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THE COST OF EQUITY OF DUAL-LISTED SOUTH AFRICAN COMPANIES

by

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Abstract

Since the late 1990s South African companies have started to dual list their shares in different countries, mainly to source capital from larger and more developed economies. In addition to this the level of participation by foreigners in the buying and selling of South African shares has increased. This leads to the question: should a local or a global CAPM (capital asset pricing model) be used to value shares that are traded in integrated global capital markets?

This study focuses on dual-listed South African shares as these shares are most likely to be traded by investors globally. This study replicated aspects of earlier studies conducted in the Unites States of America and the United Kingdom, which are developed economies. By applying the same principles within a South African context, valuable insights might be derived relating to companies from developing economies.

The main purpose of this study is to investigate the impact of using a global CAPM instead of a local CAPM to determine the cost of equity of South African companies. To this end, a sample of 26 dual-listed South African companies was selected using non-probability judgement sampling. Descriptive research was undertaken using quantitative analysis of secondary data. The cost of equity using the local and global CAPM was calculated for each of the selected dual-listed South African companies. The historical monthly returns of the dual-listed shares as well as each of the local and global risk factors during the period from 1 January 2005 to 31 December 2009 were used to calculate the local and global beta coefficients. The estimates of the local and global cost of equity were compared to ascertain whether there were significant differences for individual shares, as well as across different market sectors.

While the results from similar previous studies on shares of developed countries by Koedijk and van Dijk (2004:474); Koedijk et al (2002:911); and Mishra and O'Brien (2001:28) indicated insignificant differences between the local and global CAPM, this study indicated differences of 400 basis points and above for the sample of dual-listed South African companies. The findings in this study therefore suggest that the findings from studies conducted in developed economies cannot be generalised for companies in developing economies. In the South African market, shares across different sectors behave differently towards global risk factors; therefore this study highlighted the need for financial analysts to carefully consider using the global CAPM instead of the local CAPM when valuing shares

that are traded in globally integrated capital markets. Using the incorrect cost of equity may result in incorrectly valuing a company as well as incorrect decision making.

Key words

Keywords: capital asset pricing model, cost of equity, dual listings, global capital asset pricing model, local capital asset pricing model.

Declaration of original work

I, Phililе Maphumulo, declare that this minor dissertation is my own unaided work. Any assistance that I have received has been duly acknowledged in the dissertation. It is submitted in partial fulfilment of the requirements for the degree of Master of Commerce at the University of Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

_____ _____

Signature Date

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Dedication

To my daughter Nandi Maphumulo who was born in the midst of this research and to my late mother Mary Ntombana Ka-Manyathi, I know you would be proud.

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1 CHAPTER 1 - CONTEXTUALISATION

1.1 INTRODUCTION AND CONTEXTUALISATION

South African companies are continuously expanding internationally in order to diversify their earnings streams and to become globally competitive. In addition, some have decided either to have a secondary share listing in or to move their primary share listing to a foreign country. This has resulted in a number of companies that were originally established and listed only in South Africa now having a share listing on a foreign stock exchange. In South Africa, such companies are referred to as 'dual-listed companies'.

Stulz (1995:13) has highlighted two different capital market scenarios: a segmented market versus an integrated market. In the former, local investors can only invest in their home stock market, to which foreigners do not have access; whilst in the latter, local and foreign investors have access to both the home and foreign stock markets (Stulz, 1995:13). According to Beckers, Connor and Curds (1996:31), if all investors were to have equal access to all the securities in the world then by definition capital markets would be fully integrated.

The reintegration of post-apartheid South Africa into the global economy, through various deliberate exchange control liberalisation initiatives, has ended the isolation of its companies from global equity markets. For example, exchange control restrictions on foreigners buying and selling South African shares have been lifted (Exchange Control Manual, 2011:C2). Net purchases of shares listed on the Johannesburg Stock Exchange (JSE Limited) by foreign investors had averaged R40 billion in the four years from 2006 to 2009. Net purchases of local listed shares by foreign investors increased from R33 billion in 2004 to R75 billion in 2009 (JSE Limited, 2009:1). As foreign investors increasingly participate in the buying and selling of South African equities, the country's equity market becomes less segmented from the global investment community and increasingly integrated with global capital markets. These findings are particularly true in the case of dual-listed South African companies, with even greater evidence that their shares are not traded in segmented capital markets but rather in globally integrated markets. This gives rise to the question: what valuation methods should be applied to shares that are traded in globally integrated capital markets?

1.1.1 Valuation of shares in a globally integrated market

A biennial valuation survey conducted by PricewaterhouseCoopers (PWC) (2010:21) confirms that the Discounted Cash Flow (DCF) valuation approach is the primary method used by South African financial analysts and corporate financiers to value shares, a finding consistent with previous surveys conducted by the same firm. In the 2010 and 2008 valuation surveys PWC (2010:26; 2008:17) found that the Capital Asset Pricing Model (CAPM) was possibly the most widely used method to estimate cost of equity in South Africa, with little use being made of other methods. As a result of it being widely used by investment professionals, the CAPM will also be used to determine the cost of equity of dual-listed companies in this study.

The use of the CAPM involves estimating the risk of a share relative to the market portfolio. Numerous research studies have questioned whether the market portfolio used in the CAPM should be a domestic or a global market portfolio, especially in the case of shares that are traded in globally integrated capital markets (Koedijk, Kool, Schotman & van Dijk, 2002:905; Koedjik & van Dijk, 2004:467; Mishra & O'Brien, 2001:27, O'Brien & Dolde, 2000:7). Furthermore, researchers have questioned whether other global risk factors, such as exchange rate risk, should be taken into account when applying the CAPM (Mishra & O'Brien, 2001:28; O'Brien & Dolde, 2000:8).

According to PWC (2010:30-31), in practice, a broad-based equity index is most often used as a proxy for the market portfolio, notably the All Share Index (ALSI). The ALSI is a South African index made up of all the country's listed equities. Stulz (1995:14) argued that the risk of shares that are traded in integrated global markets should be determined in a global setting, i.e., by the risk of the share relative to the global market portfolio. For O'Brien and Dolde (2000:7), in the case of globally integrated capital markets, a global CAPM, using the global market portfolio, is most appropriate.

1.2 PROBLEM STATEMENT

A number of South African companies have listed their shares in foreign countries, in line with the precipitous opening of the South African and world economies. This has resulted in a number of South African companies' shares being traded in different geographical regions. It also contributes to the difficulty experienced by investors and investment professionals about the valuation methods that should be applied when valuing shares that are traded in global capital markets.

Since their shares are traded in global capital markets, the returns on South African dual-listed companies can reasonably be expected to be influenced largely by global market risk factors and not only South African risk factors. However, research indicates that South African investors and professionals only take into account the local market risk when valuing such shares. PWC (2010:31) found that most of the respondents to their valuation survey only took into account the risk of a share relative to the local ALSI when applying the CAPM. Therefore, global market risk factors such as exchange rate risk are generally not taken into account when calculating the cost of equity.

The problem is that a purely South African or domestic discount rate may not be the most theoretically correct rate to use when valuing shares being traded in global capital markets (Stulz, 1995:14). The cost of equity estimate, calculated using a global CAPM instead of the local CAPM, may result in different values for the same company. Using a lower or higher cost of equity for the same company will result in an overvaluation or undervaluation, respectively. It is therefore imperative that investors use the most theoretically correct cost of equity to value a company.

1.3 PURPOSE OF THE STUDY AND RESEARCH QUESTIONS

The purpose of the study is to investigate the impact of using a global CAPM model instead of the local CAPM to determine the cost of equity of South African companies. This study focuses on dual-listed South African companies, as they are most likely to have foreign operating activities and therefore attract foreign investors in addition to local investors.

In light of the problem statement, the overarching research question is: does the cost of equity of South African dual-listed companies derived using a local CAPM differ from the cost of equity derived using a global CAPM?

Based on the overall research question, the study has the following sub-research questions:

- What is the correlation between the monthly movements of the local market portfolio and those of the global market portfolio?
- Are there differences or similarities with regard to the local and global cost of equity estimates for South African dual-listed companies within different market sectors?

- How do the results of this study compare with the results of previous similar studies?

1.4 RESEARCH METHODOLOGY

The nature of the research problem influences the choice of the research method, i.e., whether the research is exploratory, causal or descriptive (Zikmund, 2003:54). *Exploratory research* is normally conducted to clarify ambiguous research problems, i.e., it assists to crystallise the problem and identify further information needs for future research, whilst *causal research* is conducted to identify cause and effect relationships among different variables once the research problem has been clearly defined. The main purpose of *descriptive research*, meanwhile, is to describe the characteristics of a phenomenon, i.e., to determine answers to questions such as what, who, where, when and how. Descriptive research normally is conducted to describe various situations and not to determine why certain things are the way they are (Zikmund, 2003:54-56).

Based on the aforementioned, and the nature of the research questions of this study, the research method selected is descriptive research, carried out by performing a quantitative analysis of secondary data.

1.4.1 Target population and sampling

The target population is all South African dual-listed companies. The sampling method will be non-probability sampling, a method in which the probability of any particular member of the total population being selected is unknown. As Zikmund, (2003:380-382) notes, this is the opposite of probability sampling, in which every element in the population has a known non-zero probability of selection. In non-probability sampling, the selection of sampling units is arbitrary as the researcher relies heavily on personal judgement. This method was considered the most appropriate for the purposes of the study because by applying judgement sampling (a form of non-probability sampling), the researcher will be able to select a sample based on judgement about the appropriate characteristics required for the sample members. According to Zikmund (2003:382), "judgement sampling is a non-probability sampling technique in which an experienced individual selects a sample based on his or her judgement about some appropriate characteristic required of the sample members." In the case of this study, only those dual-listed South African companies whose shares were liquid and who were listed during the entire sample period made up the final sample.

Koedijk and van Dijk (2004:471-472) did not specify any specific sampling technique for the shares which were included in their study but rather used judgement sampling. That study took all the dual-listed shares from nine industrialised countries and used specific selection procedures to exclude certain shares from the sample, excluding shares for which the dividend data was missing, that had outlier observations, or that were not listed over the whole period during which the study was performed. However, the study did not set out how the nine industrialised countries were selected. Similarly, Mishra and O'Brien (2001:32) did not specify a specific sampling technique but instead selected all non-bank companies listed in the United States of America (USA) with a market capitalisation exceeding $10 million and with an average daily trading volume of more than 10 000 shares.

1.4.2 Collection and analysis of secondary data

Monthly share prices, index levels as well as exchange rates over the historical period between 1 January 2005 and 31 December 2009 (sample period) will be obtained from *Bloomberg*. Current local as well as foreign bond yields will be obtained from financial publications such as the *Financial Times* and *Business Day* newspapers. The secondary data downloaded from *Bloomberg* will be analysed using *MS Excel* software. Descriptive statistics will be used to further describe the characteristics of the population. Regression analysis will be used to calculate Beta coefficients of each of the shares that made up the final sample. The results of the regression analysis will be evaluated using standard econometric methods. All CAPM calculations will be performed according to standard valuation methods and procedures (PWC, 2012:25).

1.4.3 Ethical considerations

The data gathered from the secondary data sources will be downloaded using valid subscriptions, where necessary.

1.5 VALUE OF THE STUDY

Valuations are used to determine the fair value of a company's shares. Although the basic principles of valuations have been developed over time and are widely standardised, the global integration of financial markets raises a number of valuation-related questions.

Stulz (1995:12) noted that most valuation methods were developed in the USA and at a time when it made up most of the world's equity market, whilst other foreign markets were closed to external investors. Therefore, at the time, using a broad-based United States (US) market index as a proxy for the market portfolio in the CAPM was considered reasonable. Smaller developing countries have simply mimicked this US technique when valuing their own shares, without considering whether their shares were being traded in segmented or integrated capital markets. Today, many more capital markets are open to foreign investors and the USA's share of the world's equity markets is substantially smaller (Stulz, 1995:12).

The value of this study will be to highlight to investors the need to consider carefully whether the shares of a company are traded in globally integrated or segmented capital markets when applying the CAPM. Furthermore, there is no evidence of similar research conducted specifically on South African company shares. Most of the prior research studies identified that compare the use of the global versus the local CAPM were conducted on shares of developed regions such as the USA and Europe.

1.6 LIMITATIONS OF THE STUDY

Amongst the limitations of the study are that it will not aim to:

- provide an answer to the question: which CAPM (i.e. local or global) is the most correct model to use in valuing all or certain South African companies? However, arguments in favour of the local and global CAPM's as contained in past literature will be reviewed and documented
- evaluate the validity of the CAPM and the theoretical assumptions thereof
- compare the CAPM to other methods for calculating cost of equity but rather it will add to the body of research on applying the CAPM to shares that are traded in globally integrated capital markets.

1.7 DEFINITIONS OF TERMS USED IN THIS STUDY

For the remainder of this study, the CAPM that uses a global market index as a proxy for the market portfolio is referred to as the 'global CAPM'. The CAPM that uses a local market index is referred to as the 'local CAPM' or 'traditional CAPM'. A further distinction is made between two types of global CAPMs, i.e., the 'multi-factor global CAPM' and the 'single-factor global CAPM'. These will be described in detail in Chapter 4: Basis for determining cost of capital.

1.8 SUMMARY AND CONCLUSION

South African equity markets have become integrated with global ones, due to the opening up of the local and foreign capital markets. South African dual-listed companies are the most likely to be held by foreign shareholders and have foreign operating activities. The shares of South African dual-listed companies are therefore traded in integrated global capital markets and are affected by global risk factors. This has raised the question of whether it is appropriate to use the local CAPM to calculate the cost of equity for South African dual-listed shares. This study aims to highlight to investors the difference in the cost of equity (if any) when the global CAPM as opposed to the local CAPM is applied to dual-listed South African companies.

1.9 CHAPTER OUTLINE

The remainder of this study is set out as follows:

Chapter 2 presents a historical and theoretical background to dual listings, mainly in South Africa, followed in **Chapter 3** by a discussion of the various research themes that have been conducted over time regarding dual-listed companies. **Chapter 4** looks at the valuation implications of dual listings and specifically the basis for determining the cost of capital for dual-listed companies. **Chapter 5** discusses the research methodology to be used for this study, specifically the research orientation, research design, methods of data analysis, and ethical considerations. **Chapter 6** presents the findings from the secondary data analysis in a step-by-step manner and discusses trends observed. It also discusses the market proxies used in this study as well as the rationale thereof. **Chapter 7** analyses the difference in the cost of equity estimated using the global CAPM versus that estimated using the local CAPM for each of the shares included in the final sample. Specific trends within different sectors are discussed. **Chapter 8** concludes the study by discussing its motivation, with a summary of findings, the contribution of the study and a list of its limitations. Finally, recommendations for further research are presented.

2 CHAPTER 2 – REVIEW OF DUAL LISTINGS

2.1 INTRODUCTION

Chapter 1 provided the background and contextualisation of the study as well as the overall research problem, research purpose and research questions. In Chapter 1 it was concluded that the opening up of the South African economy has resulted in South African shares being traded in globally integrated markets. Reference was made to prior studies that found that global market risk factors, as opposed to local market risk factors, must be taken into account when valuing shares that are traded in globally integrated markets (Koedijk et al., 2002:905; Koedjik & van Dijk, 2004:467; Mishra & O'Brien, 2001:27, O'Brien & Dolde, 2000:7). It was found that dual-listed companies' shares are more likely to be traded on global markets and therefore influenced by global risk factors as opposed to just local risk factors. Chapter 2 discusses the historical and theoretical background to dual listings, mainly in South Africa.

2.2 OUTWARD FOREIGN DIRECT INVESTMENT AND GOVERNMENT INTERVENTION

Since 1995, government policy interventions have been structured to promote outward foreign direct investment by South African companies. This international diversification is regarded as beneficial to the economy due to the expected improvement in the competitiveness of their products and export revenues (South Africa, 2003:16).

2.2.1 Foreign direct investment and the Exchange Control Regulations

Foreign direct investment by South African companies involves the export of capital from the country or accessing of foreign loans to fund it. Such actions fall under the ambit of the Exchange Control Regulations and would therefore have to be carried out in compliance with them. The South African Reserve Bank (SARB) is responsible for regulating and monitoring this compliance by South African companies, whilst through a gradual approach to exchange control liberalisation, the government has played a role in encouraging and facilitating their international diversification.

2.2.1.1 Foreign direct investment monetary limits

One of the most recent significant policy interventions aimed at promoting outward foreign direct investment was the abolition of all monetary limits on the foreign direct investments by South African companies. Prior to 1997, South African companies were allowed to invest only R20 million per calendar year abroad (Exchange Control Manual: C5), but since then the limit on foreign investment has

increased gradually. By 2003 it amounted to R1 billion per calendar year and at R2 billion per calendar year for investments within the African continent (Exchange Control Manual: C5). Circular number D443 issued in October 2004 by the SARB announced that all such limits were to be abolished with immediate effect. However, South African companies are still required to make an application to the SARB for all intended foreign direct investment that exceeds the threshold of R500 million in a calendar year (Exchange Control Manual: C5).

2.2.1.2 ***Requirement for the control of foreign entities***

Prior to 1995, South African companies were required to control all foreign entities in which they invested, with 'control' defined as holding more than 50% of the votes in the foreign entity, reduced to 25% in 2007, and currently at 10% with effect from 2008 (Exchange Control Manual: C5).

2.3 THE EMERGENCE OF DUAL LISTINGS

Despite the recent liberalisation of certain foreign exchange regulations by the government, using South African capital to fund outward foreign direct investment falls within the ambit of the Exchange Control Regulations. Having a dual-listed company structure was one of the methods which companies used to raise money overseas in order to fund foreign expansions. For some that already had operations in various foreign countries it was important to have a strong visibility in them, as well as to be able to raise foreign capital. Therefore, a number of these companies became dual-listed, particularly in the late 1990s. Some took a step further and moved their primary listings to foreign destinations whilst retaining a secondary listing in South Africa. This was predominately done by those with a very strong presence overseas and with a large base of foreign shareholders.

2.4 MECHANICS OF DUAL LISTINGS

A dual listing can be carried out either by issuing new shares for cash or by way of an introduction with no new shares issued on the foreign exchange. An introduction of existing shares involves an application to the foreign exchange for the listing and trading of the shares on it. In the event of a dual listing a company needs to distinguish between its primary and secondary listing, and with more than two listings it will have one primary listing and multiple secondary listings. In certain instances, South African companies have chosen to move their primary listing to a foreign country, with the JSE Limited becoming a secondary listing platform. This was usually for strategic reasons and would have required the prior approval of the SARB.

The following sub-section provides an overview of some of the most publicised foreign dual listings by South African companies since 1995. Their main feature is that the South African companies simultaneously changed their registered domicile and primary listing to the foreign country, with South Africa becoming the secondary listing platform.

2.4.1 Practical examples of South African companies listing their shares abroad

By reviewing the shareholder circulars prepared by each of the following companies, the sub-section summarises the methods used to achieve dual listings in foreign countries.

*2.4.1.1 **Anglo American Corporation of South Africa***

Originally incorporated and listed in South Africa, the *Anglo American Corporation* (*AAC*) had mining operations mainly located in the country (92% of turnover in the three years to 1998) and held, directly and indirectly, 45% of the shares in *Minorco Societe Anonyme* ("*Minorco*"). *Minorco* was incorporated in Luxembourg, with listings in Luxembourg, Johannesburg, London and Paris, and made 100% of its turnover outside South Africa. In 1999 the management of *AAC* made a strategic decision to combine its business operations with those of *Minorco*, which had previously remained separate due to South Africa's political and economic isolation from the international community. This resulted in the formation of *Anglo American Plc*., a company incorporated in England and Wales, which acquired all the shares in *AAC* in exchange for its own shares, and all the shares in *Minorco* in exchange for its own shares or cash. This resulted in *AAC* and *Minorco* becoming wholly-owned subsidiaries of *Anglo American Plc.*, which applied for and received approval for the primary listing of its shares on the London Stock Exchange (LSE), and for secondary listings on the Johannesburg, Botswana, Namibia, Nasdaq and Swiss exchanges. *AAC* thus moved its primary listing from South Africa to London by way of an introduction of shares through *Anglo American Plc*. on the LSE. Prior to this transaction, *AAC* already had a secondary listing in London dating back to the early 1900s. However, the significance of the latter transaction was that it resulted in a change in the primary listing from Johannesburg to London (Anglo American Plc., 1999:1-299).

2.4.1.2 *Old Mutual Group (Old Mutual)*

Old Mutual is a financial services company with the bulk of its business conducted in South Africa. In recent years it has adopted an international growth strategy which entailed starting operations in countries such as the United Kingdom (UK), Bermuda, Guernsey, Hong Kong, Ireland, the Isle of Man and the USA. In May 1999, *Old Mutual* was demutualised and *Old Mutual Plc*., incorporated in England and Wales, became the Group's holding company. The final stage in the demutualisation process was the primary listing of the shares on the LSE and the secondary listings on the Johannesburg, Malawi, Namibia and Zimbabwe stock exchanges. The listings were implemented by way of an offer for shares in *Old Mutual Plc*. together with applications to the LSE, JSE Limited and the other exchanges for the listing of the shares (Old Mutual Plc., 1998:1-332).

2.4.1.3 *Investec Limited*

Prior to obtaining a dual listing in London, the *Investec Group Limited* (*IGL*) was listed on the JSE Limited, with secondary listings on the Botswana and Namibia Stock Exchanges. Pursuant to the London dual listing, *IGL* transferred all its business operations located outside Southern Africa into a separate wholly-owned subsidiary, *Investec Plc*. *IGL* restructured its issued share capital and distributed its shares in *Investec Plc.* in such a way that *IGL* shareholders who previously would have held only *IGL* shares now held an equivalent value of both *IGL* and *Investec Plc.* shares. *Investec Plc.* applied for and received a primary listing on the LSE and a secondary listing on the JSE Limited. *IGL* changed its name to *Investec Limited* and has continued to have a primary listing on the JSE Limited, with secondary listings in Namibia and Botswana. The listing of *Investec Plc.* on the LSE was by way of an introduction of shares that were already in issue.

