantly different from zero at a 1% level, only the small cap South African portfolio is significant at the 5% level and the large cap and value, South African portfolios are significant at the 10% level. In the small cap and value Bulgarian portfolios, the Sharpe ratios are not statistically significantly different from zero.

The data for the difference in the Sharpe ratio, whether the combined equal weighted portfolios (SR-B) is larger than the individual South African and Bulgarian equal weighted portfolios (SR-A), indicate that the differences are not statistically significantly different from zero except in the in large cap South African portfolio where the difference is significant at a 5% level.

Table 16: Equal weighted portfolio's - Sharpe Ratio p –values

Equal Weighted

South Africa & Bulgaria individually vs. Combined portfolio

Inferential Statistics:	**SR-A** 2-tailed p-value Ho: SR-A = 0	**SR-B** 2-tailed p-value Ho: SR-B = 0 (combined)	**SR-Diff** 2-tailed p-value Ho: (SRB - SRA) = 0	Pearson's Linear Correlation Coefficient
Large Cap SA	0.0531 *	0.0000 ***	0.0342 **	0.2435
Large Cap BG	0.0000 ***	0.0000 ***	0.5674	0.9597
Small Cap SA	0.0251 **	0.0499 **	0.8291	0.0350
Small Cap BG	0.1306	0.0499 **	0.1344	0.9806
Value SA	0.0672 *	0.0080 ***	0.2060	0.6650
Value BG	0.1164	0.0080 ***	0.5147	0.7326
Growth SA	0.0008 ***	0.0010 ***	0.8250	0.2480
Growth BG	0.0095 ***	0.0010 ***	0.1147	0.9722

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

The Pearson's linear correlation coefficient (r) describes how closely the portfolio returns track, or are related to one another. In order to determine what in terms of correlation is "high" and what is "low" Franzblau's (1958) rules of thumb will be used. He states that "r" of zero to .20 can be regarded as none or a negligible correlation, an "r" between .20 and .40 indicates a low degree of correlation, an "r" between .40 to .60 indicates a moderate degree of correlation, an "r" between .60 and .80 indicates a marked degree of correlation, and "r" values between .80 and 1.00 indicate high correlation.

From the data above one can see that all the Bulgarian portfolios are highly correlated with the combined portfolio and that all the South African portfolios have a low degree of correlation with the combined portfolios with the exception of the South African value portfolio which has a marked degree of correlation with the combined portfolio.

5.7 Solver weighted portfolio descriptive results

Table 17 below is a summary of the Solver weighted portfolio's period and mean return, standard deviation and Sharpe ratios. All the combined portfolios have higher Sharpe ratios than the individual South African and Bulgarian portfolios with all having values above 0.3, with the exception of the small cap combined portfolio which has a value of 0.2742. Looking at the period return, i.e. the growth of a one Rand invested at the beginning of the period, it is clear that the Bulgarian portfolios delivered superior returns taking into account that the risk associated with the investments were also substantially higher, as indicated by the higher standard deviation values.

Table 17: Descriptive statistics for solver weighted portfolios

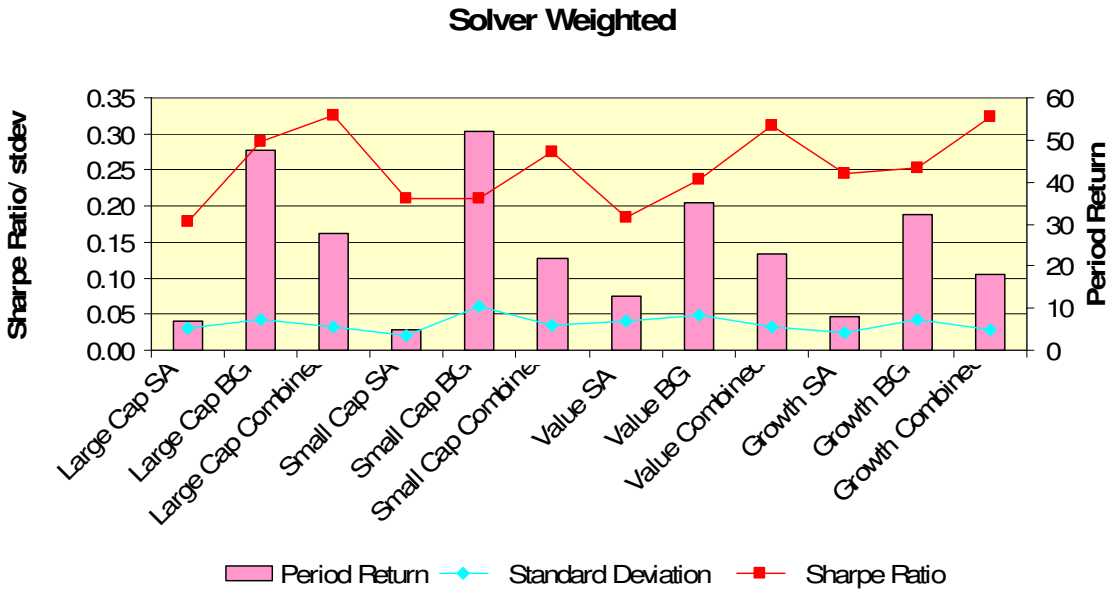
Combined vs. South Africa & Bulgaria individually
Solver Weighted