The *Investec Group* dual-listed company structure is unique in that *Investec Limited* and *Investec Plc*. have separate corporate identities but function as a single entity (or a synthetic group), by way of legal agreements between them. The two entities therefore function as if they are a single group, with consolidated financial statements and a shareholder body holding one class of shares. The intention was that an *Investec* shareholder should be largely indifferent to the entity in which he or she holds shares. Therefore, an ordinary share held in either *Investec Limited* or *Investec Plc.* should confer upon its holder the same rights to dividends, capital and voting in respect of joint matters. Dividends are determined on the basis of the distributable reserves of the combined group, on a sterling per share basis.

Shareholders registered in South Africa are paid their dividends in rand and those registered in the UK in sterling (Investec Plc., 2002:1-10; Investec Holdings Limited and Investec Group Limited, 2002:1-160).

*2.4.1.4 **Summary of the mechanics of recent dual listings***

As can be deduced from the preceding examples, dual listings in foreign countries are generally carried out by companies expanding abroad. The purpose may be to increase awareness about the company to potential investors, and it is an efficient way to raise foreign capital to fund the foreign expansion. In the case of *Investec Plc.* and *Anglo American Plc.* the listings on foreign stock exchanges were carried out by way of an introduction of shares on the LSE. In the case of *Old Mutual Plc.*, the dual listing was carried out by way of an offer for shares in a newly incorporated entity in the foreign country. The *Investec Group*'s dual-listed company structure is unique in that there are two entities which are essentially seen as one group from a shareholder's perspective.

2.5 SOUTH AFRICAN REGULATORY FRAMEWORK FOR DUAL LISTINGS

From discussions with SARB and JSE Limited officials it was concluded that there are not many regulatory requirements with which South African companies need to comply locally in order to obtain a foreign dual listing. The two main regulations applicable to implementing and maintaining a dual listing are the JSE Listing Requirements and the South African Exchange Control Regulations.

2.5.1 Johannesburg Stock Exchange Listing Requirements

From the JSE Limited's point of view, the South African company merely needs to comply with the foreign stock exchange's listing requirements upon obtaining a dual listing. Generally, the exchange on which the primary listing resides takes precedence in the enforcement of listing requirements ahead of the exchange on which the secondary listing resides (Section 18.4 JSE Listing Requirements). If the primary listing is not on the JSE Limited, the JSE Limited has the right to request that the company comply with certain specific sections of the JSE Listing Requirements (Section 18.19, JSE Listing Requirements).

2.5.2 South African Exchange Control Regulations

The South African exchange controls differ for shareholders and companies, as outlined in this section.

2.5.2.1 *Exchange control restrictions on South African shareholders*

The South African Exchange Control Regulations restrict the export of capital from South Africa. Therefore, in the event of dual listings which result in South African shareholders exchanging shares in a South African-listed entity for shares in a foreign-listed entity, the approval of the SARB is required. For example, in May 1999, South African shareholders were awarded London-listed *Anglo American Plc*. shares in exchange for their *AAC* shares that were listed on the JSE Limited.

The following exchange control restrictions are applicable to such foreign shares held by South African shareholders:

- South African shareholders are required to register such shares on the South African branch register of the company (Anglo American Plc., May 1999:265)
- South African shareholders cannot subscribe for further shares in the foreign entity, for example under a rights issue, without the prior approval of the SARB (Anglo American Plc., May 1999:223).

In general, ordinary shares issued by foreign entities through a secondary listing on the JSE Limited to South African shareholders are treated as domestic assets in the hands of the latter, as long as the holdings are through the South African branch register. Therefore, holding such shares would not affect the offshore allowance of individual shareholders.

The offshore allowance is the monetary allowance that the SARB permits South African individuals to invest in offshore assets using South African savings. It was only in 1997 that South African individuals were granted permission to invest abroad and then only a limited amount or to hold foreign currency deposits with an authorised dealer or a foreign bank. The initial limit was set at R200 000, on condition that individuals were at least 18 years old and were taxpayers in good standing. This allowance has gradually been increased over the fiscal years, and since 2009 the limit is R4 million.

2.5.2.2 *Exchange control restrictions on South African companies*

In the event of a South African company moving its primary listing and domicile to a foreign country there are certain restrictions placed by the SARB on its future existence. According to discussions with SARB employees, these restrictions are determined on a case-by-case basis for each company and some are subject to a

confidentiality agreement between the SARB and the company. The common restrictions are the following:

- The former South African company may be required to have a secondary listing on the JSE Limited in addition to its primary listing in the foreign country
- No additional capital may be raised on the JSE Limited without prior SARB approval.

For the more recent foreign dual listings by South African companies, the SARB and South African Ministry of Finance have insisted on a dual-listed company structure whereby the South African operations are kept in a South African company which has a primary listing on the JSE Limited and the foreign operations are kept in a foreign company which has a secondary listing in South Africa. *Investec Limited* is an example of one of the first South African companies to implement this structure.

2.6 ADVANTAGES OF DUAL LISTINGS

The following section sets out the perceived advantages of dual listings, as previously communicated by company management and researchers.

2.6.1 Liquidity

One of the perceived financial benefits of a dual listing is market liquidity (Bhana, 2000:38), defined as the trading volume in the securities market and the ability of companies to issue new securities at existing market prices (Saudagaran, 1988 in Bhana, 2000:38). Empirical evidence indicates that a dual listing in the USA is often accompanied by a 40-50% increase in the number and value of shares traded in the combined US and home markets (Foerster & Karolyi, 1998, in Baruch, Karolyi & Lemmon, 2007:1).

Ayyagari and Doidge (2010:209) also found that overall; a dual listing has a positive effect on the liquidity of a firm's shares. This was the outcome of studies that examined shares with dual listings in the USA, finding that although liquidity was substantial in the USA, the liquidity of the shares in the home market also improved after the dual listing took place (Ayyagari & Doidge, 2010:209). This finding is consistent with Baruch et al. (2007:3), who stated that trading in dual-listed shares will migrate to the listing destination whose assets are most closely correlated to the

dual-listed shares. Therefore, liquidity can reasonably be expected to improve both at home and abroad.

Hail and Leuz (2009:429) states that a dual listing would often increase the liquidity of a company's shares because of the increased investor base and the fact that to some degree it overcomes market segmentation. Hargis (2000:101,105) has found evidence that foreign dual listings should increase market liquidity along with share prices in the home market, and that foreign dual listings are a catalyst to reduce investment barriers due to the greater disclosure of information across markets. Hargis has also noted that integration can be expected to improve liquidity in the domestic market because when markets are integrated, all investors globally, not just domestic investors, can trade a share. In an earlier study, Hargis (1998a, b, in Hargis, 2000:105) found that dual listings improve liquidity in the domestic market, even in cases where the foreign market dominates trading. Finally, the improvement in liquidity was found to be greater for companies from countries which had greater foreign ownership restrictions prior to the foreign dual listings (Hargis, 1998b, in Hargis, 2000:118).

2.6.2 Cost of capital and valuation

Ayyagari and Doidge (2010:209) found that dual listings had the effect of lowering the cost of capital and therefore also improved access to equity markets both in the home market and in the foreign jurisdiction. As expected, there was a positive price reaction when firms announced a dual listing in the USA. Although there were large increases in share prices prior to the listing, with valuations reaching a peak during the listing year, the valuation gain was found to be permanent. These findings are consistent with those of Bhana (2000:38) and Baker, Nosfinger & Weaver (2002:498).

2.6.3 Marketing and Public Relations Benefits

A foreign listing is often accompanied by increased publicity and name recognition, with potential investors becoming much more interested in the company, and so possibly creating greater demand for its shares and products (Bhana, 2000:38). Mittoo (1992, in Bhana, 2000:38) refers to a foreign listing as a signalling mechanism, i.e., that management of a company are signalling to the market that the company is attempting to be a major role player in international markets.

Ayyagari and Doidge (2010:209) found that firms are more visible when dual-listed, as the media pays them more attention, more analysts follow them and the investor base expands. Similarly, Hail and Leuz (2009:429) claim that dual listings can improve a company's recognition by foreign investors and enlarge the investor base.

The study by Baker et al. (2002:1) referred to above was performed primarily to demonstrate that firms incorporated outside the USA and the UK that choose to dual-list their shares on the New York Stock Exchange (NYSE) and the LSE experience a significant increase in visibility. This was measured by using an increase in analyst coverage and print media attention as proxies (Baker et al., 2002:1). Similar studies conducted prior to that used the number of shareholders as a proxy for increased visibility (Baker et al., 2002:496). As not all countries require companies to disclose the number of shareholders, Baker et al. were able to include more countries in their sample than in the previous studies.

The limitation of the study by Baker et al. (2002:497) was that it focused on only two sets of print media, namely *The Wall Street Journal* (*WSJ*) and the *Financial Times* (*FT*), before and after the dual listing on the NYSE and the LSE. An increase of print media coverage in the same country in which the dual listing is obtained is arguably inevitable, therefore this increase in visibility cannot be generalised to other countries in which the company does not obtain a dual listing. The study seems to have proved an increase in visibility only in the country of the dual listing and not in all countries. The location of the analysts covering the companies, before and after the dual listing on the LSE or the NYSE, is not disclosed.

The study by Baker et al. (2002:498) found that a dual listing on the NYSE resulted in a 128% increase in the number of analysts covering the company and a 32% and 78% increase in the number of citations in the *WSJ* and *FT* respectively per year. A dual listing on the LSE resulted in an increase of 48% in analyst coverage and a 9% decrease and 49% increase in *WSJ* and *FT* citations, respectively. The study also compared the visibility of the firms that obtained dual listings on the NYSE and the LSE with similar domestic companies that did not obtain any dual listing during the same period. Analyst coverage increased more for the dual-listed companies, following a listing on both the NYSE and the LSE. The study found a similar result with regards to citations in the *FT* for both NYSE and LSE dual-listed companies compared to the domestic counterparts. The number of citations in the *WSJ* increased for dual-listed companies following a listing on the NYSE compared to their

domestic counterparts; however there was no statistically significant difference in the number of citations in the *WSJ* following a dual listing on the LSE compared to the domestic counterparts (Baker et al., 2002:508).

Baker et al. (2002:498) explain the higher visibility associated with an NYSE dual listing compared to an LSE dual listing with their finding that the costs of an NYSE listing are much higher than the costs of an LSE listing. Furthermore, the NYSE requires more disclosure about share trades compared to the LSE, therefore the apparent higher benefit of the NYSE listing is in line with this higher degree of transparency (Domowitz, Glen & Madhavan, 1998, in Baker et al., 2002:498).

2.6.4 Governance and monitoring

Companies that choose to be dual-listed in the USA are subject to its securities laws and disclosure rules, and additional monitoring by analysts and institutional investors (Ayyagari & Doidge, 2010:209). Therefore, should the company's home market have less stringent regulations a dual listing in a foreign country such as the USA would result in greater disclosure and monitoring.

2.6.5 Political benefits

There can also be certain political benefits to be derived from a foreign listing. As companies conduct business abroad they are often confronted by protectionist attitudes from the various governments and consumers. By listing on foreign exchanges not only do dual-listed companies derive the public relations benefit of the listing but also their shares become available to meet local ownership requirements. Furthermore, in politically or economically unstable markets, a company would rather tap local capital markets than put more of its capital at risk (Bhana, 2000:38).

In South Africa, a dual listing by a foreign company on the JSE Limited could enable it to comply with South African government charters on broad-based black economic empowerment (BBBEE) by issuing local shares to South African residents and employees (JSE Limited, 2009).

2.6.6 Mergers and acquisitions

Foreign listings can also facilitate foreign mergers and acquisitions by creating local shares to satisfy local regulatory requirements (Bhana, 2000:38). For example, if company A wishes to acquire a foreign entity, i.e., company B, by using its shares to pay for part or all of the purchase price, then company A can issue shares to

company B shareholders. The newly issued company A shares could be listed in the foreign country in which company B shareholders reside.

2.7 DISADVANTAGES OF DUAL LISTINGS

Since academic literature focuses on the advantages rather than the disadvantages of dual listings, this section briefly sets out to rectify the imbalance.

2.7.1 Share volatility associated with dual listings

Freedman (1989, in Bhana, 2000:40) stated that a dual listing causes the volatility of the shares to increase, regardless of the number of informed traders. This is because a dual listing provides traders with additional opportunities to trade and take profits as trading takes place between two markets that are not always open at the same time.

2.7.2 Costs of obtaining a foreign listing

The costs of obtaining a foreign dual listing are both financial and non-financial (Bhana, 2000:38). Financial costs include the first-time registration fee paid to the foreign exchange and the legal, accounting and printing costs. The non-financial costs are the additional financial disclosures that are required; however one could also argue that the expense of additional disclosure is a financial cost, as this may lead to higher accounting and audit fees.

2.8 SUMMARY

The South African government has actively supported outward foreign direct investment by South African companies through various regulatory interventions. Despite this, the government is wary of South African capital being used to fund expansions in foreign jurisdictions and would rather see it being deployed in expanding South African operations. South African companies therefore need to notify the SARB of all investments being made in foreign countries that exceed R500 million in a calendar year. Furthermore, the South African capital base (i.e., the amount of capital that companies can raise from South African shareholders) is limited. Both the regulatory framework and the limited capital base in South Africa have resulted in a number of South African companies obtaining share listings in foreign countries, which allows them to source capital in foreign countries in order to fund foreign expansion projects.

A dual listing can be carried out either by issuing new shares for cash or by way of an introduction where no new shares are issued on the foreign exchange. Following a

dual listing, a company needs to distinguish between its primary and secondary listing. In the event of more than two, a company will have one primary listing and multiple secondary listings. In certain instances, South African companies have moved their primary listing to foreign countries with the local JSE Limited becoming a secondary listing destination.

The main South African regulations that are applicable to obtaining and maintaining a dual-listed company structure are the JSE Listing Requirements and the South African Exchange Control Regulations. There are also Exchange Control Regulations that are applicable to South African shareholders holding shares in dual-listed companies.

A significant amount of research has been conducted into the advantages and disadvantages of dual listings. Some of the advantages to dual listings are improved liquidity of the shares (Ayyagari & Doidge, 2010:209; Bhana, 2000:38; Hail & Leuz, 2009:429; Hargis, 2000:101); reduced cost of capital (Ayyagari & Doidge, 2010:209; Bhana, 2000:38); and improved visibility of the dual-listed company in a foreign country (Ayyagari & Doidge, 2010:209; Baker et al., 2002; Hail & Leuz, 2009:429). Ayyagari and Doidge (2010:209) also found that dual listings in the USA by companies from countries with less stringent company regulations resulted in improved disclosure and increased governance and monitoring of them.

Some of the disadvantages to dual-listed company structures are increased costs of complying with the global listing, other regulatory requirements and increased volatility in share prices (Bhana, 2000:38, 40).

2.9 CONCLUSION

The South African economy is not isolated from the global economy and South African companies are continuously expanding into foreign countries. Such international growth has made it necessary for some with a strong foreign presence to obtain dual listings in the foreign countries. Dual listings in foreign countries by South African companies have therefore become a common phenomenon in today's economic world. The prominence of dual-listed companies makes it a business imperative that the correct valuation technique is used when valuing dual-listed companies' shares.

3 CHAPTER 3 – REVIEW OF PREVIOUS STUDIES ON DUAL LISTINGS

3.1 PREVIOUS STUDIES ON DUAL LISTINGS

This chapter explores the various research themes that have been conducted over time regarding dual-listed companies. The plethora and variety of these studies are evidence that dual listings have become a prominent feature of global capital markets.

3.2 SCOPE OF PREVIOUS RESEARCH ON DUAL-LISTED COMPANIES

Koedijk and van Dijk (2004:466) found that prior research on dual listings focused on three main issues. Firstly, prior studies such as Foerster and Karolyi (1993); Werner and Kleidon (1996) and Doukas and Switzer (2000) cited in Koedijk and van Dijk (2004:466) examined the impact of a foreign listing on a share, particularly on its abnormal returns, liquidity and risk. Secondly, the characteristics of companies that choose to dual-list their shares and their motivation for doing so was studied by Saudagaran (1988), Biddle and Saudagaran (1989) and Fuerst (1998) cited in Koedijk and van Dijk (2004:466). Lastly, Eun and Sabherwal (2000) and Grammig, Melvin and Schlag (2000) cited in Koedijk and van Dijk (2004:466) made use of high-frequency data of dual-listed shares to analyse price discovery.

Some of the more recent literature on dual-listed companies and the findings from previous studies on dual-listed companies are reviewed below.

3.3 WEALTH EFFECTS OF DUAL LISTINGS

Bhana (2000:37) undertook research to investigate whether dual listings by South African companies had resulted in an increase in shareholder wealth. Bhana's study in 2000 was motivated by a hypothesis that the cost of capital will be higher in markets that are small and relatively thinly traded; therefore a foreign listing is likely to result in a lower cost of capital, as the share will be priced in an integrated rather than a segmented market. He analysed the reaction of the share prices of South African companies listed on the LSE during the period 1986–1997 and found statistically significant positive abnormal returns around the listing period. Analysis was made of returns 150 days before and 150 days after the listing, therefore the results were not based on a few days' returns. Furthermore, companies which made any important announcements within 40 days of the foreign listing were excluded from the testing sample. The positive share price reaction suggested that there is value associated with a South African company listing on the LSE, and Bhana (2000:43) concluded that

this value exists because foreign listings provide South African companies with access to other capital markets which may provide a cheaper source of capital.

3.3.1 Wealth effects of dual listings in the USA

Hail and Leuz (2009:429) examined whether and to what extent obtaining a dual listing in the USA reduced a company's cost of capital. Companies that list on the NASDAQ or NYSE are required to comply with US Securities and Exchange Commission (SEC) disclosure rules (Hail & Leuz, 2009:429). This increased disclosure could then result in a lower cost of capital (Lambert, Leuz & Verrachia, 2007, in Hail & Leuz, 2009:429).

A company's value could increase due either to a reduction in cost of equity or an increase in growth expectations. Studies performed prior to that by Hail and Leuz (2009:429), which examined the valuation effects of dual listings, failed to separate those valuation effects resulting from increased growth expectations and those resulting from a reduced cost of equity. The decision to dual list could be taken when firms experience an expansion in their growth opportunities (Hail & Leuz, 2009:429) and therefore any increase in value after a dual listing could be as a result of increased growth opportunities, and unrelated to the dual listing.

In order to shed light on the question of whether a dual listing in the USA resulted in a reduced cost of equity, the study by Hail and Leuz (2009:429) analysed the estimated cost of equity implied by market prices as well as analysts' growth forecast. This method explicitly took into account any changes in growth expectations and gave the researchers the ability to gauge the valuation effects of both growth expectations and cost of equity. Hail and Leuz (2009:429) found evidence that the reduction in cost of equity around dual listings was larger for firms from countries with weaker regulations regarding disclosure and minority protections. Another important feature in their study was that it differentiated between the different types of US dual listings. The sample of 1 097 US dual listings that took place between 1990 and 2005 was classified into exchange listings, over-the-counter (OTC) listings and private placements. As the regulatory consequences of each type of listing are different, the study was able to gauge the role played by regulation in a reduced cost of equity. Exchange listings have the most regulatory oversight, OTC listings have less regulatory oversight and private placements have the least regulatory oversight, as there are no additional public disclosures required (Hail & Leuz, 2009:433).

Hail and Leuz (2009:449-450) found strong evidence that dual listings on US exchanges reduced cost of equity and the reduction was larger than for any other type of dual listing, i.e., between 70 and 120 basis points. OTC dual listings also reduced cost of equity; however, the effect was smaller, between 30 and 70 basis points on average. Dual listings via private placements did not show any evidence of significant changes in cost of equity and in some cases resulted in an increased cost of equity. These findings clearly demonstrated the effect that regulatory oversight has on cost of equity, a separate subject.

3.3.2 Wealth effects of dual listings resulting from improved investor recognition

As early as 1987, Merton (in Baker et al., 2002:495) developed the concept of an investor recognition hypothesis, which stated that all else being equal, an increase in the number of investors who are aware of a company lowers investors' expected returns by reducing the 'shadow cost' of not knowing about that specific company. A reduction in the expected return will then result in an increase in the market value of the company. Managers may therefore choose to dual list a company's shares to reduce the shadow cost and therefore increase the value to shareholders (Baker et al., 2002:496).

Baker et al. (2002:498, 511-514) tested whether it is correct to associate a reduced cost of equity with an international dual listing. Their study used the international asset-pricing model to calculate abnormal returns of dual-listed companies from various countries, with abnormal returns defined as the excess returns above the local Eurodollar deposit rate. The results revealed a reduction in abnormal average returns during the 52-week period following the international dual listing, a finding that was tested to ensure that the observed results were not due to home market liberalisation. Upon testing the abnormal returns of similar companies with no international listing at the time, the researchers found no similar reduction. This confirmed that the initial results were not due to home market liberalisation and therefore that international dual listings can indeed be associated with a reduced cost of equity (Baker et al., 2002:514).

3.4 DUAL LISTINGS AND CHANGES IN CORPORATE CONTROL

Ayyagari and Doidge (2010:208) investigated whether controlling shareholders of foreign companies could use a dual listing to facilitate a change in ownership and control. In many countries in which stock markets are poorly developed and illiquid, listed companies are typically controlled by a single shareholder, usually an individual

or a family. Poorly developed stock markets are often characterised by weak legal institutions and low corporate valuations, which in turn negatively affect the ease and cost with which controlling shareholders can dispose of their shares. When controlling shareholders face such constraints in the home market, one avenue to sell their shares may be a dual listing in a foreign country with more developed capital markets, such as the USA. Their study specifically investigated whether controlling shareholders of foreign firms use a dual listing on a US stock exchange to facilitate a change in ownership and control.

The study examined ownership dynamics around dual listings by using a sample of 416 foreign companies that obtained dual listings in the USA between 1990 and 2002. It examined the ownership structures of these companies prior to the dual listing and noted how these changed after listing. The results were compared to a matched sample of 132 benchmark companies that did not obtain a dual listing and that contained similar companies, based on industry and size (total assets), that were only listed in the home market. The results showed that not all the voting rights of controlling shareholders decreased after the dual listing, but only half, while in other cases the voting rights remained the same or increased. For those controlling shareholders who did reduce their voting rights, the average decrease in voting rights was 24%. Compared to the decrease in voting rights of controlling shareholders of the matched sample, i.e., 7%, this result was economically significant.

By the fifth year after the dual listing in the USA, 22% of the controlling shareholders no longer held their control block of shares. In some cases, the controlling shareholders sold their shares to outside shareholders so that the company became widely held, while in other cases the controlling shareholder sold the control block to another controlling shareholder. In almost 40% of the cases, the new controlling shareholder was a foreigner. In the benchmark sample of non-dual-listed companies, only 12% of the controlling shareholders relinquished their control stake after five years. The conclusion therefore was that dual-listed companies are almost twice as likely to undergo a change in control following a dual listing, and the controlling shares of dual-listed companies are more likely to be purchased by a foreign shareholder. The study also found that companies that were most likely to undergo a change in control of voting rights after a dual listing were from countries with less developed stock markets, with less visibility and with weaker institutions to protect investors. Overall, the results of this study by Ayyagari and Doidge (2010) suggested that domestic market constraints, such as poor stock market development and illiquidity, encourage

controlling shareholders to use a dual listing in the USA to facilitate a sale of all or a portion of their shares.

3.5 MULTI-MARKET TRADING EFFECTS OF DUAL LISTINGS

Baruch et al. (2003:2) noted that there were, at times, noticeable differences in the share of trading volume between the home market and the foreign market. Their study investigated and attempted to explain these differences and found that for some shares, US trading typically represented less than 5% of global trading, while for others it comprised over 90% of global trading. Furthermore, there were significant differences among shares from the same countries, which indicated that the observed trading patterns were not driven by specific country regulations or trading hours. For example, two Canadian companies, *Placer Dome*, a precious metals company, and *Toronto Dominion Bank*, reflected significant differences in the US share of trading volume. Over 50% of *Placer Dome*'s trading volume was US-based, whereas US trading accounted for less than 5% of *Toronto Dominion Bank*'s trading volume, with the home market accounting for the rest.

It is important for managers of dual-listed companies to understand the reasons behind such differences in trading activities across global listing platforms. Particularly for managers for whom US-based trading volume is much less than expected, such knowledge is important for them to assess the long-term viability of the dual listing and its potential as a platform for raising capital, broadening the shareholder base and enhancing company visibility and profile (Baruch et al., 2003:2).

Baruch et al. (2003:3) developed a theoretical model to explain the distribution of trading of dual-listed shares across listing platforms. This model predicted that a dual-listed company's trading volume migrates to the market whose assets have a greater level of correlation with the company's assets. Informed traders will prefer to submit their orders to the market where the returns of the other assets are relevant in pricing the dual-listed company's shares.

3.6 PRICE DISCOVERY OF DUAL-LISTED COMPANIES

Eun and Sabherwal (2003:550) examined the extent to which US exchanges contributed to price discovery of non-US stocks listed in the USA. Grammig, Melvin and Schlag (2000, in Koedijk & van Dijk, 2004:466) examined price discovery for a sample of German shares with dual listings in the USA. Price discovery is an important

function of an exchange and was described by Schreiber and Schwartz (1986, in Eun & Sabherwal, 2003:550) as the search for an equilibrium price.

The study by Eun and Sabherwal (2003:551) of the price discovery of companies listed in the USA focused on Canadian ones, for several reasons: they represented the largest group of foreign companies listed in the USA from a single country, the trading hours in Canada and the USA coincide, and Canadian stocks are listed in the USA as ordinary shares, whereas stocks from other countries are usually listed as American Depositary Receipts (ADRs). They expected to find that the home market contributed the most to the price discovery of dual-listed shares, as this was the one from which most information on the stock should be produced. On the other hand, the dominance of US exchanges as the largest and most liquid exchanges in the world could result in the USA contributing significantly to the price discovery of non-US stocks. They concluded that although both the US exchanges and the Toronto Stock Exchange (TSE) contributed to the price discovery of Canadian stocks, the TSE was the main contributor. On average, the US exchanges' contribution to price discovery was 38%, less than half. Despite this result, the US exchanges were indeed the dominant contributor to the price discovery of many stocks. Finally, their study found that the main factors that influenced the USA's share of price discovery were its share of trading and the ratio of bid-ask spreads. The greater the USA's share of total trading volume the greater its contribution to price discovery was found to be. The smaller the bid-ask spreads on the US exchanges relative to the TSE, the greater the number of informed share trades in the USA and the greater the USA's contribution to price discovery was found to be (Eun & Sabherwal, 2003:573).

Grammig et al (2000, in Koedijk & van Dijk, 2004:466) examined intra-day share prices of large German companies listed on the Frankfurt as well as the NYSE, and also found that price discovery mainly occurs in the home market. However, adjustments to exchange rate movements (i.e., to maintain the law of one price) predominantly took place on the NYSE.

3.7 IMPACT OF DUAL LISTINGS ON EMERGING MARKET ECONOMIES

Whereas the benefits of dual listings for individual companies are discussed at length in various pieces of literature, similar research has been conducted on the benefits of outward foreign listings for individual countries. One such study, by Hargis (2000:103), developed and illustrated a model to explain how outward dual listings can transform a segmented domestic equity market from a low liquidity and low market capitalisation market into an integrated market with high liquidity and market capitalisation. The

study focused on emerging markets, and the results of the theoretical model were supported by empirical evidence from five emerging market stock markets, i.e., Latin America, Argentina, Brazil, Chile and Mexico. Outward foreign dual listings became increasingly popular among Latin American companies during the 1990s, with the number of dual listings increasing from two in 1989 to 106 by January 1999. Policymakers feared that the issuance of equity globally from emerging markets would inhibit the development of their stock markets, as trading would be diverted to the foreign market. In contrast, the expansion in outward foreign dual listings was accompanied by rapid development of the Latin American equity markets. Total market capitalisation increased from $66 billion to $434 billion between 1990 and 1996, and total value traded increased from $22 billion in 1990 to $245 billion in 1996. The USA's share of Latin American companies' trading value increased from $2.7 billion to $77.2 billion over the same period. There was a growth in participation by foreign investors into Latin America during this period, reflected in the increase in private portfolio equity flows from $3.2 billion in 1990 to $45.7 billion in 1996 (Hargis, 2000:102).

In summary, the study by Hargis (2000:119) provided a theoretical model and supporting evidence that the global integration of emerging stock markets is beneficial to their development and improves their ability to provide liquidity and diversification opportunities.

3.8 SUMMARY

This section examined evidence that dual listings have become a prominent feature in global capital markets. Bhana (2000:37) undertook research to investigate whether dual listings by South African companies had resulted in increased shareholder wealth and found a positive share price reaction in companies which chose to list on the LSE between 1986 and 1997. This result suggests that there is value associated with a South African company listing on the LSE.

Hail and Leuz (2009:429) examined whether and to what extent obtaining a dual listing in the USA reduced the cost of capital of a company. The increased disclosure requirements of the USA could result in a reduced cost of capital. They found that the reduction in cost of equity around dual listings was larger for firms from countries with weaker regulations regarding disclosure and minority protections.

Baker et al. (2002:498,511-514) tested whether it is correct to associate a reduced cost of equity with an international dual listing. Their study concluded that an international dual listing can indeed be associated with a reduced cost of equity.
Ayyagari and Doidge (2010:208) investigated whether controlling shareholders of foreign companies could use a dual listing to facilitate a change in ownership and control. They concluded that dual-listed companies are almost twice as likely to undergo a change of control following a dual listing and the controlling shares are more likely to be purchased by a foreign shareholder.

Baruch et al. (2003:3) developed a theoretical model to explain the distribution of trading of dual-listed shares across listing platforms. The model predicted that a dual-listed company's trading volume migrates to the market whose assets have a greater level of correlation with the company's returns. Informed traders prefer to submit their orders to the market where the returns of the assets are relevant in pricing the dual-listed company's shares.

Eun and Sabherwal (2003:551) found that both the US exchanges and the TSE contributed to price discovery of Canadian companies with a dual listing in the USA. However the TSE, being the home market, was found to be the main contributor to price discovery.

The study by Hargis (2000:119) provided theoretical evidence that outward foreign dual listings can transform a segmented domestic equity market from a low liquidity and market capitalisation market into an integrated market with high liquidity and market capitalisation.

3.9 CONCLUSION

The studies referred to herein all point to dual listings being a positive phenomenon, both for the home market as well as for the shareholders of the company which chooses to obtain one.

The global integration of equity markets, either through dual listings or any other means can be expected to continue in future years as the benefits thereof are clear to both investors and regulators in the global equity market. It is therefore imperative that valuation methods applied to shares that are traded in globally integrated capital

markets are correct and take into account the appropriate market risk factors. Chapter 4 discusses whether global market risk factors; as opposed to local market risk factors; should be taken into account when calculating the cost of equity of dual-listed companies' shares.

4 CHAPTER 4 – BASIS FOR DETERMINING COST OF CAPITAL

4.1 INTRODUCTION

The previous two chapters explored the history of dual listings in South Africa, their advantages and disadvantages, as well the various themes of prior research studies on them. This chapter discusses the main focus of this research study, i.e., the valuation aspects of a dual-listed company.

4.2 VALUATION IMPLICATIONS OF DUAL LISTINGS

Given the popularity of the CAPM, it is used extensively in research to illustrate the concept of domestic versus global pricing models. The prior research studies referred to throughout this study (Koedijk et al., 2002:907; Koedjik & van Dijk, 2004:468; Mishra & O'Brien, 2001:27 and O'Brien & Dolde, 2000:9) make use of three types of CAPMs. :

- the traditional or local CAPM
- the single-factor global CAPM
- the multi-factor global CAPM.

This study will use the same convention. All three CAPM's will be defined further below.

4.2.1 Background of the Capital Asset Pricing Model

Developed in the 1960s by three economists, William Sharpe, John Lintner and Jack Treynore (Brealey, Myers & Allen, 2008:214), the CAPM provided the first coherent framework for calculating how the risk of an investment should affect its expected return (Perold, 2004:3). It was developed at a time when the theory of decision-making under uncertain conditions was still new and the empirical facts about risk and return in the capital markets were not yet known (Perold, 2004:3).

Prior to the development of the CAPM, a popular method for estimating the cost of equity was the Gordon and Shapiro (1956) model (Perold, 2004:4), which today is commonly referred to as the Gordon Growth Model or the Dividend Growth Model.

The CAPM is generally regarded by investment professionals and investors as superior to the Dividend Growth Model.

4.2.2 Theoretical assumptions of the Capital Asset Pricing Model

It is important to underline the theoretical assumptions of the CAPM, which are as follows (Damodaran, 2001:164; Perold, 2004:16):

- Investors are risk-averse and evaluate their investment portfolios only in terms of expected return and standard deviation
- All investors can borrow and lend at the risk-free rate
- There are no transaction costs and taxes
- All assets are traded and investments are infinitely divisible (i.e., one can buy a fraction of a unit of an asset)
- All investors have access to the same information and therefore cannot find undervalued or overvalued assets in the marketplace
- All investors make the same estimates of individual expected asset returns, standard deviations of return and the correlations among asset returns.

Making these assumptions assumes that investors will continue diversifying at no additional cost and therefore eliminate all unsystematic risk (Damodaran, 2001:164).

4.2.3 The domestic Capital Asset Pricing Model

The CAPM in its original form, before taking into account global risk, is as follows:

$E(Ri) = r_0 + \beta_{IL}[E(R_L) - r_0]$

Where:

E (Ri) =required return (cost of equity) for company i,

r_0 =risk-free rate,

β_{IL}= beta of company i's equity against the local market returns,

$E(R_L)$ =equilibrium expected return on the local market,

(Mishra & O'Brien, 2001:29).

4.2.4 Components of the Capital Asset Pricing Model

In this sub-section, the components of the CAPM are briefly described.

Risk-free rate

For an investment to be regarded as risk-free, the following two conditions have to be met:

- No default risk: this implies that the investment must be in a government-issued security (Damodaran, 2001:188). Although not all governments are viewed as default-free (particularly those of countries with small emerging economies), for simplicity's sake it will be assumed for the purposes of the study that the term 'risk-free rate' refers to the rate of return on government-issued paper.

- There is no uncertainty about reinvestment rates: this implies that there are no cash flows prior to the end of the investment period (Damodaran, 2001:188). If there were, reinvestment risk would arise because those cash flows would need to be reinvested at future rates of return, which are unknown today.

Risk Premium

The risk premium measures the extra return that investors demand for shifting their money from a risk-free investment to an average risk one, such as shares (Damodaran, 2001:190). The risk premium will be related to how risk averse investors are and is estimated as the weighted average of the premiums demanded by all investors in the market (Damodaran, 2001:190). One method of estimating the risk premium for the entire market is to look at the past and to measure the rate of return earned by risky investments, such as shares, and to subtract from this return the rate of return earned by risk-free government securities over the same time horizon (Damodaran, 2001:190). This is also the method implied by the CAPM formula set out above. An overriding principle of the CAPM is that in a competitive market the expected risk premium of a company varies in direct proportion to the beta of that company (Brealey et al., 2008:214).

The 2008 PWC survey (2008:31), found that the method most frequently used by local professionals for estimating the South African market risk premium was to calculate the historical spread of returns achieved by equity investments against those earned by South African government bonds. According to PWC, the average market risk premium used by 80% of the South African investment professionals interviewed in the survey was found to range between 5% and 6%, and had consistently narrowed since the 2003 survey (PWC, 2008:30). The narrowing of the risk premium demanded from South African equities is reasonable, taking into account the recent reintegration of the South African economy with the global

economy and the liberalisation of certain South African regulations. The results of the 2010 PWC survey reflect an average market risk premium of 5-6% as being what is used by investment professionals in South Africa (PWC, 2009/2010:37).

Beta

Perold (2004:17) states that the Beta of a company's shares is a measure of the risk that cannot be eliminated through diversification, i.e., market or systematic risk. The risk associated with a specific company's shares can be eliminated by holding a diversified portfolio of investments (PWC, 2008:24). However, risks that are endured by the market as a whole (i.e., market risks) cannot be eliminated through diversification (PWC, 2008:24). The underlying principles of the CAPM state that an investor should only be compensated for this market risk (PWC, 2008:24).

The conventional approach to estimating the beta of a share is a regression of the returns on the share against the returns on the market portfolio, i.e., a portfolio of all the risky assets in the market (Damodaran, 2001:196). Simply put, this means that the volatility of the individual share is measured against that of the whole market, which gives an estimate of the market risk of the share. For firms that have been publicly traded for a length of time, the historic returns of the shares can be measured simply. These historic returns are then related to the returns on the market portfolio over the same period (Damodaran, 2001:196). The slope of the regression of an individual share's returns against the market portfolio's returns is the beta of the share, and measures its market risk (Damodaran, 2001:196). Since the market portfolio contains all risky assets in the market it is not observable (Bartholdy & Peare, 2003:70). Therefore, in practice a market index is used as a proxy for the market portfolio (Bartholdy & Peare, 2003:70; Damodaran, 2001:196).

PWC (2008:28) found that the most popular market index among South African investment professionals, for use as a proxy for the market portfolio when calculating the beta of South African shares, was the local JSE Limited ALSI. It was this local market index that Stulz (1995:14) stated should be replaced by a global one when the cost of equity of shares traded in the integrated global financial markets is estimated using the CAPM.

4.2.5 Motivation for a global Capital Asset Pricing Model

South African dual-listed companies are analysed and traded by investors globally, therefore barriers to international investing are reduced significantly. Some academic literature (Koedijk et al., 2002:926; Koedjik & van Dijk, 2004:37; Mishra & O'Brien, 2001:46) states that using domestic asset-pricing models to value companies that are traded in globally integrated capital markets may not be the most theoretically correct approach. O'Brien and Dolde (2000:31) have questioned whether there is indeed a need for global asset-pricing models, as they tend to be more complex than local asset-pricing models. Despite the finding that using global rather than local pricing models did not lead to statistically significant differences in valuation, authors tend to concur that global asset-pricing models are the most appropriate to use when valuing shares traded in globally integrated capital markets (Koedijk et al., 2002:926; Koedjik & van Dijk, 2004:37; Mishra & O'Brien, 2001:46).

*4.2.5.1 **Are dual-listed shares traded in integrated capital markets?***

The term 'capital market integration' was first defined by Beckers, Connor and Curds as early as 1996. All three definitions focused on the barriers to international investing, for example regulatory, fiscal or administrative impediments (Beckers et al., 1996:31). The first definition stated that if all investors have equal access to all the securities in the world then by definition markets would be fully integrated. The second definition focused on the consistency of asset pricing across markets and stated that in fully integrated markets any two assets with the same level of risk and cash flows should always have the same price, irrespective of the markets in which they trade. The third and last definition focused on the correlations of security returns across different markets, stating that if capital markets were fully integrated then factors explaining correlations of returns would be international ones, with no role for national factors.

The first definition of capital market integration supports the view that dual-listed companies are indeed traded in at least partially integrated capital markets. The second definition implies that the cost of capital of a dual-listed company should be the same, no matter where it is traded, e.g., whether on the JSE Limited or the LSE. The third definition implies that factors explaining the returns of dual-listed companies should be global factors and not just national ones. According to the above definitions by Beckers et al. (1996:31), even companies that are not dual-listed could also be regarded as trading in integrated capital markets. However, this study focuses on dual-listed South African companies.

4.2.5.2 *Choosing between the global and local Capital Asset Pricing Models*

In 1995, Stulz (1995:11) presented arguments in favour of using global pricing methods to value shares traded in markets that were not segmented from the rest of the world. The CAPM was developed in the USA at a time when the US stock market made up most of the world's stock market capitalisation, and others were closed to foreign investors (Stulz, 1995:12). Therefore, in the USA, the CAPM has traditionally been applied by using a broad US index as a proxy for the market portfolio (Stulz, 1995:12). Many markets are now easily accessible to foreigners and the share of the US stock market in the world market capitalisation is substantially less than in the 1960s or 1970s, therefore it is no longer appropriate to use a local index as a proxy for the market portfolio when applying the CAPM (Stulz, 1995:12). In smaller countries, where valuation literature is not extensively developed, practitioners simply mimic the earlier US method of applying the CAPM by using a local index as a proxy for the market portfolio (Stulz, 1995:11).

Beta is the risk that a share adds to the portfolio of securities held by investors (Stulz, 1995:13). The CAPM assumes that all investors hold the portfolio of securities that minimises risk for a given expected return; therefore, in equilibrium, all investors hold the same portfolio of risky assets, i.e., the market portfolio (Stulz, 1995:13). In a case of segmented capital markets, where local investors cannot invest abroad and foreign investors cannot access the local market, the market portfolio as defined must be the home market. In the case of globally integrated capital markets, the market portfolio held by investors must be the market portfolio made up of all securities that are freely accessible to investors. Stulz (1995:14) refers to this portfolio as the global market portfolio because it includes more than just the local market but does not contain all securities in the world, as some markets may well be closed to foreign investors. In the case of globally integrated capital markets, if investors only hold securities from their home country they forgo the benefits of international diversification. By selling off some local shares in exchange for foreign shares investors could reduce the portfolio risk without affecting its expected return. Therefore, in globally integrated capital markets, the beta of a share is measured by its contribution to the risk of the global portfolio held by investors, i.e., the global beta (Stulz, 1995:14).

Koedijk and van Dijk (2004:468) stated that companies with an international listing tend to have a large market capitalisation and a high percentage of sales abroad.

These firms show a clear orientation towards international markets and their returns can therefore be expected to be substantially influenced by global risk factors, including exchange rates. Koedijk and van Dijk (2004:468) add that this exposure to global factors cannot always be captured in the international pricing of the local market index, therefore the cost of capital estimated using the local CAPM can reasonably be expected to differ substantially from that calculated using the global CAPM.

O'Brien and Dolde (2000:7) stated that in a global financial market, arbitrage should result in the value of an internationally traded asset being the same, after adjusting for exchange rate differences, no matter where it is valued. Their study further advocates, given this condition, using a global CAPM as a method of calculating an asset's expected return in any currency. They stated that in 'globally integrated markets', using a global CAPM is more appropriate than using the domestic CAPM, which is regarded as segmented, but their study did not specifically define 'globally integrated markets'. It has reasonably been assumed that 'globally integrated markets' refers to the same market conditions as used by Beckers et al. (1996:31) to define 'capital market integration'.

Mishra and O'Brien (2001:27) use Stulz (1999) to argue that a global market index should be applied instead of a local one when using the CAPM to estimate the cost of equity of companies whose shares are traded in integrated global financial markets. Since many firms have a different correlation with the global markets compared to local markets, the index used in the CAPM will theoretically affect a firm's cost of equity estimate.

Using a global CAPM may be theoretically superior; however, the domestic CAPM does not necessarily provide an incorrect estimate of the cost of equity. The local and global CAPMs could lead to the same result if the local market portfolio contains all the relevant information required to price domestic assets internationally (Koedijk et al., 2002:906).