Sharpe Ratio and Descriptive Statistics	Mean Return	Standard Deviation	Sharpe Ratio	Period Return
Large Cap SA	0.0070	0.0302	0.1781	6.77
Large Cap BG	0.0140	0.0430	0.2895	47.58
Large Cap Combined	0.0121	0.0323	0.3249	27.81
Small Cap SA	0.0056	0.0194	0.2099	4.72
Small Cap BG	0.0144	0.0602	0.2112	51.88
Small Cap Combined	0.0112	0.0349	0.2742	21.97
Value SA	0.0092	0.0407	0.1833	12.67
Value BG	0.0129	0.0480	0.2366	35.20
Value Combined	0.0114	0.0314	0.3110	22.94
Growth SA	0.0076	0.0246	0.2450	8.13
Growth BG	0.0126	0.0435	0.2535	32.16
Growth Combined	0.0105	0.0275	0.3246	18.07

* Sharpe ratio has been bias corrected

Figure 2 is a graphic representation of the of the Sharpe ratio, the period return, and the associated standard deviations of each of the Solver weighted portfolios. Looking at the differences it would appear that statistically there is a significant difference in the Sharpe ratio values.

Figure 2: Solver weighted portfolio's risk, return and standard deviation



5.8 Solver weighted portfolio inferential results

Table 18 below represents the results of the Solver weighted, individual portfolios compared with the combined portfolios for each style mandate.

The p-values indicate whether the individual Sharpe ratios of either fund are statistically significantly larger than zero, and whether the Sharpe ratio of one fund B, in this case the combined Solver weighted portfolios, is larger than that of the other A (Solver weighted South African and Bulgarian individual portfolios) with a statistical significance. From the data one can see that the Sharpe ratios of the combined Solver weighted portfolios (SR-B) are all statistically significantly different from zero at a significance level of 1% as well as all the individual Solver weighted portfolios of South Africa and Bulgaria (SR-A).

The data for the difference in the Sharpe ratio, whether the combined Solver weighted portfolios (SR-B) is larger than the individual South African and Bulgarian Solver weighted portfolios (SR-A), indicates that the differences are not statistically significantly

different from zero except in the in large cap South African and the South African value portfolio where the differences are significant at a 5% level indicating that investing in a combined portfolio within these two styles of investing would have rendered superior returns on a return per unit of risk basis.

Table 18: Solver weighted portfolio's Sharpe ratio p-values

Solver Weighted
South Africa & Bulgaria individually vs. Combined portfolio

Inferential Statistics:	**SR-A** 2-tailed p-value Ho: SR-A = 0	**SR-B** 2-tailed p-value Ho: SR-B = 0 (combined)	**SR-Diff** 2-tailed p-value Ho: (SRB - SRA) = 0	Pearson's Linear Correlation Coefficient
Large Cap SA	0.0035 ***	0.0000 ***	0.0475 **	0.2550
Large Cap BG	0.0000 ***	0.0000 ***	0.4453	0.9367
Small Cap SA	0.0009 ***	0.0000 ***	0.4051	0.1853
Small Cap BG	0.0001 ***	0.0000 ***	0.1411	0.8928
Value SA	0.0004 ***	0.0000 ***	0.0266 **	0.6691
Value BG	0.0001 ***	0.0000 ***	0.1549	0.7195
Growth SA	0.0002 ***	0.0000 ***	0.2093	0.5437
Growth BG	0.0000 ***	0.0000 ***	0.1562	0.8735

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Pearson's linear correlation coefficient (r) describes how closely the portfolio returns track, or are related to one another.

From the data above one can see that all the Bulgarian portfolio returns are highly correlated with the combined portfolio, and that all the South African portfolios have a low degree of correlation with the combined portfolios, with the exception of the South African value and growth portfolios which have a marked and moderate respective degree of correlation with the combined portfolios.

5.9 Equal vs. Solver weighted portfolio descriptive results

Table 19 below is a summary of the combined equal and Solver weighted portfolio's period and mean return, standard deviation and Sharpe ratios. Without exception the Solver weighted portfolios have higher Sharpe ratios than the equal weighted portfolios. The period return values is the growth of a single Rand invested at the beginning of the period. From the data it is clear that the Solver weighted portfolios delivered superior returns. The higher period returns were also associated with lower standard deviations, i.e. risk as well as higher mean returns.

Table 19: Descriptive statistics for equal vs. Solver weighted portfolios

Combined
Equal vs. Solver weighted

Sharpe Ratio and Descriptive Statistics	Mean Return	Standard Deviation	Sharpe Ratio	Period Return
Growth Equal weighted	0.0099	0.0401	0.2059	15.34
Growth Solver weighted	0.0105	0.0275	0.3246	18.07
Value Equal Weighted	0.0105	0.0600	0.1439	17.85
Value Solver Weighted	0.0114	0.0314	0.3110	22.94
Small Cap Equal Weighted	0.0102	0.0681	0.1236	19.59
Small Cap Solver Weighted	0.0112	0.0349	0.2742	27.81
Large Cap Equal Weighted	0.0108	0.0331	0.2785	16.57
Large Cap Solver Weighted	0.0121	0.0323	0.3249	21.97

* Sharpe ratio has been bias corrected

Figure 3 below is a graphic representation of the of the Sharpe ratio, the period return and the associated standard deviations of each of the Solver and equal weighted combined portfolios. Looking at the differences it would appear that statistically there is a significant difference in the Sharpe ratio values of each of the paired investment styles based on an equal vs. Solver weighting strategy.

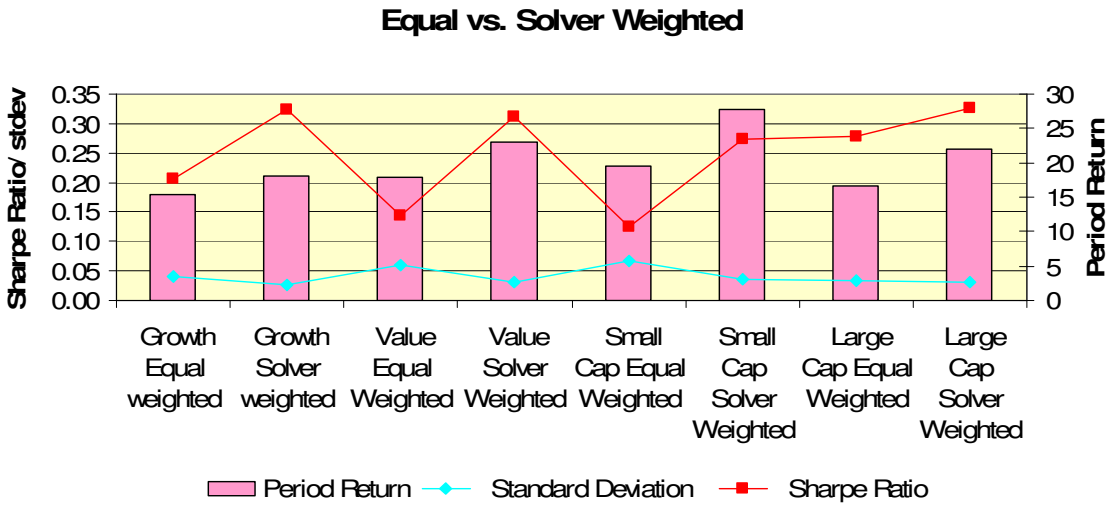


Figure 3: Equal vs. Solver weighted portfolios risk, return and standard deviation