*4.2.5.3 **The single-factor and multi-factor global Capital Asset Pricing Models***

The basic premise of the global CAPM is that investors hold globally diversified portfolios and therefore their required return is based on global risk-factors, i.e., the risk of investing in global markets. The single-factor global CAPM is similar to the

traditional CAPM, but uses a global share index instead of a local index as a proxy for the market portfolio. The single-factor global CAPM is as follows:

$E(Ri) = r_0 + \beta_{IL}[E(R_L) - r_0]$

Where:

E (Ri) = required return (cost of equity) for company i,

r_0 = risk-free rate in the pricing currency,

β_{IL} = beta of company i's equity against the global market index returns,

E (R_L) = equilibrium expected return on the global market index, in the pricing currency

(Mishra & O'Brien, 2001:29).

Theoretically, the global CAPM calculates expected return in any currency and therefore the pricing currency becomes relevant when applying it.

A growing body of researchers believe that systematic exposure to fluctuations in exchange rate returns is a risk that is priced in international markets, over and above systematic exposure to market risk (O'Brien & Dolde, 2000:8; Koedijk & van Dijk, 2004:468). In their studies, they therefore focus on the multi-factor global CAPM, which takes into account exchange rate risk as well as global market risk in calculating the risk premium.

The multi-factor global CAPM applied by O'Brien and Dolde (2000:8) is as follows:

$$E(Ri) = r + \beta im[E(Rm) - r] + \beta ix[E(Rx) - r]$$

Where, Ri, r, Rm and Rx are nominal returns based on one currency, i.e., the pricing currency; and

Ri = the return on asset i

r = the nominal risk-free rate of the pricing currency;

Rm = the return (in the pricing currency) on the global market portfolio;

Rx = the return on an index of currency deposits, where the return on each currency deposit includes both the nominal risk-free rate of that currency plus the percentage change in the value of that currency relative to the pricing currency;

βix and βim are bivariate regression coefficients of Ri versus Rm and Rx.

The multi-factor global CAPM can also be stated with any currency serving as the pricing currency (O'Brien & Dolde, 2000:9). As with all international asset-pricing

models, the conversion from one currency to another preserves the no-arbitrage value of an internationally traded asset at spot exchange rates (O'Brien & Dolde, 2000:9). The systematic risk factors (i.e., the market portfolio and the currency index) do not have to be uncorrelated (O'Brien & Dolde, 2000:9). As a result, the currency index (Rx) affects the expected return on the asset (Ri) both directly through Bix and indirectly via the covariance between the currency index (Rx) and the market portfolio (Rm).

Using the multi-factor global CAPM of Solnik (1983) and Sercu (1980), the respective studies of Koedijk et al. (2002:907) and Koedijk and van Dijk (2004:468) describe the multi-factor global CAPM as follows:

$$\mathrm{E[Ri - r0]} = \mathrm{E[Rg - r0]di1} + \mathrm{E[S + r - ır0]'di2}$$

Where: Ri and Rg= return of asset i and the global market respectively in the home currency;

S = the vector of nominal exchange rate returns of the other N countries against the home currency;

r = the vector of nominal returns on risk-free assets in the N countries;

r0 = the risk-free return in the home country;

di1 and di2= the global market beta and the exchange rate beta respectively and are the regression coefficients in:

$$\mathrm{Ri} = \propto \mathrm{1i} + \mathrm{RGdi1} + \mathrm{S'di2} + \mathrm{ui}$$

The multi-factor global CAPMs used by Koedijk et al. (2002:907); Koedijk and van Dijk (2004:468) and O'Brien and Dolde (2000:9) are identical in their make-up, but presented slightly differently.

4.2.5.4 *Scope of prior studies on the valuation of shares in global markets*

The prior studies referred to in this section investigated whether using the global CAPM instead of the local CAPM would result in a different cost of equity estimate for the same share. These studies refer to different types of shares as samples but they all focus on shares that are seen to be traded on globally integrated equity markets as in this study. The prior studies focus on companies that are domiciled in developed markets such a Europe and the USA whereas this research study focuses on South African companies with dual listings in foreign countries.

Stulz (1995:11) presented arguments in favour of a global CAPM when valuing companies that are traded in globally integrated capital markets. The study proposes and explains a formula which quantifies the extent of the mistake one makes by using a domestic instead of a global CAPM (Stulz, 1995:11).

O'Brien and Dolde (2000:10) illustrated the application of the multi-factor global CAPM using the actual returns realised by the American Depository Receipts (ADRs) of a British company, *Grand Metropolitan Plc.* (*GrandMet*). The study used monthly historical returns from April 1991 to March 1997 (i.e., six years). The multi-factor global CAPM was first applied using US dollars and then British sterling as the pricing currency to calculate the consistent equilibrium expected rate of return in both currencies (O'Brien & Dolde, 2000:12). Therefore, the cost of equity for *GrandMet* was calculated as it would have been by an investor in the USA using US dollar returns and also by an investor in Britain using sterling returns (O'Brien & Dolde, 2000:12). The Morgan Stanley Capital International (MSCI) World Index was used as a proxy for the global market portfolio and the Federal Reserve Trade-Weighted Index of G-10 currencies was used as a proxy for the currency index (O'Brien & Dolde, 2000:10).

The research purpose of the study by Koedijk et al. (2002:905) was to analyse the extent to which global versus local asset-pricing models may lead to a different cost of equity estimate for the same company. The study compared the result of the multi-factor global CAPM to that of the domestic CAPM for a sample of 3 293 companies from nine industrialised countries, namely, Australia, Canada, France, Germany, Japan, the Netherlands, Switzerland, UK and the USA.

The research purpose of this study is similar to Koedijk et al. (2002:905), except that it focuses on South African companies that have obtained dual listings in various foreign countries.

Koedijk et al. (2002:908) compared the local CAPM to the multi-factor global CAPM by performing a pricing error test to analyse whether the following equation was true for each share included in the research sample:

$$d_i = d_L b_i$$

Where d_i = the international beta of share i (incorporating the global market and foreign exchange betas);

d_L= the global beta of the local market index;
b_i= the beta of share i versus the local market index (as used in the domestic CAPM) (Koedijk et al., 2002:908).

The pricing error test is supported by the underlying theory that each local market index is driven by global risk factors, just as each share is also driven by global risk factors. The right side of the equation ($d_L b_i$) is the indirect global beta of share i – i.e., the global beta of the local market multiplied by the local beta of share i.

To the extent that above equation was true for an individual share, it was concluded that there was no pricing error or vice versa. If indeed there was no pricing error it was concluded that the domestic market contained all the information relevant to price assets in the global market. A significant pricing error implied that the cost of equity derived using the domestic CAPM would be significantly different from that derived using a multi-factor global CAPM. Koedijk et al. (2002:908) also performed a pricing error test comparing the single-factor global CAPM (i.e., excluding exchange rate risk factors) to the domestic CAPM.

Koedjik and van Dijk (2004:465) analysed the cost of equity of firms with foreign dual listings, mainly to investigate whether using a global rather than a local CAPM would lead to a significantly different cost of equity for the dual-listed companies. Koedjik and van Dijk (2004:465) compared the results of the multi-factor global CAPM to those of the domestic CAPM for a sample of 336 dual-listed companies from nine industrialised countries. Since dual-listed companies are often large multinationals with a strong international orientation, they expected to find a substantial difference between their global and local costs of equity.

Mishra and O'Brien (2001:28) compared the cost of equity calculated using three pricing models, i.e., the traditional CAPM, the single-factor global CAPM and the multi-factor global CAPM. The tested sample consisted of 2 989 non-financial US shares, 70 developed market ADRs and 48 emerging market ADRs. The study made use of five years of monthly returns, from January 1995 to December 1999. The theoretical significance of including the single-factor global CAPM in the study is questionable because once integrated markets are assumed then foreign exchange risk becomes a market risk that should be priced.

4.2.5.5 *Findings of previous studies on the valuation of shares in global markets*

Using US dollars as the pricing currency, O'Brien and Dolde (2000:11) found there was a 25 basis point difference between the expected return of *GrandMet* calculated using a multi-factor global CAPM and one using a single-factor global CAPM. Using the same historical data, but with British sterling as the pricing currency, there was a 61 basis point difference between the cost of equity estimated using a multi-factor global CAPM and a single-factor global CAPM (O'Brien & Dolde, 2000:13-14). Given that the US dollar is the most influential currency, the single-factor global CAPM may be a better estimate of the true cost of equity in that currency than in any other. This means that the price of exchange rate risk may not be as high for assets that are denominated in US dollars as they are for other currencies.

Koedijk et al. (2002:911) found that only 5% of the total 3 293 companies tested reflected a significant pricing error, at a 95% confidence interval. This implied that only 5% of the companies tested yielded a significant difference in their cost of equity derived using a domestic versus a multi-factor global CAPM. Table 4.1 (below) presents the results of the pricing error test as performed by Koedijk et al. (2002:912), by country.

Table 4.1: Percentage of companies (by country) that reflected a significant pricing error when comparing the domestic CAPM to the multi-factor global CAPM

Country	Percentage of companies with a significant pricing error
Australia	4.63
Canada	4.11
France	5.51
Germany	6.74
Japan	5.79
Netherlands	7.32
Switzerland	3.10
United Kingdom	4.19
United States	6.05
Average	**5.16**

Source: Koedijk et al. (2002:912)

This evidence was interpreted as an indication that the domestic and multi-factor global CAPMs rarely result in significantly different cost of equity estimates, therefore, a risk that can be diversified locally rarely contains any additional systematic risk in the global market (Koedijk et al., 2002:912). Table 4.2 (below) sets out the percentage of the companies in each country for which a significant pricing error was detected when comparing single-factor global CAPM (i.e., excluding exchange rate risk factors) to the domestic CAPM.

Table 4.2: Percentage of companies (by country) that reflected a significant pricing error when comparing the domestic CAPM to the single-factor global CAPM

Country	Percentage of companies with a significant pricing error
Australia	8.33
Canada	3.65
France	3.94
Germany	3.37
Japan	8.93
Netherlands	0.81
Switzerland	6.20
United Kingdom	2.57
United States	0.19
Average	**4.22**

Source: Koedijk et al. (2002:913)

These results indicate that it is not critical which version of the global CAPM is used, i.e., the multi-factor or the single-factor, as the domestic CAPM will rarely result in a significantly different cost of equity estimate when compared to the global CAPM (Koedijk et al., 2002:913).

Koedijk et al. (2002:918) also investigated the extent to which risk that is specific in the domestic country is actually systematic in the global market. They used a variance decomposition metric, which enabled the assessment of the respective contributions of the local market, the global market and exchange rate changes to an individual asset's returns. The starting point of the decomposition was the domestic CAPM, followed by an investigation into how much global market and currency risk factors each added to the local market index, as measures of systematic risk. The

result of this analysis was that the contributions of the global market and currency risk factors were on average negligible across companies in each country. The local market index of each country was the main contributory risk factor, with little or no contribution from the global market and currency risk factors. This further emphasised that it is not critically important to choose between a domestic CAPM and a global CAPM for the computation of cost of equity (Koedijk et al., 2002:919).

The results of the decomposition also indicated that most firms within one country share a common behavioural pattern in response to global stock market and currency risk factors (Koedijk et al., 2002:919). As this average behaviour is captured in the international pricing of the local market index, the local index becomes a sufficient benchmark against which to measure an individual firm's sensitivity to global market risk factors. Therefore, even in integrated markets, the local market index is sufficient to use as a proxy for those global market risk factors that are omitted in the domestic CAPM. Koedijk et al. (2002:920) further concluded that it is only when an individual company exhibits significantly different behaviour from the local market in response to global risk factors that the domestic CAPM would result in a pricing error (Koedijk et al., 2002:920).

By running a regression of the returns on individual shares against the returns on the world market index and several exchange rates, Koedijk et al. (2002:925) found evidence that a large number of companies were indeed exposed to fluctuations in exchange rates. Foreign exchange exposure was significant for more than 45% of the companies included in the sample. However, after incorporating the domestic market index into the regression, both the world market factor and the foreign exchange factor became insignificant for the majority of the companies included in the sample. From this analysis, they concluded that companies within a country exhibited similar exposure to global risk factors, which was in turn jointly reflected in the variability of the domestic market index (Koedijk et al., 2002:926). For a large majority of companies in each country, the domestic market index therefore becomes a sufficient explanatory variable for the variability of its returns, with no additional requirement for global risk factors. Only when an individual firm has a different behavioural pattern in response to global risk factors compared to the average local firm will the local market be insufficient in explaining all the variability in that specific share's returns.

An explanation for the outcome of the study by Koedijk et al. (2002:926) is the lack of real capital market integration, i.e., companies in the same countries will behave very similarly due to cyclical, structural and institutional country-specific factors, which closely tie the fortunes of all firms operating in the same country. The lack of real capital market integration is separate from financial integration and the assumption of financial integration is already established by virtue of the use of international asset-pricing models. Therefore, the results of the study by Koedijk et al. have no implications for the integration of global financial markets, but rather indicate that these financial markets can be used to diversify into different countries.

As part of their overall study, Koedijk and van Dijk (2004:472) calculated the correlation coefficients between the local and global stock market returns in US dollars. The local stock market returns included in this analysis were those of the nine industrialised countries in the study. Overall, they found that domestic stock markets generally moved together, although they are far from being perfectly correlated. The correlation coefficients ranged from 0.31 (Australia and Canada compared to Japan) to 0.73 (Canada compared to the USA). They also found a high level of correlation between the global market index and each of the local market indices for the nine countries included in their study.

Koedijk and van Dijk (2004:474) stated that due to the high level of correlation between the global and domestic market indices, one may expect the difference between the domestic and single-factor global CAPMs to be small. The single-factor global CAPM ignores currency risk, therefore any difference between the cost of capital derived using the single-factor global CAPM and the domestic CAPM would result mainly from the difference in the global market beta and the domestic market beta of a stock. However, the study explicitly included foreign exchange risk, and the researchers argued that in the presence of multiple risk factors the local beta of a stock could not generally be expected to capture the multi-dimensional exposure to global factors. Therefore, despite the high level of correlation between the global and local stock market indices, they had still expected to find a substantial difference in comparing the global cost of equity to the domestic one for the dual-listed companies included in their study. They found significant differences for approximately 12% of the 336 dual-listed companies included in their sample.

Table 4.3 (below) reflects the percentage of companies (by country) which reflected a significant difference between the cost of equity derived using a multi-factor global CAPM and one using the domestic CAPM. The average percentage is calculated as the weighted average across all nine countries, determined using the weights as reflected in column 2. The researchers also made an interesting observation that the companies that had a significant cost of equity differential were typically from the larger countries, i.e., the USA, Germany, Japan and the UK. There was no further explanation provided for this finding.

Table 4.3: Percentage of dual-listed companies (by country) reflecting a significant cost of equity differential using a domestic versus a multi-factor global CAPM

Country	Number of companies by country	Percentage of companies with significant differences in cost of equity
Australia	24	4.17
Canada	29	6.90
France	22	4.55
Germany	24	12.50
Japan	127	19.69
Netherlands	26	3.85
Switzerland	14	7.14
United Kingdom	17	5.88
United States	53	11.32
Total / Average	**336**	**12.20**

Source: Koedijk and van Dijk (2004:476)

Similarly to Koedijk et al. (2002:918), Koedijk and van Dijk (2004:478) performed a variance decomposition to assess the respective contributions of the local market, the global market and the vector of exchange rates to the systematic risk of an individual company's shares. However, the variance decomposition they performed was only on dual-listed companies' shares. Again, the intention was to find supporting evidence to their earlier finding that using a domestic CAPM rather than a multi-factor global one does not result in a significantly different cost of equity. The outcome of the variance decomposition on dual-listed shares showed that the contribution of the global market index is virtually non-existent for companies within the different countries. The exchange rate risk factors did, on the other hand, reflect some explanatory power on the returns, although this was found to be very little.

Koedijk and van Dijk (2004:481) reached a similar conclusion to Koedijk et al. (2002:919), namely that companies within a country share a similar exposure to the global market and currency risk factors. The exposure to global factors for all the companies within a country is in turn captured in the international pricing of the local market index. This results in the local market being a sufficient statistic for measuring a firm's sensitivity to global factors; therefore even in integrated markets the domestic and global CAPMs do not result in a significantly different cost of equity. It is thus expected that the multi-factor global CAPM and the domestic CAPM will only yield a significantly different cost of equity for companies that behave significantly differently in response to global factors compared to the average company within their country (Koedijk & van Dijk, 2004:481).

Mishra and O'Brien (2001:37) noted that the global Beta of the local US Index (i.e., the Standard and Poor's (S&P) 500 index compared to the MSCI World Index) was very close to 1, which meant that the two indices were highly sensitive to each other. Furthermore, this meant that the global market risk premium would be similar to the local market risk premium. However, the beta coefficients of individual shares against each of the indices may be very different. In order to avoid the results of individual shares cancelling each other out, Mishra and O'Brien (2001:28) reported the average absolute differences between the costs of equity estimates derived using all three CAPM models. Using the US dollar as the pricing currency, they found that the average absolute difference between the local CAPM and the single-factor global CAPM cost of equity estimates was 48 basis points. The average absolute difference in the cost of equity calculated using the single-factor global CAPM and the multi-factor global CAPM was 61 basis points. In both cases the differences were lower for the large capitalisation shares included in the sample tested. Mishra and O'Brien (2001:46) concluded that whilst the choice of the model makes little difference to the cost of equity estimate, on average, there were instances of greater differences across the three CAPM models for individual shares and individual industries.

4.3 SUMMARY

Previous research had been conducted to test whether using a global CAPM or a local CAPM resulted in a significantly different cost of equity estimate (Mishra & O'Brien, 2001; Koedijk et al., 2002; Koedijk & van Dijk, 2004). The common finding was that the cost of equity does not change significantly when a global CAPM instead of a local CAPM is used. This finding was mainly attributed to country factors, i.e., that most companies within a country reflect similar joint sensitivity to global risk factors. This similar joint sensitivity is captured in the pricing of the local market index; therefore the local market index contains all the information necessary to price assets globally. Mishra and O'Brien (2001:38) used only US shares in their study and found that the local US index was highly correlated with the global market index. Therefore, whether a local market index or a global market index was used in the CAPM, the resulting costs of equity were found not to be significantly different (Mishra & O'Brien, 2001:38). There were, however, instances of greater differences for individual shares and individual industries (Mishra & O'Brien, 2001:38).

4.4 CONCLUSION

Despite finding that using global rather than local pricing models did not lead to statistically significant differences in valuation, authors tend to concur that global asset-pricing models are the most appropriate to use when valuing shares traded in globally integrated capital markets (Koedijk et al., 2002:926; Koedjik & van Dijk, 2004:37; Mishra & O'Brien, 2001:46).

5 CHAPTER 5 – RESEARCH METHODOLOGY

5.1 INTRODUCTION

The previous chapter set out the theoretical background to the CAPM and how it can be applied when valuing dual-listed companies. In this chapter the research methodology used for this study is discussed, as well as the overall research approach, sampling design and the methods of data gathering and data analysis employed.

5.2 RESEARCH APPROACH

The overall research approach of this study is quantitative in nature. The purpose of quantitative research is to determine the quantity or extent of a phenomenon in the form of numbers (Zikmund, 2003:111). This study involved a quantitative analysis of secondary data gathered from various secondary data sources as identified below. Zikmund (2003:136) defines secondary data as that gathered and recorded by someone else prior to the research study and not necessarily for its current needs. The results of the quantitative testing of the data were further analysed by way of comparison to similar prior research studies as well as identifying specific trends and characteristics.

5.2.1 Pricing currency

The focus of this study is on equity instruments that are traded in integrated capital markets and whether these should be valued using global or local pricing models. The global CAPM assumes that equity instruments can be valued in any currency using global risk factors (O'Brien & Dolde, 2000:7). Local pricing models on the other hand assume that the domestic market is segregated from the rest of the world (Stulz, 1995:12). Furthermore, the focus is specifically on dual-listed South African shares, which by virtue of their listings in more than one country are also quoted and traded in currencies other than the rand, i.e., their home currency. By definition, these companies are listed on the JSE Limited as well as on one or more international exchanges, such as the LSE or the NYSE. Therefore, it is possible to obtain the official published historical share prices in rands and other currencies, for example in pounds sterling (in the case of the UK-listed shares) or in US dollars (in the case of US-listed shares.) Due to the nature of this study, the first step in designing a research approach was to select the pricing currency, i.e., the currency used to calculate the cost of equity. As this research study is on South African

companies which so happen to have dual listings in other countries, the pricing currency was the home currency i.e., the South African rand. Therefore, the share prices of the dual-listed South African companies were the rand-based share prices as quoted by the JSE Limited. Furthermore, the returns on the global market index were converted from US dollars into rand denominated returns. Foreign exchange risk was estimated using long-term historical movements of other major world currencies against the rand.

5.2.2 Sample period

One of the components of both the local as well as the global CAPM is the beta coefficient. Beta can be calculated by regressing the returns of individual shares against a market index such as the ALSI in the case of the local CAPM (PWC 2009/2010:31) or the MSCI World Index in the case of the global CAPM. A foreign exchange beta coefficient is an additional component of the multi-factor global CAPM, which features prominently in this study. The foreign exchange beta coefficient is obtained by regressing the returns on individual shares against movements of other major world currencies against the home currency (Koedjik & van Dijk, 2004:469).

The second step in designing the overall research approach is to select the period over which share prices, foreign exchange movements as well as market indices are to be analysed (sample period) and to select the intervals (e.g., daily, weekly, monthly) over which the returns on each of these components will be calculated.