5.10 Equal vs. Solver weighted portfolio inferential results

Table 20 below represents the results of the combined portfolios comparing the equal vs. Solver weighting for each style mandate. The p-values indicate whether the individual Sharpe ratios of either fund are statistically significantly larger than zero, and whether the Sharpe ratio of one fund B, in this case the Solver weighted portfolios, is larger than that of the other A (equal weighted portfolio) with statistical significance. From the data one can see that the Sharpe ratios of the combined Solver weighted portfolios (SR-B) are all statistically significantly different from zero at a significance level of 1% as well as all the combined equal weighted portfolios (SR-A) except the small cap equal weighted combined portfolio which is significant at a 5% level.

The data for the difference in the Sharpe ratio, whether the combined Solver weighted portfolios (SR-B) is larger than the combined equal weighted portfolios (SR-A), indicates that this is indeed the case. The large cap portfolio differences are not statistically significantly different from zero while the differences in growth portfolios is statistically

significant at a 10% level; the small cap portfolios at a 5% level, and the value portfolios at a 1% level.

Table 20: Sharpe ratio, p values for the combined portfolios

	Equal vs. Solver Weighted Combined Portfolios			
Inferential Statistics:	**SR-A** 2-tailed p-value Ho: SR-A = 0 (Equal)	**SR-B** 2-tailed p-value Ho: SR-B = 0 (Solver)	**SR-Diff** 2-tailed p-value Ho: (SRB - SRA) = 0	Pearson's Linear Correlation Coefficient
Combined Growth	0.0010 ***	0.0000 ***	0.0664 *	0.7031
Combined Value	0.0080 ***	0.0000 ***	0.0057 ***	0.6707
Combined Small Cap	0.0499 **	0.0000 ***	0.0246 **	0.4881
Combined Large Cap	0.0000 ***	0.0000 ***	0.3217	0.9220

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Pearson's linear correlation coefficient (r) describes how closely the portfolios returns track, or are related to one another.

From the data above one can see that all the combined equal weighted portfolios' returns are all correlated to the combined Solver weighted portfolios' returns. The combined small cap portfolio has the lowest correlation (moderate) followed by the value and growth portfolios (marked degree) and the large cap has a (high) correlation with the Solver weighted returns. The high level of correlation is not surprising as the portfolios are made up of exactly the same shares with the only difference being the weighting.

5.11 Conclusion

From the figures and the tables above it is clear that some benefit exists when investing in both the Bulgarian and the South African markets. An equal weighted strategy for each of the South African and Bulgarian portfolios compared with a combined portfolio does not deliver statistically significantly different from zero results. In only one case, i.e.

the large cap South African portfolio, is the difference statistically significant different from zero at a 5% significance level.

The benefit seems to increase when an intelligent weighting system (Solver) is used to allocate the holding weights of the individual stocks included in the portfolios. When the Solver weighted portfolios of South African and Bulgarian are compared with a combined portfolio one observes that only in the case of the South African large cap and value portfolios is the difference significantly different from zero.

Three of the four equal vs. Solver weighted combined portfolios were statistically significantly different from zero.

The following chapter provides a more detailed interpretation of the results.

CHAPTER 6 INTERPRETATION OF RESULTS

6.1 Introduction

Investors are always looking for ways to maximise returns without taking too much risk. The Sharpe ratio is widely used as a measure to select a portfolio that would have the best risk to return ratio, i.e. the highest Sharpe ratio. Whether the differences in the Sharpe ratios are statistically significantly different from zero has not had much attention as it has mainly been used as a ranking tool. The results indicate that using different styles and weighting systems does in some instances produce results that are statistically different from zero.

6.2 Results

Here the results are related to the hypothesis in the study.

6.2.1 Hypothesis 1a

The null hypothesis states that the equal weighted Sharpe ratio is not significantly different from zero.

The alternative hypothesis states that the equal weighted Sharpe ratio is significantly different from zero.

The research reveals that the Sharpe ratios of the Bulgarian small cap and value portfolios are not statistically significantly different from zero and based on a risk return ratio not worth investing in.

All the other combined and individual portfolios reveal that there is a statistically significant positive value of the Sharpe ratios.

6.2.2 Hypothesis 1b

The null hypothesis states that the difference between the combined and the individual South African and Bulgarian equal weighted Sharpe ratios is not significantly different from zero.

The alternative hypothesis states that the difference between the combined and the individual South African and Bulgarian equal weighted Sharpe ratio is significantly different from zero.

The research reveals that the difference in Sharpe ratios is not statistically different from zero in seven of the eight comparisons, proving the null hypothesis that no benefit exists when investing in a combined portfolio rather than individual portfolios.

The null hypothesises is rejected in favour of the alternative in the large cap South African portfolio where a combined investment strategy would have produced a Sharpe ratio that was statistically significantly better.

6.2.3 Hypothesis 2a

The null hypothesis states that the Solver weighted Sharpe ratio is not significantly different from zero.

The alternative hypothesis states that the Solver weighted Sharpe ratio is significantly different from zero.

The research reveals that for all the individual and combined Sharpe ratios, the null hypothesis is rejected in favour of the alternative hypothesis, i.e. that the Sharpe ratios are statistically significantly different from zero indicating that the expected return per unit of risk taken is positive.

6.2.4 Hypothesis 2b

The null hypothesis states that the difference between the combined and the individual Bulgarian and South African Solver weighted Sharpe ratios is not significantly different from zero.

The alternative hypothesis states that the difference between the combined and the individual Bulgarian and South African Solver weighted Sharpe ratio is significantly different from zero.

When testing the differences in the individual and combined portfolios the research reveals that one accepts the null hypothesis, i.e. that the differences in weekly Sharpe ratios are not statistically significantly different from zero and an investment in a combined portfolio is not justified except in the case of the large cap and value South African portfolios.

6.2.5 Hypothesis 3

The null hypothesis states that the difference in Solver vs. equal weighted Sharpe ratios is not significantly different from zero.

The alternative hypothesis states that the difference in Solver vs. equal weighted Sharpe ratios is significantly different from zero.

When testing the differences in the combined portfolios the research reveals that one rejects the null hypothesis in favour of the alternative, i.e. that the differences in weekly Sharpe ratios are statistically significantly different from zero in three of the four investment styles. Using Solver to allocate holding weights, rather than following an equal weighted strategy, results in Sharpe ratios that are better and statistically significant, except in the large cap grouping.

From the data it is clear that the grouping with the most significance is the combined value grouping with significance at the 1% level, followed by combined small cap, with significance at a 5% level and combined growth with significance at the 10% level.

6.3 Summary of the findings

Given the evidence, one can see that with the exception of the equal weighted Bulgarian small cap and value portfolios, the individual Sharpe ratios were statistically significantly different from zero indicating that a positive outcome is expected based on the excess return per unit of risk taken following an equal weighted approach.

Banz (1981) found that smaller firms had higher risk adjusted returns over a 40- year period than their larger counterparts. However, one notes that this is not the case when examining the data for the Sharpe ratio of the Bulgarian Equal weighted Small Cap portfolio.

Contrary to the findings of Basu (1977) and Fama and French (1998), i.e. that value stocks outperform growth stocks, the research shows that the Sharpe Ratio of the Bulgarian equal weighted value portfolio, when adjusted for risk, is not statistically different from zero. It has to be noted that the Sharpe ratio comparisons make use of a different scale to that of the two authors mentioned above and that this could have an influence on the findings.

Rodriguez (2006) confirmed that in developing markets over the period 1988 to 2005, value outperformed growth and small caps outperformed large caps stocks. This is contrary to the findings of this research following an equal weighted approach and comparing Sharpe ratios.

The research shows that when an intelligent weighting system (Solver) is used, all portfolio Sharpe ratio values are statistically significantly different from zero at a 1% significance and that a style comparison cannot be made.

The comparison of whether an investment in both markets is strategically better than having money invested in the individual markets, based on a risk to return comparison (Sharpe ratio), indicates that there is no statistical significant difference other than the South African large cap and value styles. A combined portfolio investment in these styles produced Sharpe ratios that were statistically significantly better indicating that the return per unit of risk taken was superior.

The research reveals that when funds are invested in both markets, according to the style mandates and a comparison made between Solver weighted and equal weighted portfolios, the Solver weighted portfolios render Sharpe ratios that are statistically significantly better in three of the four styles, thus indicating that the return per unit of risk taken is better following a Solver weighted approach.