Mishra and O'Brien (2001:31) analysed five years of monthly returns for the period January 1995 to December 1999 whilst Koedijk and van Dijk (2004:472) analysed 19 years of monthly returns. O'Brien and Dolde (2000:10) used six years of monthly returns on shares and indices over the period April 1991 to March 1997. A five-year period of monthly historic returns from the first of January 2005 to 31 December 2009 (sample period) was used for this study as it is a reasonably extended period of time and provided sufficient observation points to run a meaningful regression on the data. The period from the first of January 2005 to 31 December 2009 was the most recent five year period at the time of doing this study.

5.3 RESEARCH DESIGN

The nature of the research problem influences the choice of the research design, i.e., whether exploratory, descriptive or causal (Zikmund, 2003:54). *Exploratory research* is

normally conducted to clarify ambiguous research problems, and assist in crystallising the problem and identifying further information needs for future research (Zikmund, 2003:54). It is performed where the research problem is not yet clearly identifiable. *Causal research* is normally conducted to identify cause and effect relationships amongst different variables once the research problem has been clearly defined (Zikmund, 2003:56). The main purpose of *descriptive research* is to describe the characteristics of a phenomenon, i.e., to determine answers to exploratory questions such as what, who, where, when and how, and to describe various situations rather than answer why certain things are that way (Zikmund, 2003:55). Based on the nature of the research objectives described in Chapter 1, the primary design for this research was descriptive, carried out by quantitatively, analysing secondary data and describing the results of the analysis.

5.4 SAMPLING DESIGN

Non-probability sampling, in which the probability of any particular member of the total population being selected is not known (Zikmund, 2003:380), is the opposite of probability sampling, in which every element in the population has a known non-zero probability of selection (Zikmund, 2003:379). In non-probability sampling, the selection of sampling units is arbitrary as the researcher relies heavily on personal judgement (Zikmund, 2003:380).

Judgement sampling (a form of non-probability sampling in which the researcher is able to select a sample based on judgement about the appropriate characteristics required for the sample members) was considered the most appropriate sampling method for this study (Zikmund, 2003:382). Zikmund (2003:382) states that "judgement sampling is a non-probability sampling technique in which an experienced individual selects a sample based on his or her judgement about some appropriate characteristic required of the sample members". An example provided in Zikmund (2003:382) of the application of judgement sampling is that of the consumer price index which is based on a judgement sample of a basket of household goods, household costs and other goods and services that are selected to reflect a representative sample of items purchased by most consumers.

In the case of this study, only those South African dual-listed companies listed on the JSE Limited over the entire sample period and were liquid (using the average monthly liquidity of the JSE Limited as a benchmark) were included in the final sample selected for further testing.

5.4.1 Target population and final sample selection

All South African dual-listed companies' shares (target population) were included. As confirmed by correspondence with the JSE Limited's market information department, there were 85 dual-listed shares on the JSE Limited as at July 2010. Of these, 28 were inward foreign listings as classified by the JSE Limited. Inward foreign listed companies are foreign companies that are using the JSE Limited as an additional listing destination for various reasons, for example: to establish a presence on the growing African continent. These foreign shares were excluded from the study as the focus is on South African companies with dual listings in foreign countries. Dual-listed preference shares were also excluded as the focus is on equity instruments and the cost of equity funding. There are two dual-listed preference shares not already excluded from the sample by virtue of their being inward foreign listed companies. Another 29 shares were excluded from the final sample for a number of reasons, including their illiquidity; their being foreign, although not formally classified as inward foreign listed shares by the JSE Limited; and because they were not trading on the JSE Limited over the entire sample period. Therefore, the final sample of shares is made up of 26 dual-listed South African companies' shares, which for this study will be referred to as the "sample shares". Refer to Table 6.1 (Annexure 1) for the complete list of sample shares.

*5.4.1.1 **Foreign shares***

The JSE Limited recently introduced the classification of inward foreign listed shares, though there are foreign companies that listed theirs on the JSE Limited before this classification was introduced. For example, *Compagnie Financière Richemont SA* is a Swiss luxury company that was listed on the JSE Limited in 1960 and is not formerly classified as an inward foreign listed company unlike the other more recent listings by foreign entities such as *Oando Plc.*, a Nigerian company which has had a secondary listing in South Africa since 2005. An additional 17 foreign shares were excluded.

*5.4.1.2 **Illiquidity***

Liquidity was tested by comparing the average monthly trading volume on the JSE Limited to the average monthly trading volume of the shares making up the target population. Using the latest trading volumes on the JSE Limited, the total volume traded during July 2010 was 5.7 billion shares across 408 listed shares. A simple calculation reveals that the latest average trading volume per share on the JSE

Limited is 13.9 million per month. For those shares that were listed over the entire sample period, the average trading volume per month as recorded by *Bloomberg* over the sample period was compared to the JSE Limited's average monthly trading volume of R13.9 million. Ten of the South African dual-listed shares were excluded from the sample shares by virtue of the average monthly trading volume falling below 13.9 million shares. Prior similar studies excluded shares that were regarded as being illiquid from the final sample selected (Koedijk and van Dijk, 2004:476; Koedijk et al., 2002:925). The market prices of illiquid shares cannot be relied upon to provide an accurate reflection of the share price sensitivity to market risk factors over time. This is because the market prices of illiquid shares are generally not regarded as being a fair reflection of their true market value.

5.4.1.3 ***Shares not listed throughout the sample period***

There were two dual-listed South African companies' shares that did not trade on the JSE Limited over the entire sample period and these have been excluded from the sample. Any regression of their returns against indices would have to be limited to the period during which they traded, which may not be long enough to provide an accurate estimate of the beta coefficients.

5.5 DATA GATHERING

The secondary data was gathered from *Bloomberg* and various publishers of financial information, such as the *Financial Times* and the *Business Day* newspapers. Mishra and O'Brien (2001:32), Koedijk and van Dijk (2004:471), Koedijk et al. (2002:910) and Stulz (1995:19) used secondary data downloaded from financial data sources such as MSCI, *International Financial Statistics* and *Standard and Poors,* as well as data published in the *Financial Times*.

The secondary data required for this study was:

- the share prices of the sample shares for the months ending during the sample period
- the levels of indices such as the MSCI World Index (in rand) and the ALSI for all months ending during the sample period
- the latest yield-to-maturity on risk-free debt instruments
- the R/US$ exchange rate over the sample period.

5.5.1 Morgan Stanley Capital International world index

The MSCI World Index is a free float-adjusted market capitalisation weighted index that is designed to measure the equity market performance of developed markets. It tracks 23 developed countries and is published in US dollars; however, it is possible to convert it to other currencies using official exchange rates. *Bloomberg* is able to perform this conversion for users, therefore the MSCI World Index, in rands, will be downloaded from *Bloomberg*.

5.5.2 All Share Index

The ALSI is published by the JSE Limited, South Africa's official exchange for equities and other financial instruments. The ALSI is a rand-based index and there is no need to convert it as it is already denominated in the pricing currency.

5.5.3 Risk-free yield to maturity

South African government bonds are used as a proxy for risk-free debt instruments in the local CAPM. For purposes of the multi-factor global CAPM, South African government bonds are used as a proxy for risk-free debt instruments that are denominated in the pricing currency. The annual returns on US Treasury bonds are used as the proxy for dollar denominated risk-free returns for purposes of calculating the foreign exchange risk premium in the multi-factor global CAPM. This is discussed in more detail in Chapter 6.

5.5.4 Foreign currency movements against the pricing currency

The R/US$ exchange rate is used as a proxy for measuring the valuation of the rand against other world currencies. This is discussed in more detail in Chapter 6.

5.6 DATA ANALYSIS

To get a logical flow for performing and recording the quantitative data analysis, the researcher decided to follow the following fourteen steps (own deduction):

Step 1:

The sample shares were divided into different sector classifications, as in the JSE Limited sector classifications. This enabled analysis of the similarity of results amongst shares within the same sector and the difference in the average result between different sectors.

The broad sector classifications of the JSE Limited used for this exercise were as follows:

Table 5.1: JSE Limited sector classifications

Sector
Basic materials
Oil and Gas
Industrials
Consumer goods
Health care
Consumer services
Telecommunications
Financials
Technology

Source: *Business Day*, Tuesday 9 November 2010

The industry sectors outlined in Table 5.1 (above) can be further broken down into sub-sectors; however, due to the small number of the sample shares this was not done.

Step 2:

The monthly percentage returns (i.e. percentage change in the share prices from month to month) on individual shares were calculated using the monthly share prices. The monthly percentage returns on the ALSI and MSCI World Index were calculated using the index levels at month end, over the sample period. For purposes of the multi-factor global CAPM, which assumes that cost of equity can be calculated in any currency (O'Brien & Dolde, 2000:7), the pricing currency for this study was rands. Therefore, all the monthly returns on the sample shares and on the MSCI World Index, as well as the ALSI, were rand denominated returns.

Step 3:

Prior to embarking on using the data gathered above, it is important to have a thorough understanding of the same. The following descriptive statistics were calculated and used for this purpose:

- the mean return of each of the sample shares (by sector classification) over the sample period

- the mean return of each of the MSCI World Index as well as the ALSI over the sample period
- the mean return of the US dollar against the rand over the sample period
- the standard deviation of the returns of each of the sample shares (by sector classification) over the sample period
- the standard deviation of the returns of each of the MSCI World Index and the ALSI over the sample period
- the standard deviation of the returns in the R/US$ exchange rate over the sample period
- the correlation coefficients between each of the sample shares
- the correlation coefficients between each of the sample shares and each of the market indices
- the correlation coefficients between each of the market indices
- the correlation coefficients between the movements in the R/US$ exchange rates against each of the sample shares as well as each of the indices.

Step 4:

In preparing for the regression analysis to be performed according to the steps below, the dependent and independent variables must be clearly distinguished. The dependent variables are each of the sample shares and the independent variables are the market indices and the R/US$ exchange rate.

Step 5:

In order to conduct a valid regression analysis, there must be a linear relationship between the dependent and independent variables (Greyling, 1997:226). Therefore further analysis was performed to assess whether there is indeed any linear relationship between each of the individual sample shares and the independent variables, namely the MSCI World Index, the ALSI and the R/US$ exchange rate.

Single regression analysis

A linear relationship can be identified by way of a scatter plot of the dependent and independent variables over time (Greyling, 1997:226). A scatter plot of each of the sample shares and the ALSI was performed. The scatter plots were then inspected to assess whether there was any positive or negative linear relationship between each of the sample shares and the ALSI.

Multiple regression analysis

For purposes of the multiple regression analysis, as there were two independent variables, it was more efficient to inspect the correlation coefficients between each of the sample shares and the two independent variables, i.e., the MSCI World Index and the R/US$ exchange rate. Correlation indicates evidence of a linear relationship between two variables and that movements between the two variables are on average related (Brooks, 2002:43). Correlation coefficients calculated according to step 3 above were inspected to assess whether there was indeed any linear relationship between each of the sample shares and each of the independent variables. A correlation coefficient of zero would indicate no linear relationship between the individual share and the independent variable (Brooks, 2002:43).

Step 6:

Single regression analysis was performed using *Microsoft Excel* in order to calculate the local market beta coefficient of each of the sample shares. The local market beta coefficient is the regression coefficient resulting from regressing the monthly returns on the ALSI against the monthly returns of each of the sample shares over the sample period.

Step 7:

Multiple regression analysis was performed using *SPSS* in order to calculate the bivariate beta coefficients of each of the sample shares against the MSCI World Index and the R/US$ exchange rate. In each instance, the dependent variable is the monthly return on the sample share over the sample period and the two independent variables are the monthly returns on the MSCI World Index and the monthly returns on the US dollar against the rand.

Step 8:

Statistical tests were performed to check whether the results of the regression analysis performed in steps 6 and 7 above are valid. The following criteria were tested for each of the single as well as the multiple regression functions:

- Economic criteria
- Statistical criteria
- Econometric criteria.

Economic criteria

Economic criteria are based on the principles of economic theory and involve evaluating the signs and magnitudes of the regression coefficients (Greyling, 1997: 237). If the estimated coefficients do not comply with the expected sign or magnitude, the regression result must be rejected, unless it can be proven that the economic theory can be violated in that specific instance (Greyling, 1997:237). The signs and magnitudes of each estimated regression function were assessed to determine whether they conformed to expected financial theory.

Statistical criteria

Testing the statistical criteria of a regression function involves testing the statistical significance of the regression itself and of the estimated regression parameters (Greyling, 1997:238). The following statistical tests were conducted for each of the single as well as the multiple regression functions:

- the t-test for the individual statistical significance of each of the estimated regression coefficients
- the coefficient of determination (R^2) of the regression equation, which measures the success of the fit of an estimated regression equation (Greyling, 1997:246).

Econometric criteria

This step of evaluating a regression function involves applying a number of econometric tests to determine whether there is any statistical bias in the estimated regression functions. Regression analysis is a procedure conducted to estimate the mathematical or economic relationship between a dependent variable and one or more independent variables. Often the entire population of interest is not available or is too large to feasibly work with in its entirety (Brooks, 2002:53). In this case, a sample of data is used to estimate the regression function of the entire population (Brooks, 2002:53). The mathematical procedure used to estimate the regression function is termed 'ordinary least squares' (OLS) (Brooks, 2002:49).

There are certain statistical assumptions that need to be met for the estimated regression parameters to be the best linear unbiased estimators of the true parameters of the entire population (Brooks, 2002:56). The five statistical assumptions of OLS and the statistical test used to ascertain whether each assumption was met are listed in Table 5.2 (below). Testing econometric criteria involves testing that these statistical assumptions are not violated in the case of any regression analysis conducted. One of

the consequences of a violation of certain of these statistical assumptions is that the estimated coefficients of a regression function may be incorrect (Brooks, 2002:145).

Table 5.2: The five statistical assumptions of OLS and the statistical test

OLS Assumption		Statistical test to be conducted
$E(\mu)_t = 0$	The error terms have zero mean (Brooks, 2002: 56; Greyling, 1997:227)	Calculate the mean of the error terms of each regression function and check that it is zero
$var(\mu_t) = \sigma^2 < \infty$	The variance of the error terms is constant and finite over all values x_t (Brooks, 2002: 56; Greyling, 1997:227)	White's test (Brooks, 2002:148)
$Cov(\mu_i, \mu_j) = 0$	The error terms are statistically independent of each other (Brooks, 2002: 56; Greyling, 1997:228)	Durban Watson test (Brooks, 2002:159; Greyling, 1997:248)
x_t *are non-stochastic*	The regressors or independent variables are fixed in repeated samples and their values are determined outside the regression model (Brooks, 2002:56)	No statistical test required
$\mu_t \sim N(0, \sigma^2)$	The error terms are normally distributed (Brooks, 2002:56; Greyling, 1997:229)	Perform histograms to determine whether the error terms fall within the range -3 to +3.

Source: Brooks (2002:56); Greyling (1997:228-229)

Step 9:

Those shares with estimated regression equations deemed to be statistically valid, based on the econometric tests above, became the remaining sample. The remaining sample shares were the final set of shares used to calculate and compare cost of equity using the local and multi-factor global CAPMs.

Step 10:

The components of the local CAPM were identified or calculated, as set out below.

Risk-free rate:

PWC (2009/2010:28) found that the R157 is the most commonly used government bond for the purposes of the risk-free component in the local CAPM, with more than half the respondents in their survey applying it. The latest yield on the R157 was obtained from the *Business Day* newspaper, companies and markets section. All South African government bonds make semi-annual coupon payments and therefore the published yield is a semi-annual yield. This was converted into an effective annual yield using normal finance formulae developed for the purpose. The cost of equity is a required return of equity investors and is usually stated as an annual expected return, hence the requirement for an annual yield.

Beta coefficient:

The beta coefficient was calculated by regressing the monthly returns of each share against the returns on the ALSI over the sample period, using *Microsoft Excel*.

Local market risk premium:

This component of the local CAPM was calculated using normal market conventions as determined by the PWC survey (2009/2010:32).

Step 11:

The components of the multi-factor global CAPM were identified or calculated, as set out below.

Local market risk-free rate:

The same risk-free rate identified and converted according to step 10 above was applied.

Foreign currency risk-free rate:

The risk free rate published by the *Financial Times* newspaper, in the companies and markets section was used. The *Financial Times* publishes yields on different countries' government bonds on an annualized basis; therefore no further conversion of the yields was necessary.

Global market beta coefficient and foreign currency risk beta coefficient:

These were the bivariate beta coefficients calculated by performing a multiple regression of the monthly returns on individual shares against the monthly returns on the MSCI World Index and the monthly movements of the R/US$ exchange rate over the sample period. *SPSS* was used to perform the multiple regression analysis.

Global market and Foreign exchange risk premium:

The global market and foreign exchange risk premium were calculated using formulae as set out in Chapter 4.

Step 12:

Following the detailed analysis of the secondary data as outlined above and identifying the components of the local and global CAPM, the cost of equity of the remaining sample of shares was calculated using the local CAPM. The global cost of equity of the remaining sample shares was calculated using the multi-factor global CAPM.

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Step 13:

The differences between the resulting local and global cost of equity estimates of the remaining sample shares were quantified and analysed. The differences and similarities of the results amongst the market sectors (as identified in step one) were also quantified and analysed.

Step 14:

In the final step of the data analysis the overall results of this study were contrasted with the results of previous similar studies. This was followed by a discussion of recommendations for further study and a conclusion.

5.7 SUMMARY

The overall research approach is quantitative analysis of secondary data. The pricing currency for the study was rands. The sample period was five years and monthly historical data between 1 January 2005 and 31 December 2009 was used. Based on the research questions outlined in Chapter 1, the research design was descriptive research. The sampling method was non-probability or judgement sampling; therefore all dual-listed South African companies that were listed on the JSE Limited over the entire sample period and were liquid formed part of the initial target population.

There was a final sample of 26 dual-listed South African shares used throughout the study, after excluding shares that were illiquid, not listed through the entire sample period or foreign (sample shares). The MSCI World Index was used as proxy for the global market portfolio, and the ALSI as a proxy for the local market portfolio. The R/US$ exchange rate was used to measure the sensitivity of the sample shares to exchange rate fluctuations. South African government bond yields were used as a proxy for South African risk-free yields and US Treasury bond yields as a proxy for

dollar denominated risk free yields. All secondary data was gathered from financial publications such as *Bloomberg, Financial Times and Business Day newspapers*. Using the JSE Limited sectors as a guideline, the sample shares were divided into sector classifications, enabling the comparison of the results of the detailed analysis amongst the various sectors.

Microsoft Excel was used to calculate the historical monthly movements of the sample shares and indices. Descriptive statistics on the historical monthly movements were calculated and analysed in order to provide an understanding of the data. Once the dependent and independent variables were identified, linear and multiple regression analysis was performed in order to calculate the local and global beta coefficients. The resulting regression equations were tested for economic, statistical and econometric validity. Those shares whose single and multiple regression analysis were found to be economically plausible as well as statically and econometrically valid were defined as the 'remaining sample shares' and used for the remainder of the study. The cost of equity of each of the remaining sample shares was calculated using the local CAPM. The cost of equity of the remaining sample shares was calculated using the multi-factor global CAPM. The cost of equity calculated using the local CAPM was compared to that calculated using the multi-factor global CAPM. The results between the different shares and market sectors were compared and analysed further. The overall results of this study were compared to the results of previous similar studies and points for further research highlighted.

6 CHAPTER 6 - DATA ANALYSIS AND INTERPRETATION

6.1 INTRODUCTION

The previous chapter reviewed the research approach and research design used in this study. This chapter describes the sample shares and the market proxies used, followed by descriptive statistics. Finally it sets out the results of the empirical data analysis.

6.2 SAMPLE SHARES

A description of each of the sample shares which have been identified using the sampling procedures defined in Chapter 5 are set out in Table 6.1 in Annexure 1.

6.3 MARKET PROXIES USED IN THIS STUDY

Three types of proxy were used in the study, namely proxies for: the local market portfolio; the global market portfolio; and exchange rate risk. Following is a discussion of each proxy, and the rationale for its appropriateness.

6.3.1 Proxy used for the local market portfolio

The ALSI was used as a proxy for the local market portfolio in the local CAPM. The monthly returns on the ALSI were regressed against the monthly returns on each of the sample shares over the sample period, with the ALSI as the independent variable. The resulting coefficient was applied as the beta coefficient in the local CAPM. Using the ALSI as a proxy for the local market portfolio when applying the local CAPM is consistent with the method used by most investment professionals in South Africa (PWC 2009/2010:31).

6.3.2 Proxy for the global market portfolio

The MSCI World Index was used as a proxy for the global market portfolio when applying the multi-factor global CAPM. This is in line with previous studies that have applied the multi-factor global CAPM (Koedijk & van Dijk, 2004:471; Koedijk et al., 2002:910; Mishra & O'Brien, 2001:32).

6.3.3 Proxy for exchange rate risk

Previous similar studies applying the multi-factor global CAPM used the monthly fluctuations in the pricing currency against a basket of foreign currency as a proxy for exchange rate risk (Koedijk & van Dijk, 2004:468; Koedijk et.al, 2002:907; Mishra &

O'Brien, 2001:31). In this study, with the rand being the pricing currency, the monthly movements of the R/US$ exchange rate were used as a proxy for exchange rate risk. The rationale for this is explained below.

6.3.3.1 *Foreign currency indices published in South Africa*

In South Africa, the only indices which track the value of the rand against a basket of foreign currencies are the nominal and real effective exchange rate indices published by the SARB. The nominal effective exchange rate index measures the movements of the rand against a basket of currencies belonging to South Africa's main trading partners (SARB, 2008:61). The real effective exchange rate index is the nominal effective exchange rate index adjusted for the inflation differential between South Africa and its major trading partners (SARB, 2008:61). The foreign countries that are included in the basket of trading partners are selected based on their relative importance in South Africa's bilateral trade (SARB, 2008:61). There are 15 countries included in the basket of foreign trading partners and each represents more than 1% of South Africa's total bilateral trade in manufactured goods (SARB, 2008:61).