CHAPTER 7 CONCLUSION

7.1 Introduction

The purpose of this research was to investigate whether any benefit exists for a South African investor when diversifying into another developing market, in this case Bulgaria, through a comparison of the Sharpe ratios of the different investment styles.

7.2 Benefit of the research

Investors are generally looking for ways to increase their return and to decrease their risk. The Sharpe ratio captures both risk and return in a single measure and it has become popular with investors in decision-making as the portfolio with the higher Sharpe ratio is preferred. It is a well known fact that the expected returns and volatilities are generally not observable and have to be estimated, along with estimation errors, which implies that these Sharpe ratios are also estimated with error. The question of how accurately the Sharpe ratios are measured is addressed using the methods of Opdyke (2007) in deriving the asymptotic distribution of the sample-based-estimator of the Sharpe ratio permitting time-varying volatilities, serial correlation and returns that are not independent and identically distributed. Using these corrections one is able to calculate whether the observed Sharpe ratio of one portfolio is statistically significantly larger than that of another.

This information could be used by investors to determine whether the Sharpe ratio of one portfolio is statistically significantly larger than the other rather than the observed differences being a reflection of the volatility of the financial returns.

7.3 Limitations of the research

Given the sample in this study and the time period allowed it is not plausible to imagine that the researcher has been able to encompass the diversification possibilities between developing markets. As the technique of statistically testing whether Sharpe ratios are different is new, there is not much in the literature to compare it with. The results, however, indicate that choosing a specific style as well as method of allocating holding weights does have an influence on the Sharpe ratios as well as their differences even though the results oppose the results of various other authors.

The period used stretched over five years due to the limited share price data available. Had a longer period been selected the sample population might have been compromised. A longer period and multiple rolling period comparisons might have given insight into some of the dynamic changes that continuously occur in the market environment.

A drawback that should be considered is that only one random sample of 15 shares was selected for each of the portfolios, and had multiple samples been drawn and compared a more representative result might have been achieved.

7.4 Future research

A number of topics were touched upon but not fully explored in the research presenting opportunities for further studies.

An attempt should be made to explore the Sharpe ratio differences within the South African market with particular reference to mutual funds (better known as Unit Trusts or Collective Investment Schemes CIS) as this will now be possible using the techniques explored in the research. This could be done by comparing the funds that are grouped together i.e. growth funds, value funds, international funds or even balanced/ managed funds to mention a few.

The researcher merely examined two markets and a few randomly selected stocks, however the method allows one to make comparisons across all markets and potentially identify opportunities to increase earning potential. This could include comparing the different South African sector returns i.e. All Share, Resources, Financial & Industrial, Mid-Cap Fledgling or going so far as comparing different country indices.

An expanded time period will allow for the comparison of results using weekly, monthly and even yearly Sharpe ratios as well as the results using different window periods to determine how stable the results are over time.

A comparison of indices with portfolios created from the underlying stocks would be another interesting area to explore.

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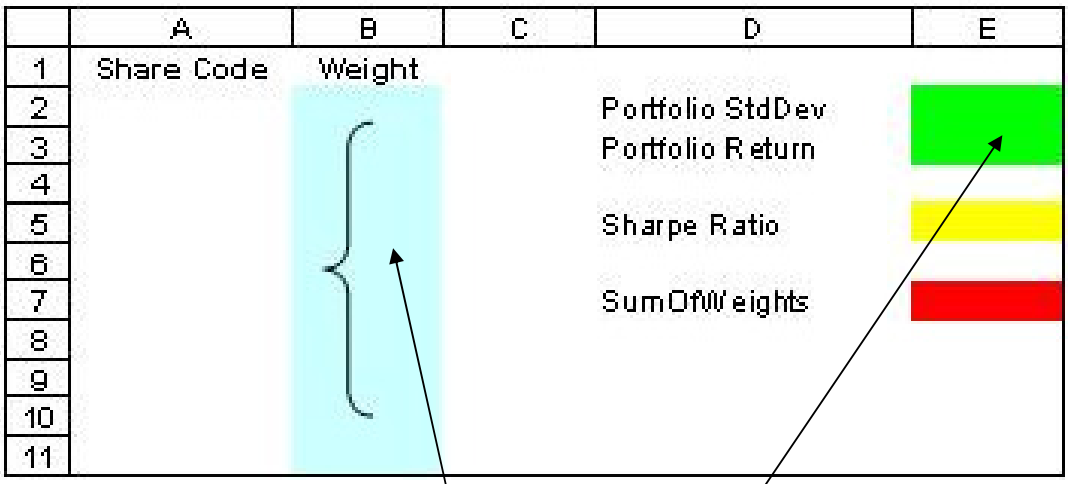
APPENDIX

The Sharpe Ratio for each of the combined style portfolios will be calculated and the following preparation will be done in order for Solver to be used in the next step to maximise returns. The range of returns will be named “Returns”. The mean return (using the “average” Excel function) and standard deviation (STDEVP) of each stock will be calculated. The range of means will be named “Means”.

A covariance matrix of the portfolio (now 30 shares) will be created utilising VBA code and the range will be named “covariance”.

Next a sheet will be created in order to use Solvers ability to calculate an optimal solution.



- Share Codes will be entered in the same sequence as they appear in the covariance matrix.
- The decision variables in this case the “Weights” are named as a range.
- The formulae for the portfolio return and standard deviation will be recorded in the green blocks

The standard deviation of the portfolio is calculated by:

$$SD_{port} = \sqrt{\sum_{i=1}^{n} \cdot \sum_{j=1}^{n} x_i \cdot x_j \cdot COV_{i,j}}$$

Expressed in matrix formation below:

$$SD_{port} = \sqrt{\begin{pmatrix} w_1 & \dots & w_n \end{pmatrix} \begin{pmatrix} \sigma_1^2 & \text{cov}_{12} & \dots & \text{cov}_{1n} \\ \text{cov}_{22} & \sigma_2^2 & \dots & \text{cov}_{2n} \\ . & . & \dots & . \\ \text{cov}_{n1} & \text{cov}_{n2} & \dots & \sigma_n^2 \end{pmatrix} \begin{pmatrix} w_1 \\ . \\ w_n \end{pmatrix}}$$

With the equivalent formula in Excel being:

= (MMULT (MMULT (TRANSPOSE (Weights), Covariance), Weights)) ^0.5

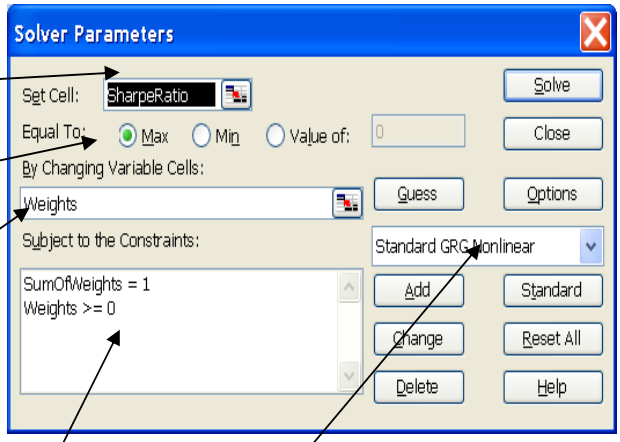
Portfolio return is calculated by multiplying the “weights” with the “Returns” in Matrix formation.

$$R_{Port} = \sum_{i=1}^{n} weights_i \cdot returns_i$$

The Sharpe Ratio formula is recorded in the Yellow block with formula Portfolio Return – Risk free rate divided by the Portfolio Standard Deviation.

The sum of the “weights” is recorded in the red block and the block is named “SumOfWeights”.

Solver parameters specified:



- The target cell or objective function is selected as the Sharpe Ratio.
- The Sharpe Ratio must be maximised.
- The changing variable cells are specified as the “weight”.
- The constraints are that the weights have to be greater or equal to 0 (we are creating a long only portfolio) and that the sum of the weights must be equal to 1 or 100%.
- The existence of exponentiation as well as elements sharing disproportional relationships with each other makes the problem nonlinear and the Standard GRG Nonlinear modelling option is selected.

The mean daily returns as well as the daily standard deviation will be calculated based on the weight allocation of the Solver solution and the Sharpe ratio will be calculated using the above data.