6.3.3.2 *Rationale for using the rand / dollar exchange rate as a proxy for exchange rate risk*

Global market participants who invest in rand denominated assets face foreign currency risk as long as they continue to hold such assets which are priced in a currency which is not their home currency. However, market participants generally do not measure appreciation or devaluation in the rand against a basket of currencies. Instead, movements in the rand are generally tracked versus the US dollar, pound and the euro. The most attention is paid to the R/US$ exchange rate as opposed to the rand versus the other currencies. This analysis is based on what is usually discussed in financial publications with regard to the local currency. It is uncommon for the rand to be tracked against a basket of foreign currencies and therefore it is unlikely that the local stock market movements would be influenced by the movement in the rand against a basket of foreign currencies. In publishing the nominal and effective exchange rate indices, the SARB tracks the external price competitiveness of South African manufactured goods against those of their largest trading partners (SARB, 2008:61). The R/US$ exchange rate is more likely to influence local equities as this is what market participants, both locally and internationally, pay attention to.

6.4 REGRESSION ANALYSIS

There are two forms of regression analysis applicable to this study. *Single regression analysis* was performed in order to calculate the local market beta coefficient of each of the sample shares. The local market beta coefficient is the regression coefficient resulting from regressing the monthly returns on the ALSI against the monthly returns of each of the sample shares over the sample period. The local market beta coefficient was applied in calculating the cost of capital using the local CAPM.

The second form, *multiple regression analysis* was performed by regressing the monthly returns on each of the sample shares over the sample period against two independent variables, namely, the monthly returns on the MSCI World Index and the monthly movements on the R/US$ exchange rate. The resulting regression coefficients were used as the global market beta coefficient and exchange rate beta coefficient in the multi-factor global CAPM.

6.5 DESCRIPTIVE STATISTICS

In order to gain a broad understanding of the pattern of the returns on the sample shares, as well as the market indices, descriptive statistics were calculated using the monthly returns over the sample period.

6.5.1 Correlation coefficients

The first set of descriptive statistics calculated comprised the correlation coefficients between each of the sample shares and the independent variables. The correlation coefficient between two variables measures the degree of linear association between them (Brooks, 2002:43). Correlation does not imply causality, i.e. that a change in one variable will cause a change in the other variable; but rather linearity i.e., that there is evidence of a linear relationship between two variables and that movements in them are on average related, as measured by the correlation coefficient (Brooks, 2002:43).

Table 6.2 in Annexure 1 sets out the correlation coefficient between each of the sample shares and the independent variables.

*6.5.1.1 **Correlation of the sample shares with the All Share Index***

Table 6.2 (Annexure 1) reflects that each of the sample shares has a positive correlation coefficient, when compared to the local market (ALSI). Truworths International Limited *(TRU)* and DRD Gold *(DRD)* have the lowest correlation

coefficients against the ALSI. Upon analysing the correlation results by sector, the oil and gas as well as the technology sectors reflect the highest average correlation coefficients with the ALSI. The industrials sector reflects the lowest correlation coefficient with the ALSI. Based on this finding, it would appear that performing a valid regression analysis of each of the sample shares against the ALSI would be possible.

6.5.1.2 *Correlation of the sample shares with the Morgan Stanley Capital International world index*

The correlation coefficients of each of the sample shares with the MSCI World Index are somewhat diverse, as reflected in Table 6.2 (Annexure 1). Some of the sample shares, such as Pretoria Portland Cement Company Limited *(PPC)*, have little or no correlation with the MSCI World Index whereas others, such as Anglo American Plc. *(AGL)* and SABMiller Plc. *(SAB)*, have a very strong correlation. All the sample shares are positively correlated with the MSCI World Index, except for *TRU*. The oil and gas as well as the basic materials sectors reflect the highest average correlation coefficient with the MSCI World Index. The financials and industrials sectors reflect the lowest average absolute correlation coefficients against the monthly returns on the MSCI World Index. Based on these findings it appears that it will be possible to perform a valid regression analysis of the sample shares against the MSCI World Index.

Testing of the validity of the regression equations is discussed further in this chapter.

6.5.1.3 *Correlation of the sample shares with the rand / US dollar exchange rate*

Table 6.2 (Annexure 1) reflects that the correlation coefficients of each of the sample shares with the returns on the R/US$ exchange rate are all very low. This result is unexpected as one would expect to find that the South African equity markets are driven by global market risk factors, including foreign exchange risk, due to their being traded both by local and foreign investors as well as that their revenue sources have become diversified over time. Old Mutual Plc. (*OML)*, Standard bank Group Limited (*SBK)* and Naspers Limited (*NPN)* have the highest correlation with the returns on the R/US$ exchange rate. All of these companies have operations outside of South Africa and therefore a portion of their revenue is earned in US dollars. Amongst the sectors, the financial sector shares have the highest average absolute correlation coefficient with the R/US$ exchange rate. The

oil and gas sector has the lowest absolute correlation coefficient with the R/US$ exchange rate.

The validity of the regression equations of each of the sample shares against the R/US$ exchange rate will be tested further in this chapter.

6.5.2 Average percentage return and standard deviation of the returns

The average monthly percentage return (i.e. the percentage month to month movement in a share price) as well as the standard deviation of the returns of each sample share over the five-year sample period were calculated and further analysed by way of histograms. Figure 6.1 (below) reflects that the average monthly return of each sample share was likely to be 1.4% or more. This result is in line with the average monthly return on the local market index i.e. the ALSI which was 1.47% over the sample period. The average monthly return on the MSCI World Index was only 0.49% over the sample period. The local market index (i.e., the ALSI) is made up of South African shares and it is therefore plausible that the average monthly percentage return on the sample shares is similar to that of the ALSI.

Figure 6.2 (also below) reflects that the standard deviation of the monthly percentage returns on each of the sample shares was likely to be between 9.2% and 11.8%. This can be compared to the standard deviation of the monthly returns on the local market index, which was only 5.55% and that of the monthly returns on the MSCI World Index of 4.15%.

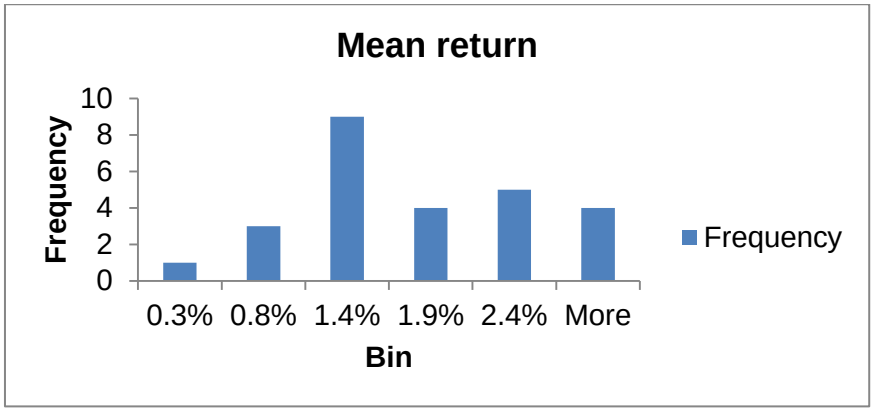


Figure 6.1: Histogram of the mean return of each of the sample shares

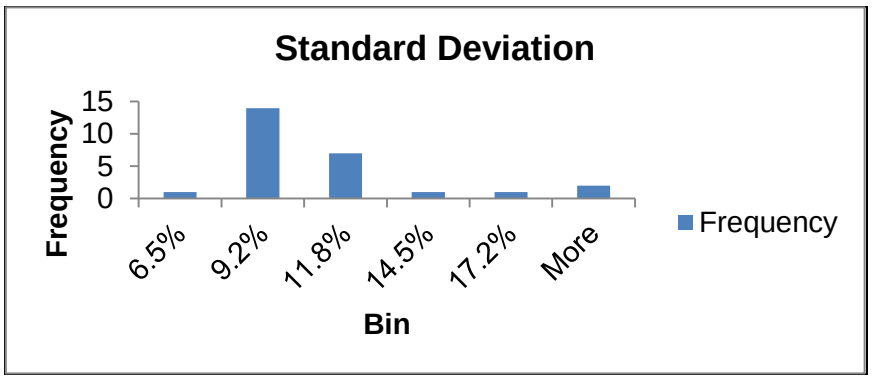


Figure 6.2: Histogram of the standard deviation of returns

6.6 LINEAR RELATIONSHIP BETWEEN THE DEPENDENT AND INDEPENDENT VARIABLES

In this section, careful consideration is given to the decision to use regression analysis to estimate the local as well as the global beta coefficients of each of the sample shares. An overriding principle of regression analysis is that there must be a linear relationship between the dependent and independent variables (Brooks, 2002: 54; Greyling, 1997:226). If neither a positive nor a negative linear trend is identified, regression analysis cannot be applied and another forecasting technique must be used (Greyling, 1997:226). Prior to performing regression analysis, tests were conducted to identify a linear relationship, if any, between each of the dependent and independent variables.

6.6.1 Linear relationship: single regression analysis

A graphical test for a linear relationship between the ALSI and each sample share was carried out as follows: a scatter plot of each share against the ALSI was obtained using *Microsoft Excel*. By observing each of the scatter plots, all the shares appeared to have a positive linear relationship with the ALSI.

It is appropriate at this stage to point out that this outcome is in line with the correlation analysis discussed above. Each of the sample shares were found to have a positive correlation coefficient against the ALSI as is reflected in Table 6.2. Correlation amongst two variables is an indication that there is a linear relationship between them and a scatter plot provides graphical evidence of the linear relationship, if any (Brooks, 2002:43).

6.6.2 Linear relationship: multiple regression analysis

To assess whether there is indeed a linear relationship between the dependent variable and each of the independent variables, reference is made to Table 6.2.

6.6.2.1 ***Linear relationship with MSCI World Index***

Upon analysing the correlation output in Table 6.2, it can be concluded that most of the sample shares have a linear relationship with the MSCI World Index. *PPC* has zero correlation with the MSCI World Index. Metropolitan Holdings Limited (*MET)*, *SBK*, Shoprite Holdings Limited *(SHP)* and *TRU* reflect correlation coefficients that are very close to zero against the MSCI World Index. At this stage, it can be argued that a valid regression analysis of the monthly returns on the said shares against the MSCI World Index cannot be performed due to the lack of a linear relationship. Further statistical tests of the multiple regression equations for each of the sample shares will be conducted later in this chapter.

6.6.2.2 ***Linear relationship with rand / dollar exchange rate***

The low correlation coefficients between each of the sample shares and the R/US$ exchange rate, as reflected in Table 6.2, reflect that the linear relationship between each of the sample shares and the R/US$ exchange rate is either very small or does not exist. Once again, from this analysis alone it could be argued that a valid regression of most the sample shares against the R/US$ exchange rate is not possible. Further statistical tests will be conducted in order to gain conclusive evidence in this regard.

6.7 EVALUATION OF THE SINGLE AND MULTIPLE REGRESSION FUNCTIONS

Subsequent to estimating the regression functions of each of the sample shares against the local and global risk factors, the validity and accuracy of these regression equations as well as the resulting coefficients needed to be tested. There are three main criteria against which an estimated regression function can be tested: economic, statistical and econometric (Greyling, 1997:237).

6.7.1 Economic criteria

Economic criteria are based on the principles of economic theory and involve evaluating the signs and magnitudes of the regression coefficients. If the estimated coefficients do not comply with the expected sign or magnitude, the regression result must be rejected unless it can be proven that the economic theory can be violated in that specific instance (Greyling, 1997:237).

6.7.1.1 *Economic criteria: single regression analysis*

The calculated beta coefficient of each sample share against the ALSI is reflected in Table 6.3 (below). Firstly, all the sample shares have a positive beta coefficient which is economically plausible as they are all positively correlated with the ALSI.

The oil and gas sector appears to have the highest beta coefficient with the Basic Materials sector having the second highest beta coefficient. This result is not surprising as the characteristic common to these two industries is that they are driven by global commodity prices that are known to be volatile. Therefore, the signs and magnitudes of the estimated beta coefficients resulting from the regression of each sample share against the ALSI appear valid when compared to economic theory.

Table 6.3: Beta coefficient of each sample share against the All Share Index

Basic materials sector	**Beta vs. ALSI**
AGL	1.60
BIL	1.27
ANG	0.79
DRD	0.63
GFI	0.65
HAR	0.89
IMP	1.45
MTX	1.51
SAP	1.45
Average	**1.14**
Technology	
DDT	0.88
Financials	
INL	0.96
MET	0.60
FSR	0.79
NED	0.65
SBK	0.73
SLM	0.55
OML	1.20
Average	**0.78**

Industrials	
BAW	0.98
PPC	0.47
Average	**0.72**
Consumer goods and services	
NPN	0.91
SAB	1.45
SHP	0.48
TRU	0.37
WHL	0.71
Average	**0.78**
Oil and gas	
SOL	1.18
Telecommunications	
TKG	0.59

Source: own deductions

6.7.1.2 *Economic criteria: multiple regression analysis*

The estimated beta coefficients resulting from a regression of the sample shares against two independent variables, the MSCI World Index and the R/US$ exchange rate, are set out in Table 6.4 (below). The beta coefficient of each sample share versus the MSCI World Index is the global market beta coefficient. The beta coefficient of each sample share versus the R/US$ exchange rate is the exchange rate beta coefficient.

- **Economic criteria: global market beta coefficient**

  Each of the sample shares has a positive global market beta coefficient. This appears economically plausible as one would expect the local market (which is partly made up by the sample shares) to be somewhat positively influenced by movements in global shares (which is what makes up the MSCI World Index). The level of co-movement between the local market (ALSI) and the global markets (MSCI World Index), if any, will be tested further in this chapter.

- **Economic criteria: exchange rate beta coefficient**

  The exchange rate beta coefficient is positive for some of the sample shares but negative for most. A positive beta coefficient against movements in the R/US$ exchange rate can be interpreted as follows: the sample share's price increases when the rand weakens against the US dollar. It was expected that the exchange rate beta coefficient for most of the sample shares would be positive as these are South African companies. It would also be expected that these South African companies export some products and therefore earn some of their turnover in US dollars. A weakening of the rand versus the US dollar would therefore benefit them, and the market would react to this by demanding more of their shares. The increased demand for the shares would result in an increase in their share prices.

  However this is not the case. Most of the companies making up the sample shares are global companies, with assets and operations located in various geographical regions, and are not necessarily converting export revenues into rands. Some of the companies forming part of the sample shares have extensive operations in South Africa and report their financial results in foreign exchange as a result of their primary listings having been moved to a foreign country. For example, *AGL* reports its financial results in US dollars and its primary listing was moved to the LSE in 1999. *SAB* reports its financial results in US dollars and its primary listing was moved to the LSE in 1999. Therefore, a weakening rand versus any currency will result in lower profits (from the South African operations) being reported.

  Due to the diversity of the sample shares, there cannot be a single expected result for the sign and magnitude of the exchange rate beta coefficients. At this stage there is no evidence to suggest that the signs or magnitudes of the estimated exchange rate beta coefficients are economically implausible. Further statistical and econometric tests will be carried out in this chapter.

Table 6.4: Global market and exchange rate beta coefficients

	Global market beta coefficient	**Exchange rate beta coefficient**
Basic materials sector		
AGL	1.997	-0.848
BIL	1.241	-0.640
ANG	0.401	-0.187
DDT	0.901	-0.870
DRD	0.760	0.867
GFI	0.496	-0.019
HAR	0.473	0.234
IMP	1.494	-1.066
MTX	2.465	-2.035
SAP	1.938	-1.251
Absolute Average	**1.217**	**0.802**
Financials		
INL	1.257	-0.733
MET	0.407	-0.670
FSR	0.486	-0.823
NED	0.612	-0.778
SBK	0.443	-0.811
SLM	0.537	-0.681
OML	1.481	-1.296
Absolute Average	**0.746**	**0.827**
Industrials		
BAW	1.323	-1.015
PPC	0.321	-0.636
Absolute Average	**0.822**	**0.826**
Consumer goods and services		
NPN	0.716	-0.885
SAB	1.015	-0.285
SHP	0.276	-0.451
TRU	0.044	-0.453
WHL	0.623	-0.680
Absolute Average	**0.535**	**0.551**

Oil and gas		
SOL	1.188	-0.623
Telecommunications		
TKG	0.687	-0.444

Source: own deductions

6.7.2 Statistical criteria

To test the statistical criteria of a regression, one needs to evaluate the statistical significance of the regression equation and of each of the estimated parameters (Greyling, 1997:238). The two tests for statistical significance conducted herein are the T-test as well as the coefficient of determination (R^2) for each equation.

Using the T-test to test statistical validity of the regression equations involves using hypothesis testing. The hypothesis testing used in this section does not form the basis of the overall research design of this study; it is limited to analysing the statistical validity of the single and multiple regression equations using the T-test. These particular hypotheses are discussed below.

*6.7.2.1 **T - test***

The T-test is effectively a test to determine whether the estimated coefficient of the regression is zero (Brooks, 2002:88). The regression function provides an estimate of the true coefficient; however this estimate can change if the sample of data used changes (Brooks, 2002:65). In the case of this study, the estimated coefficients would in all likelihood change if a different sample period were used. In most cases the estimated regression coefficient is never zero, but the t-test determines whether it is so insignificant that it is statistically indistinguishable from zero (Brooks, 2002:89). When conducting a t-test, the null hypothesis and alternative hypothesis are:

H_0: $\beta=0$

H_1: $\beta\neq0$ (Brooks, 2002:89).

If H_0 is rejected, the conclusion is that the independent variable is significant (Brooks, 2002:89). If the null hypothesis is not rejected and therefore the independent variable not significant, it means that although the estimated value of the coefficient is not zero, it is statistically indistinguishable from zero (Brooks, 2002:89). In other words, if the coefficient's estimated value was substituted with a zero, the dependent variable would be unaffected. The final conclusion would

therefore be that the independent variable (where the null hypothesis is not rejected) is not helping to explain the variations in the dependent variable and could be excluded from the regression equation (Brooks, 2002:89). Greyling (1997:243) states that if a variable is statistically insignificant, it should be left out of the regression equation as it does not render a statistically significant contribution to explaining the movements in the dependent variable.

6.7.2.2 ***Coefficient of determination (R2)***

The R^2 measures the extent to which an estimated regression equation successfully fits a particular set of data (Greyling, 1997:246). In other words, the R^2 measures that portion of the total movement in the dependent variable that is explained by movement in the independent variable (Greyling, 1997:246). For example, in the single regression analysis, the R^2 for each regression equation measures the movement in each sample share's price that is explained by the movement in the ALSI.

The value of the R^2 must always lie between zero and one (Greyling, 1997:246). The closer R^2 is to one then the larger the portion of the movement in the dependent variable that is explained by the movement in the independent variable (Greyling, 1997:246). An R^2 which has a value that is close to zero is interpreted to mean that the estimated regression function fits the data set poorly and a large proportion of the movement in the dependent variable is explained by the error term (Greyling, 1997:246).

A statistical problem with the R^2 function is that it will always increase if more regressors (or independent variables) are added to a regression equation (Brooks, 2002:137). To overcome this pitfall, researchers use the adjusted R^2 which is adjusted downwards for any bias caused by adding more regressors to an estimated regression function. The adjusted R^2 has also been used for the purposes of this study. Tables 6.5 and 6.6 (below) reflect the adjusted R^2 for the single regression and multiple regression equations, respectively.

6.7.2.3 ***Single regression analysis: conducting the T-test***

Table 6.5 (below) reflects the test statistics (t-statistics) and critical values used to test the statistical significance of the ALSI as an explanatory variable in the movement of each of the sample shares. The critical values were obtained from a t-distribution table (Brooks, 2002:669) using a 5% significance level for a 2-sided

test. The significance level determines the region where the null hypothesis being tested will either be rejected or not rejected (Brooks, 2002:72). As the sample period was kept constant throughout the study, the number of observations was the same for each sample share's single regression equation. The degrees of freedom, being the number of observations less the number of coefficients in the regression equation (Greyling, 1997:244), were also the same for each of the sample share's single regression equations. The single regression equations include an intercept and therefore there are two coefficients in each equation. Thus there are 57 (59 minus 2) degrees of freedom for each single regression function.

6.7.2.3.1 Single regression analysis: results of the T-test

Two out of the total sample of 26 shares fail the t-test, and this is determined by the fact that the null hypotheses (N_o: $\beta = 0$) is not rejected, as documented in column 4 of Table 6.5. It is also significant to note that these two shares *(DRD, TRU)* have the lowest R^2 and had the lowest correlation coefficients against the ALSI as was analysed in Table 6.2.

Table 6.5: Single regression analysis: T-test and coefficient of determination (R^2) by sector classification

Share	**t-statistic**	**5% critical value**	**Reject null hypothesis**	**Adjusted R^2**
Basic materials				
AGL	11.26	2.003	Yes	0.68
BIL	9.68	2.003	Yes	0.62
ANG	3.28	2.003	Yes	0.14
DRD	1.36	2.003	No	0.01
GFI	2.54	2.003	Yes	0.09
HAR	2.46	2.003	Yes	0.08
IMP	7.27	2.003	Yes	0.47
MTX	3.86	2.003	Yes	0.19
SAP	6.33	2.003	Yes	0.40
Industrials				
BAW	5.17	2.003	Yes	0.31
PPC	2.66	2.003	Yes	0.10
Technology				
DDT	5.19	2.003	Yes	0.31

Financials				
FSR	4.36	2.003	Yes	0.24
INL	5.33	2.003	Yes	0.32
MET	4.03	2.003	Yes	0.21
NED	4.14	2.003	Yes	0.22
OML	7.14	2.003	Yes	0.46
SBK	4.42	2.003	Yes	0.24
SLM	4.01	2.003	Yes	0.21
Consumer goods and services				
NPN	6.31	2.003	Yes	0.40
SAB	5.50	2.003	Yes	0.33
SHP	3.09	2.003	Yes	0.13
TRU	2.00	2.003	No	0.05
WHL	3.90	2.003	Yes	0.20
Oil and gas				
SOL	8.98	2.003	Yes	0.58
Telecommunications				
TKG	3.87	2.003	Yes	0.19

Source for critical value: Biometrika tables for statisticians (1996) in (Brooks, 2002:669)

*6.7.2.4 **Multiple regression analysis: conducting the T-test***

In the case of the multiple regression analysis, the sample period used is the same as that used for the single regression analysis. Therefore there are 59 observations for each multiple regression function. However, there is one more regressor or independent variable. Hence the number of degrees of freedom used to obtain the critical value is 56; being the number of observations less the number of coefficients (i.e. 59-3). A critical value of 2.003 is obtained from the t-distribution table in Brooks (2002:669) using a 5% significance level and a two-sided test.

6.7.2.4.1 Multiple regression analysis: results of the T-test

The results of the t-test for the multiple regression functions are mixed. Table 6.6 (below) reflects that for 11 out of the total sample of 26 shares, the null hypothesis is not rejected for either one or both of the independent variables. This means that either one or both of the independent variables is not helping to explain the monthly movements in these sample shares.

It is significant to note that the adjusted R^2 is lowest for these 11 sample shares. They all have an R^2 that is lower than 0.22, except for *SAB* which has an R^2 of 0.3.It is also significant to note that these shares had a very low correlation coefficient with either one or both of the independent variables as per Table 6.2 and therefore there was little evidence of a linear relationship. It can be concluded that in the case of these 11 sample shares, a valid multiple regression cannot be conducted in order to estimate the respective beta coefficients under the multi-factor global CAPM. Either one (or both) of the global risk factors of the multi-factor global CAPM does (or do) not influence the price movements of these shares and therefore cannot be used as a valid regressor/s.

SAB failed the t-test with regard to the R/US$ coefficient but not the MSCI World Index. Using the output of the multiple regression, the standardised coefficients reflect that the MSCI World Index explains 63% of the movement in the *SAB* share price, whereas the R/US$ exchange rate only explains 23% of the movement in the same share price. Therefore, one could still conduct a valid single regression of the movement in *SAB*'s share price against the movement in the MSCI World Index.

6.7.2.4.2 Remaining sample shares

DRD and *TRU*, which failed the t-test under the single regression analysis, are part of the 11 sample shares which have failed a t-test under the multiple regression analysis. Therefore, the movements in *DRD* and *TRU*'s share prices are not influenced by movements in the ALSI, the MSCI World Index or the R/USS$ exchange rate.

For the remainder of this study, the 11 sample shares which failed the t-test for the MSCI World Index and/or the R/US$ exchange rate were excluded from the calculations of the global CAPM as the global risk components of the multi-factor global CAPM do not appear to have any influence in the movement of their share prices. Reference to the remaining sample shares therefore is to the 15 sample shares for which each of the global risk factors forming part of the multi-factor global CAPM were determined to be significant variables by way of the t-test.

Table 6.6: Multiple regression analysis: t-test and coefficient of determination by sector classification

Share	t-statistic: MSCI World Index	Reject null hypothesis	t-statistic: R/US$	Reject null hypothesis	Adjusted R^2
Basic materials					
AGL	7.743	Yes	-4.216	Yes	0.507
BIL	4.804	Yes	-3.175	Yes	0.285
ANG	1.056	No	-0.632	No	-0.014
DRD	1.161	No	1.697	No	0.075
GFI	1.278	No	-0.062	No	-0.003
HAR	0.864	No	0.548	No	-0.006
IMP	4.502	Yes	-4.113	Yes	0.301
MTX	4.953	Yes	-5.239	Yes	0.380
SAP	5.893	Yes	-4.875	Yes	0.413
Industrials					
BAW	5.045	Yes	-4.957	Yes	0.371
PPC	1.297	No	-3.292	Yes	0.132
Technology					
DDT	3.554	Yes	-4.395	Yes	0.270
Financials					
FSR	1.784	No	-3.870	Yes	0.184
INL	4.742	Yes	-3.542	Yes	0.292
MET	1.879	No	-3.961	Yes	0.193
NED	2.727	Yes	-4.440	Yes	0.246
OML	6.660	Yes	-7.465	Yes	0.549
SBK	1.845	No	-4.326	Yes	0.224
SLM	2.807	Yes	-4.559	Yes	0.257
Consumer goods and services					
NPN	3.183	Yes	-5.044	Yes	0.303
SAB	5.307	Yes	-1.913	No	0.311
SHP	1.195	No	-2.057	Yes	0.070
TRU	0.164	No	-2.155	Yes	0.052

WHL	2.286	Yes	-3.201	Yes	0.142
Oil and Gas					
SOL	4.826	Yes	-3.241	Yes	0.289
Telecommunicat-ions					
TKG	2.996	Yes	-2.480	Yes	0.135

Source for critical value: Biometrika tables for statisticians (1996, in Brooks, 2002:669)

6.7.3 Econometric criteria

There are five standard assumptions that must be met when regression analysis has been applied to any set of data (Brooks, 2002:56). These assumptions concern the error terms resulting from the regression analysis and are that:

- The error terms have a zero mean
- The error terms have a constant variance
- The error terms of each observation are statistically uncorrelated
- There is no relationship between each of the error terms and the corresponding independent variable
- The error terms are normally distributed around the average value of zero (Brooks, 2002:56).

A violation of these assumptions may have the following consequences:

- The coefficient estimates may be wrong
- The associated standard errors may be wrong
- The distributions that were assumed for the test statistics may be inappropriate (Brooks, 2002:56).

Testing whether an estimated regression function meets all the assumptions listed above is referred to as testing that the regression function meets the econometric criteria. Each of the econometric assumptions will now be tested for each of the estimated single regression functions as well as for the multiple regression functions of the remaining sample shares. Some of the tests conducted in the sub-section below, namely White's test and the Durbin-Watson (DW) test involve the use of hypothesis testing. The hypothesis testing is limited to testing the econometric validity

of each of the regression equations and does not form the basis of the overall research design of this study.

6.7.3.1 ***Assumption 1: The error terms have a zero mean***

6.7.3.1.1 Single Regression Analysis

This assumption was met for each of the 26 sample shares' regression functions against the ALSI.

6.7.3.1.2 Multiple regression analysis

This assumption was met for each of the 15 remaining sample shares' multiple regression functions.

6.7.3.2 ***Assumption 2: The error terms have a constant variance***

This assumption is also referred to as the assumption that there is homoscedasticity in the error terms. The opposite of homoscedasticity is heteroscedasticity. If the error terms do not have a constant variance they are said to be heteroscedastic (Brooks, 2002:147).

6.7.3.2.1 Detection of heteroscedasticity

One way to detect heteroscedasticity is by way of graphical methods. This would entail plotting the error terms against one of the independent variables (Brooks, 2002:147) and observing whether there is a pattern between the error terms and the independent variable. However using graphical methods to detect heteroscedasticity is not a well recommended approach (Brooks, 2002: 147). For example, the variance of the error terms could be increasing as a function of time which would not be detected by a scatter plot of the error terms against any of the independent variables (Brooks, 2002:148).

- **Detection of heteroscedasticity using White's test**

  White's (1980) general test for heteroscedasticity is one of a number of formal statistical tests used. White's test is conducted as follows:

  Step 1: Run auxiliary regressions. This is a regression of the squared error terms against a constant, the original independent variables, the squares of the independent variables and their cross product (Brooks, 2002:148).

The reason for using squared residuals is based on the formula for calculating the variance for a random variable:

$Var(\mu_t) = E[(\mu_t - E(\mu_t))^2]$;

Where (u_t) = the error term

Under assumption 1 above, $E(\mu_t) = 0$, therefore:

$Var(\mu_t) = E[\mu_t^2]$

The auxiliary regression is performed to investigate whether the variance of the error terms (i.e. μ_t^2) varies systematically with any known variables relevant to the first estimated regression equation. The auxiliary regression must include a constant term even if the original regression did not. This is because μ_t^2 will always have a non-zero mean even if μ_t has a zero mean (Brooks, 2002: 149).

Step 2: Perform a Lagrange Multiplier (LM) test (Brooks, 2002:149). The LM test focuses on the value of the R^2 from the auxiliary regression. If any of the coefficients from the auxiliary regression are significant, then the value of R^2 will be relatively high and vice versa. Conducting the LM test involves multiplying the number of observations (T) by R^2 to obtain the test statistic. The LM test is a test of the joint null hypothesis that all the coefficients including the constant are zero.

Step 3: Compare the test statistic obtained in Step 2 to the corresponding critical value obtained from the appropriate statistical table. The statistical table used for White's test is the table of chi-squared critical values for different confidence intervals and degrees of freedom (Biometrika Tables for Statisticians, 1966, in Brooks, 2002:672/673).

If the test statistic obtained in Step 2 is higher than the corresponding critical value from the statistical table, then reject the null hypothesis that the errors are homoscedastic.

6.7.3.2.2 Single regression analysis: conducting White's test

Step 1: Run the auxiliary regression

For the purpose of testing the single regression equations using White's test, the auxiliary regression was that of the squared error terms against a constant, the monthly returns on the ALSI and the square of the monthly returns on the ALSI.

Step 2: Perform a LM test to obtain the test statistic to use in Step 3.

Step 3: Compare the test statistic to the appropriate critical value obtained from the table of chi-squared critical values in Brooks (2002:672/673).
There are 2 regressors, excluding the constant, in the auxiliary regression of the squared error terms. The 5% critical value for 2 degrees of freedom obtained from the statistical table is 5.991.

If the test statistic (TR^2) is greater than the critical value, the null hypothesis that the error terms are homoscedastic is rejected. Therefore the variance of the error terms varies systematically as a function of one of the known variables relevant to the model. On the other hand, if the test statistic is not greater than the critical value, the null hypothesis is not rejected and therefore there is no evidence heteroscedasticity, i.e., it is correct to assume that the variance of the error terms is constant.

- **Single regression analysis: result of White's test**
  Table 6.7 (below) reflects the R^2 of the auxiliary regression, the test statistic as well as the final conclusion of White's test on each of the sample shares' estimated single regression equations. There was significant evidence of heteroscedasticity for 9 out of the 26 sample shares regressed against the ALSI.

Table 6.7: Results of White's test for single regression equations of the sample shares

Share	R^2 of auxiliary regression	Number of observ-ations (T)	$T*R^2$	Conclusion
Basic materials				
AGL	0.02	59	1.11	Do not reject null hypothesis
BIL	0.02	59	1.36	Do not reject null hypothesis
ANG	0.04	59	2.22	Do not reject null hypothesis
DRD	0.00	59	0.18	Do not reject null hypothesis
GFI	0.11	59	6.21	Reject null hypothesis
HAR	0.16	59	9.18	Reject null hypothesis
IMP	0.10	59	5.77	Do not reject null hypothesis
MTX	0.02	59	0.91	Do not reject null hypothesis

SAP	0.12	59	7.33	Reject null hypothesis
Industrials				
BAW	0.04	59	2.54	Do not reject null hypothesis
PPC	0.04	59	2.54	Do not reject null hypothesis
Technology				
DDT	0.04	59	2.36	Do not reject null hypothesis
Financials				
FSR	0.14	59	8.21	Reject null hypothesis
INL	0.19	59	11.12	Reject null hypothesis
MET	0.03	59	1.63	Do not reject null hypothesis
NED	0.10	59	6.01	Reject null hypothesis
OML	0.03	59	1.54	Do not reject null hypothesis
SBK	0.17	59	10.28	Reject null hypothesis
SLM	0.02	59	1.45	Do not reject null hypothesis
Consumer goods and services				
NPN	0.10	59	6.02	Reject null hypothesis
SAB	0.05	59	2.97	Do not reject null hypothesis
SHP	0.08	59	4.75	Do not reject null hypothesis
TRU	0.12	59	7.15	Reject null hypothesis
WHL	0.04	59	2.44	Do not reject null hypothesis
Oil and gas				
SOL	0.02	59	1.23	Do not reject null hypothesis
Telecommunicat-ions				
TKG	0.10	59	5.88	Do not reject null hypothesis

Source: own deductions

6.7.3.2.3 Multiple regression analysis: conducting White's test

Step 1: Run the auxiliary regression. For the purpose of testing the multiple regression equations using White's test, the auxiliary regression was a regression of the squared error terms against a constant, the monthly returns on the MSCI World Index, the monthly returns on the R/US$ exchange rate, the squares of each of the independent variables as well as their product.

Step 2: Perform a LM test to obtain the test statistic to use in Step 3.

Step 3: Compare the test statistic to the appropriate critical value obtained from the table of chi-squared critical values in Brooks (2002:672/673).
As there are 5 regressors, excluding the constant, in the auxiliary regression of the squared error terms, the 5% critical value for 5 degrees of freedom obtained from the statistical table is 11.07.

In the event that the test statistic (TR^2) greater than the critical value obtained from the statistical tables, the variance of the error terms is regarded as varying systematically with one of the known variables relevant to the model. Therefore the null hypothesis that the error terms are homoscedastic is rejected. Otherwise the null hypothesis is not rejected and there is no evidence heteroscedasticity, i.e., it is correct to assume that the variance of the error terms is constant.

- **Multiple regression analysis: result of White's test**

  Table 6.8 (below) reflects the R^2 for the auxiliary regression, the test statistic as well as the final conclusion for White's test on the multiple regression functions of each of the remaining sample shares. Based on the results summarised in Table 6.8 (below), there was significant evidence of heteroscedasticity for only one of the remaining sample shares that were regressed against the MSCI World Index and the R/US$ exchange rate, namely INL. The consequences of heteroscedasticity are discussed below.

Table 6.8: Results of White's test for multiple regression equations of the remaining sample shares

Share	R^2 of auxiliary regression	Number of observ-ations (T)	$T*R^2$	Conclusion
Basic materials				
AGL	0.07	59	4.18	Do not reject null hypothesis
BIL	0.04	59	2.25	Do not reject null hypothesis
IMP	0.07	59	4.36	Do not reject null hypothesis
MTX	0.04	59	2.20	Do not reject null hypothesis
SAP	0.13	59	7.95	Do not reject null hypothesis
Industrials				
BAW	0.19	59	11.03	Do not reject null hypothesis

Technology				
DDT	0.03	59	1.63	Do not reject null hypothesis
Financials				
INL	0.36	59	21.08	Reject null hypothesis
NED	0.09	59	5.03	Do not reject null hypothesis
OML	0.03	59	1.77	Do not reject null hypothesis
SLM	0.02	59	0.01	Do not reject null hypothesis
Consumer goods and services				
NPN	0.49	59	0.29	Do not reject null hypothesis
WHL	0.05	59	3.16	Do not reject null hypothesis
Oil and gas				
SOL	0.02	59	1.10	Do not reject null hypothesis
Telecommunicat-ions				
TKG	0.12	59	7.13	Do not reject null hypothesis

Source: own deductions

- **Consequences of heteroscedasticity**

  If the variance of the error terms of a particular regression function is heteroscedastic, the coefficient estimates are still unbiased coefficient estimates but they no longer have the minimum variance among the class of unbiased estimators (Brooks, 2002:150). If the coefficient estimates are unbiased it means that, on average, the coefficient estimates will be equal to the true population coefficients. Therefore, even in the presence of heteroscedasticity, the estimated coefficients from the regression analysis are still considered to be accurate.

  The variance of the error terms is used to calculate the standard errors of the coefficients (Brooks, 2002:150). Therefore, if there is heteroscedasticity in the error terms, then the standard errors of the coefficients could be wrong and misleading (Brooks, 2002:151). Fortunately, the standard errors of the coefficients are not used elsewhere in this study but it is the coefficients themselves that are used as beta coefficients in the local and global CAPM's. Therefore, as the presence of heteroscedasticity does not affect the accuracy of the beta coefficients themselves it will not affect the outcome of this study.

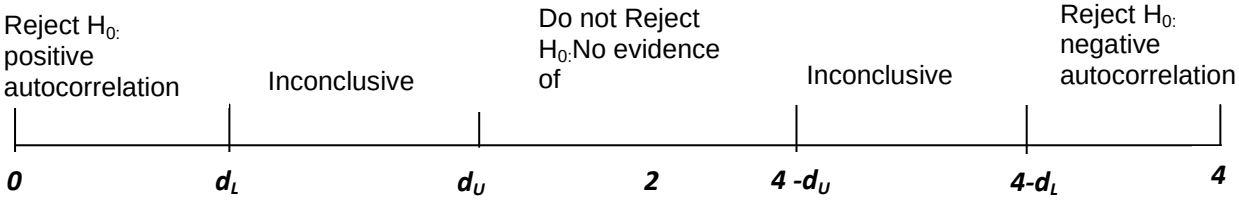
6.7.3.3 *Assumption 3: The error terms of each observation are statistically uncorrelated*

Assumption 3 can be interpreted as an assumption that the covariance of the error terms over time is zero. If the error terms are correlated with each other, it is stated that the error terms are autocorrelated (Brooks, 2002:155). Durbin and Watson (1951, in Brooks, 2002:160) developed a simple method to test for first order autocorrelation which is called the DW test.

6.7.3.3.1 Conducting the DW test

The null hypothesis under the DW test is $H_{0:}$ No evidence of autocorrelation. The DW test is based on two critical values, an upper critical value (d_U) and a lower critical value (d_L) (Brooks, 2002:163). Firstly, the DW test statistic is calculated and needs to be compared to the two critical values. Depending where the DW statistic lies between the upper and lower critical values, the null hypothesis is either rejected or not rejected. Figure 6.3 (below) reflects the timeline that can be used to perform this comparison between the upper and lower critical values and the DW statistic. There is also an inconclusive region where the null hypothesis of no autocorrelation can neither be rejected nor not rejected.

Figure 6.3: Durban-Watson number line



Source: Brooks, 2002:163

- **DW statistic**

  The DW statistic is calculated using the following formula (Brooks, 2002:160; Greyling, 1997:250):

$$\frac{\sum_{t=2}^{T}(\hat{\mu}_t - \hat{\mu}_{t-1})^2}{\sum_{t=2}^{T}\hat{\mu}^2}$$

- **Conditions for DW to be a valid test**
  - There must be a constant term in the regression
  - The regressors or independent variables must be non-stochastic
  - There must be no lags of the dependent variable.

Each of these conditions has been met for both the single as well as the multiple regression functions.

- **Single regression analysis: conducting the DW test**

The d_U and d_L values used for the DW test were obtained from the table of upper and lower critical values in Econometrica (1980:1553-1564, in Brooks, 2002:674). Based on one explanatory variable and 59 observations, the upper and lower critical values used to test the single regression results are as follows:

d_U= 1.45
d_L= 1.38

The DW statistic was calculated using the standard formula for calculating DW statistic. Where the DW statistic falls into the rejection region of the DW timeline reflected above, the null hypothesis is rejected and therefore there is either positive or negative autocorrelation. Where the DW statistic does not fall into the rejection region of the timeline, there is either inconclusive evidence or no evidence of autocorrelation.

- **Single regression analysis: results of the DW test**

Table 6.9 (below) reflects the DW statistic for the single regression function of each sample share against the ALSI. For most of the sample shares in Table 6.9 the outcome was: Do not reject the null hypothesis of no autocorrelation. For a single share, *SHP*, the outcome was inconclusive. Therefore, the overall conclusion is that there is no conclusive evidence of autocorrelation for any of the sample shares' single regression equations.

Table 6.9: Results of DW test for each sample share's estimated single regression equation

Share	DW Statistic	Outcome
Basic materials		
AGL	1.98	Do not reject null hypothesis
BIL	1.66	Do not reject null hypothesis
ANG	2.51	Do not reject null hypothesis
DRD	2.01	Do not reject null hypothesis
GFI	2.49	Do not reject null hypothesis
HAR	2.30	Do not reject null hypothesis
IMP	1.92	Do not reject null hypothesis
MTX	1.61	Do not reject null hypothesis
SAP	2.22	Do not reject null hypothesis
Industrials		
BAW	1.94	Do not reject null hypothesis
PPC	2.12	Do not reject null hypothesis
Technology		
DDT	1.93	Do not reject null hypothesis
Financials		
FSR	2.34	Do not reject null hypothesis
INL	1.97	Do not reject null hypothesis
MET	2.05	Do not reject null hypothesis
NED	2.08	Do not reject null hypothesis
OML	2.19	Do not reject null hypothesis
SBK	2.50	Do not reject null hypothesis
SLM	2.13	Do not reject null hypothesis
Consumer goods and services		
NPN	1.97	Do not reject null hypothesis
SAB	2.22	Do not reject null hypothesis
SHP	2.59	Inconclusive
TRU	1.66	Do not reject null hypothesis
WHL	1.74	Do not reject null hypothesis
Oil and gas		
SOL	1.49	Do not reject null hypothesis
Telecommunications		
TKG	2.06	Do not reject null hypothesis

Source: own deductions

- **Multiple regression analysis: conducting the DW test**

  In order to test the error terms from the multiple regression functions for autocorrelation, the upper and lower critical values were based on two explanatory variables and 59 observations. The upper and lower critical values obtained from the table of upper and lower critical values in Econometrica (1980:1553-1564, in Brooks, 2002:674) are as follows:

  d_U= 1.48

  d_L= 1.35

- **Multiple regression analysis: results of the DW test**

  Table 6.10 (below) reflects the DW statistic for the multiple regression analysis of each of the remaining sample shares against the MSCI World Index and the R/US$ exchange rate.

  The DW test outcome was: Do not reject the null hypothesis of no autocorrelation, for most of the remaining sample shares. For a single share, *OML*, the outcome was inconclusive. Therefore the overall conclusion is that there is no conclusive evidence of autocorrelation for any of the remaining sample shares' estimated multiple regression equations.

Table 6.10: Results of DW test for each remaining sample share's estimated multiple regression equation

Share	DW Statistic	Outcome
Basic materials		
AGL	2.22	Do not reject null hypothesis
BIL	2.05	Do not reject null hypothesis
IMP	1.76	Do not reject null hypothesis
MTX	1.93	Do not reject null hypothesis
SAP	2.25	Do not reject null hypothesis
Industrials		
BAW	2.05	Do not reject null hypothesis
Technology		
DDT	2.01	Do not reject null hypothesis
Financials		
INL	2.12	Do not reject null hypothesis
NED	2.10	Do not reject null hypothesis
OML	2.58	Inconclusive
SLM	2.08	Do not reject null hypothesis
Consumer goods and services		
NPN	2.27	Do not reject null hypothesis
WHL	1.75	Do not reject null hypothesis
Oil and Gas		
SOL	2.08	Do not reject null hypothesis
Telecommunications		
TKG	2.02	Do not reject null hypothesis

Source: own deductions

6.7.3.4 *Assumption 4: There is no relationship between each of the error terms and the corresponding independent variable (or the independent variable is non-stochastic)*

The assumption that the regressor or independent variable is non-stochastic can be interpreted as an assumption that it is fixed in repeated samples and its value is determined outside of the model (Brooks, 2002:56). The fourth assumption of OLS is met for both the estimated single and multiple regression functions. The returns on the ALSI, MSCI world index and the R/US$ exchange rate are all determined outside of the estimated regression models and are fixed for repeated samples.

6.7.3.5 ***Assumption 5: The error terms are normally distributed***

This last assumption is necessary in order to make valid inferences about the population parameters using the sample parameters which are estimated using a finite amount of data (Brooks, 2002:56). In the case of this research study, monthly returns over the sample period have been used to estimate the population coefficients between each of the dependent and independent variables.

6.7.3.5.1 Conducting the test for normality of the error terms

In order to test whether the error terms are indeed normally distributed, the following was performed:

- Calculated the standardised error terms by dividing the actual error terms by the standard error of the regression function
- Performed a histogram of the standardised error terns
- Ensured that all the standardised error terms fell into a range of -3 to +3.

6.7.3.5.2 Single regression analysis: result of the test for normality of the error terms

The result of this test was that all the standardised error terms of each single regression equation fell into the range -3 to +3. Therefore, the error terms of the estimated single regression functions of all the sample shares were normally distributed.

6.7.3.5.3 Multiple regression analysis: result of the test for normality of the error terms

The result of this test was that all the standardised error terms of each multiple regression equation fell into the range -3 to +3. Therefore the error terms of the estimated multiple regression functions of the remaining sample shares were normally distributed.

6.8 SUMMARY OF RESULTS OF THE EMPIRICAL ANALYSIS OF THE SAMPLE SHARES

The sample shares consisted of 26 South African shares that have stock exchange listings in more than one geographical location. The sample shares were selected using judgement sampling as set out in Chapter 5.

Each of the sample shares was positively correlated with the ALSI. However, the correlation coefficient of each sample share against the MSCI World Index reflected varied results. Some of the sample shares were highly correlated with the MSCI World Index and others reflected little or no correlation with the same. There was low correlation with the R/US$ exchange rate across all the sample shares.

The monthly returns of the sample shares and each of the independent variables over the sample period were analysed to determine whether there was a linear relationship between them. There was evidence of a positive linear trend between each of the sample shares and the ALSI. With regard to the MSCI World Index and the R/US$ exchange rate, there was evidence of a linear trend with each of the sample shares, albeit small in some cases. The local CAPM beta coefficient of each sample share was calculated using single regression analysis. The global market and exchange rate beta coefficients of each sample share were calculated using multiple regression analysis.

The validity of each single and multiple regression function was evaluated against three criteria, namely economic, statistical, and econometric criteria. Each of the single as well as multiple regression functions passed the test of economic validity. Statistical validity was tested by way of a T-test and by measuring the R^2 for each regression function. The multiple regression functions of 11 sample shares failed the T-test and therefore failed the test for statistical validity. Failing the T-test meant that the MSCI World Index and/or the R/US$ exchange rate did not help to explain the movements in the sample shares. Therefore it is not possible to calculate valid beta coefficients for each of these shares using the MSCI World Index and the R/US$ exchange rate as proxies for global market and exchange rate risk respectively. The 11 sample shares whose multiple regression functions did not pass the test for statistical validity were excluded from the remainder of the research study for purposes of calculating and comparing the local and global cost of equity.

Econometric validity of the regression functions was evaluated by testing whether the five assumptions of ordinary least squares as set out in Brooks (2002:56) are met. These five assumptions concern the error terms of the regression functions. The single regression function of each of the sample shares was tested for econometric validity and there were no exceptions found. The multiple regression functions of each of the remaining sample shares were tested for econometric validity and there were no exceptions found.

6.9 CONCLUSION

For purposes of the multi-factor global CAPM, only the multiple regression equations of the remaining sample shares, as opposed to all the sample shares, are statistically valid. In Chapter 7, the cost of equity for each of the remaining sample shares will be calculated using the local CAPM as well as the multi-factor global CAPM. The two costs of equity estimates will be compared to assess whether there are any differences.

7 CHAPTER 7 – EMPIRICAL COMPARISON OF LOCAL AND GLOBAL CAPITAL ASSET PRICING MODELS

7.1 INTRODUCTION

In the previous chapter the monthly returns on each of the sample shares as well as the independent variables were analysed using descriptive statistics, regression analysis and econometric principles. This data analysis led to a final selection of 15 sample shares for further analysis. In this chapter the components of the local as well as the multi-factor global CAPMs are discussed. The cost of equity using the local CAPM will also be calculated and compared to the cost of equity calculated using the multi-factor global CAPM.

7.2 COMPONENTS OF THE LOCAL CAPITAL ASSET PRICING MODEL

The local CAPM has a number of components, namely: risk free rate, beta coefficient and market risk. A discussion of each of these components follows before the local cost of equity is calculated.

7.2.1 Proxy for risk-free rate in the local Capital Asset Pricing Model

The risk-free rate is the starting point when calculating the cost of equity using the local CAPM (PWC, 2009/2010:27). The current yield on government bonds is most commonly used by practitioners as a proxy for estimating the cost of risk-free debt. If using government debt as the proxy for risk-free debt, the maturity of the specific security that will be used must be considered (PWC, 2009/2010:27). Two common approaches used by South African investment professionals are either:

- to match the maturity of the risk-free security to the time horizon of the cash flows
- or to match the maturity of the risk-free security to an assumed investor horizon of seven to ten years (PWC 2009/2010:27).

Table 7.1 (below) summarises the key statistics for the most liquid South African government bonds:

Table 7.1: Key statistics of the most liquid South African government bonds

Bond	Maturity	Time to maturity as at 31 January 2010 (years)	Coupon rate (%)	Yield as at 31 January 2010 (%)	Median daily traded volume 2009(1)	Highest daily traded volume 2009(1)	Lowest daily traded volume 2009
R157	15 Sept 2015	5.62	13.50	8.38	11 824	40 059	1 146
R203	15 Sept 2017	7.62	8.25	9.01	1 784	10 722	298
R207	15 Jan 2020	9.96	7.25	9.19	1 982	16 299	261
R186	21 Dec 2026	16.89	10.50	9.17	5 787	80 896	850
R208	31 Mar 2021	11.17	6.75	9.19	1 605	9 232	34
R209	31 Mar 2036	26.18	6.25	9.07	1 652	15 604	246

Note: (1) 2009 refers to the calendar year of 2009

Source: PWC (2009/2010:27)

Using the median daily traded volume during 2009 as an indicator of liquidity, Table 7.1 reflects that the R157 is the most liquid government bond. Using the median instead of the mean value helps to eliminate significant outliers. Although the R186 had the highest value for highest daily traded volume in 2009, the median daily traded volume is very low, which reflects that the daily traded volume is erratic.

For the purpose of estimating the yield on risk-free debt, PWC found that the R157 remains the most widely used government bond amongst South African investment professionals. Of all the respondents to the PWC 2009 survey, 56% used the R157 as a proxy for risk-free debt (PWC, 2009/2010:28). Although the R157 has the shortest maturity amongst the other more liquid government bonds, the liquidity makes it to continue to be a popular choice. Some respondents to the PWC 2009 survey indicated that they are considering changing to using other government bonds with longer maturity periods in the future (PWC, 2009/2010:28). The most popular choices in this regard are the R207 and R203 bonds (PWC, 2009/2010:28), which fall just after the R157 in terms of liquidity based on the median daily trade volumes in 2009.

7.2.1.1 *Proxy for risk-free rate used in this research study*

This research study will use the yield on the R157 government bond as a proxy for the cost of risk-free debt. The R157 is the most liquid government security and therefore its current yield should provide the most accurate reflection of the market related risk-free interest rate.

7.2.2 Beta coefficient used in the local CAPM

The beta coefficient for each of the remaining sample shares has been obtained by regressing the monthly returns of each share against the monthly returns of the local market portfolio over the sample period. In line with market norms (PWC, 2009/2010:31), the ALSI has been used as a proxy for the local market portfolio in this study. Therefore the beta coefficient used for the purposes of the local CAPM is the market risk of each share relative to the ALSI.

7.2.3 Market risk premium

A number of factors relating to the market risk premium are considered in this section.

7.2.3.1 *Methods for estimating the market risk premium*

The two most commonly used methods for estimating the market risk premium are the historical approach and the survey approach (PWC, 2009/2010:32).

- **Historical approach**

This approach for estimating the market risk premium is based on the assumption that in a well-functioning market, arbitrage will ensure that the required and achieved returns will be equal (PWC, 2009/2010:32). Under this approach, the actual returns earned on shares over a long period of time are compared to the actual returns earned on risk-free assets such as government bonds. The annualised difference between the two returns then represents the actual market risk premium. The historical approach assumes that the expected return is influenced by the historical performance of the market (PWC, 2009/2010:32).

- **Limitations of using the historical approach**

There are two main limitations to using the historical approach for estimating the market risk premium. Firstly, in new or emerging markets, the availability of data for the historical returns on shares and government bonds may be a restriction (PWC 2009/2010:32). Secondly, the time period used to extract

the historical data will affect the result. Shorter and more recent time periods are assumed to provide a more up to date estimate of the risk premium. However, the challenge in using shorter time periods is that it will often result in greater 'noise' in the risk premium estimate (PWC, 2009/2010:32).

'Noise' is a term used by market participants to define short-term fluctuations in market prices and volumes. Noise can confuse the interpretation of market direction and is not reflective of overall market sentiment (www.investorwords.com).

Both these limitations mean that investors need to consider carefully the length of the time period to apply when using the historical approach to estimate market risk premium.

- **Survey approach**

  This approach uses the opinions of a sample of market participants to estimate the expected risk premium of the entire market (PWC, 2009/2010:33).

  - **Limitation of the survey approach**

  The main limitation of using the survey approach is that survey results are responsive to recent movements in stock prices and therefore it is possible that they reflect what has occurred in the recent past instead of being an accurate forecast of the future (PWC, 2009/2010:33).

7.2.3.2 Market risk premium used by South African investment professionals

PWC (2009/2010:37) found that the market risk premium used by South African investment professionals ranges from 4%-8% with the average low range being 5.6% and the average high range being 6%.

7.2.3.3 Market risk premium used in this research study

This research study will use 6% as a fair market risk premium for the South African market. This is in line with the average market risk premium used by South African investment professionals as per the 2009 PWC survey (PWC, 2009/2010:37).

7.3 COMPONENTS OF THE MULTI-FACTOR GLOBAL CAPM

The multi-factor global CAPM has a number of significant components, namely the risk-free rate in the pricing currency, the global market and exchange rate beta

coefficients, the global market risk premium as well as the foreign exchange risk premium.

7.3.1 Risk-free rate to be used for the multi-factor global CAPM

For purposes of applying the multi-factor global CAPM, the risk-free interest rate used is the risk-free rate of the pricing currency (Koedijk & van Dijk 2004:469; Koedijk et al., 2002:907; Mishra & O'Brien, 2001:31; O'Brien & Dolde, 2000:9). As previously stated, the focus of this research study is on South African shares and the chosen pricing currency is South African rands. The current yield on South African government bonds will be used to estimate the risk-free rate in rands. The R157 government bond will be used as a proxy for a rand-based risk-free rate.

7.3.2 Describing the Global market beta and Exchange rate beta

The multi-factor global CAPM takes into account two global risk factors: the risk of investing in global equity markets (i.e., global market risk) as well as exchange rate risk. Therefore it consists of two beta coefficients: the global market and the exchange rate beta coefficients. The global market and exchange rate beta coefficients are bivariate regression coefficients of each share's returns against the returns on two independent variables. The two independent variables are the global equity portfolio, expressed in the pricing currency, and the movements in the pricing currency versus a basket of foreign currencies (Koedijk & van Dijk, 2004:469; Koedijk et al., 2002:907; Mishra & O'Brien, 2001:31; O'Brien & Dolde, 2000:9).

The global market beta coefficient captures the sensitivity of a share's returns to movements in global equity markets. The exchange rate beta coefficient captures that sensitivity of a share's returns to exchange rate fluctuations which is not already reflected in the global market beta coefficient (Mishra & O'Brien, 2001:33).

As explained in Chapter 6, the MSCI World Index is used as a proxy for the global market portfolio and the R/US$ exchange rate is used as a proxy for measuring the overall exchange rate risk of rand denominated assets.

7.3.3 Global market risk premium

The market risk premium estimated by the PWC (2009/2010:37) valuation survey is a risk premium for investing in local equity markets and is generally applied in the local CAPM. For purposes of the multi-factor global CAPM, the equity risk premium

demanded by investors in global equity markets is required, i.e., the global market risk premium.

In a previous study, Mishra and O'Brien (2001:29) applied the global market risk premium as estimated by Stulz (1995b). This was an estimated global market risk premium of 5.4%. O'Brien and Dolde (2000:11) also used a global market risk premium of 5.4%, which resulted from a separate study by Stulz (1995c). In further research conducted by Stulz in 1995, the global market risk premium was estimated to be 6.22% (Stulz, 1995:20).

These estimates for the global market risk premium were conducted 15 years ago and were based on US and global market returns denominated in US dollars. In this research study, a global market risk premium based in rands will be independently calculated, however, the principles and formulae used in previous studies, such as Stulz (1995:20), and Mishra and O'brien (2001:37), will be applied.

7.3.3.1 *Calculation of the global market risk premium*

In Stulz (1995:14) it was stated that if the home market is integrated with global markets then the expected return on the home market can be determined using the following formula:

$$E(R_H) = R_F + B_{HG}\,[E(R_G) - R_F]$$

This formula is applicable to the expected return on the home market using a single-factor global CAPM where:

R_H = the expected return of the home market;

R_F = the risk-free rate in the home market;

B_{HG} = the global beta of the home market portfolio, which can be obtained by regressing the returns on the home country's market portfolio against the returns on the global market portfolio;

R_G = the returns on the global market portfolio (Stulz, 1995).

This formula can be rearranged as follows:

$$E(R_H) - R_F = B_{HG}\,[E(R_G) - R_F]$$

Where: $E(R_H) - R_F$ = the risk premium of the home market.

We already know the estimated average local market risk premium in South Africa, i.e., 6% (PWC, 2009/2010:37). We can also determine the global beta of the local

market (i.e. B_{HG}) by regressing the monthly returns of the ALSI against the monthly returns of the MSCI World Index. Therefore the global market risk premium can be calculated as follows:

$$(E(R_H) - R_F) \div B_{HG} = E(R_G) - R_F$$

Using a local market risk premium of 6% and a global beta for the local market of 0.73, the global market risk premium is calculated to be 8.21%.

*7.3.3.2 **Comparison of the estimated global market risk premium to previous research studies***

This estimated risk premium is substantially larger than the previous estimates by Stulz (1995:20,1995b and 1995c), one reason for this being that Stulz used the US market as the basis for estimating global market risk premium. Historically the US market has a high beta coefficient when its returns are regressed against those of the global market. In Stulz (1995:20), the global beta coefficient of the US market was 0.98. If the global beta coefficient of the local market was 0.98 instead of 0.73, then the estimated global market risk premium would be 6.12% instead of 8.21%.

An alternative interpretation of this result is that global market risk premium is higher when calculated in rands as opposed to US dollars. Other studies by Stulz (1995:20,1995b and 1995c); O'Brien and Dolde (2000:11) as well as Mishra and O'Brien (2001:37) were US-based studies and calculated the global market risk premium in US dollars.

7.3.4 Foreign currency risk premium

The foreign currency risk premium is calculated as the excess return above risk-free rate that an investor would earn from investing in foreign currency. This excess return is made up of the expected return on a basket of foreign currencies plus the risk-free rates of the currencies in the basket less the risk-free rate in the home currency (Koedijk & van Dijk, 2004:469; Koedijk et al., 2002:907; Mishra & O'Brien, 2001:31). In the case of this study, the R/US$ exchange rate has been used as a proxy for the foreign currency risk factor in the multi-factor global CAPM. Therefore, the foreign currency risk premium is calculated as the sum of the expected average return from investing in US dollars using rands plus the expected risk-free return on US treasury bonds less the risk-free rate on South African government bonds. The expected return from investing in US dollars has been obtained from the actual monthly movement of the R/US$ exchange rate over the sample period. This return has been

calculated to be 0.49%. Therefore an investor using rands to invest in US dollars over the sample period would have expected to earn 0.49% over that period, solely based on the appreciation of the US dollar over the rand. The risk-free rate in US dollars is based on the US government bond yields as quoted by the *Financial Times* (Tuesday, 16 November 2010:25) on an annualised yield basis.

Table 7.2 (below) sets out the bond yields on US treasury bonds with different maturity dates as at 16 November 2010.

Table 7.2: Yields on US Treasury bonds with different maturity dates

Maturity Date	Coupon	Bid Price	Bid Yield
10/12	0.38	99.72	0.52
10/15	1.25	99.05	1.45
11/20	2.63	97.97	2.86
11/40	4.25	98.88	4.32

Source: *Financial Times* (Tuesday, November 16, 2010:25)

For the purposes of the multi-factor global CAPM, the US Government bond maturing in 2015 was used as a proxy for the risk-free rate. This is based on the fact that cost of equity is a required return for long term equity investments. The bond maturing in 2012 has only two years to maturity as at the date of this study. The bond maturing in 2015, which has 5 years to maturity, is regarded as a more reliable indicator of long term risk-free rates.

The foreign exchange risk premium is calculated as -5.21% based on the following formula:

$$\text{Foreign exchange risk premium} = FX + r - r_0$$

Where: FX is the return on a foreign currency deposit, r is the nominal risk-free rate of the foreign currency and r_0 is the nominal risk-free rate of the pricing currency (which in this study is rand) (Koedijk & van Dijk, 2004:469; Koedijk et al., 2002:907; Mishra & O'Brien, 2001:31).

A negative foreign exchange rate risk premium can be interpreted as follows. The sum of the return on a deposit in US dollars (i.e., 0.49% as discussed above) plus the nominal US dollar risk-free return (1.45%) is lower than the annualised nominal risk-free rate in rands (i.e., 7.15%). In order for the foreign currency risk premium to be

positive, the expected return from investing in foreign currency would have to be higher than the risk-free rate in rands. Thus there would need to be an expected devaluation of the rand and/or a high foreign currency risk-free yield, the sum of which is greater than 7.15%. In that case, global investors investing in rand denominated equities would be at a disadvantage and hence the foreign exchange risk premium.

7.4 CALCULATION OF THE COST OF EQUITY USING THE LOCAL AND MULTI-FACTOR GLOBAL CAPITAL ASSET PRICING MODELS

So far, the purpose of this chapter has been to identify the market proxies and components to be used in the calculation of the local and multi-factor global CAPM. In the section below, the local and multi-factor global CAPM's are used to calculate the local and global cost of equity estimates for the remaining sample shares.

7.4.1 Calculation of local cost of equity for the remaining sample shares

Table 7.3 (below) reflects that *AGL* has the highest cost of equity when using the local CAPM. *AGL* also has the highest beta coefficient against the ALSI. At the other extreme, Sanlam Limited *(SLM)* has the lowest beta coefficient against the ALSI and therefore the lowest cost of equity when using the local CAPM. When analysing the results of the local CAPM according to industry sectors, the basic materials sector has the highest average cost of equity and the telecommunications sector has the lowest cost of equity. This sector comparison is however not a perfect comparison as some sectors, such as telecommunications, oil and gas, technology as well as industrials only have one dual-listed company that falls within them. Thus, whilst other sectors contain a diversified portfolio of companies whose average results can be compared, the telecommunications, oil and gas, technology as well as industrials sectors only consist of one company.

Table 7.3: Cost of equity for the remaining sample shares using the local CAPM

Share	Risk-free rate[(1)]	Beta (ALSI)	Local market risk premium	Local CAPM
Basic materials				
AGL	7.15%	1.60	6%	17%
BIL	7.15%	1.27	6%	15%
IMP	7.15%	1.45	6%	16%
MTX	7.15%	1.51	6%	16%
SAP	7.15%	1.45	6%	16%
Average				**16%**
Industrials				
BAW	7.15%	0.98	6%	13%
Technology				
DDT	7.15%	0.88	6%	12%
Financials				
INL	7.15%	0.96	6%	13%
NED	7.15%	0.65	6%	11%
OML	7.15%	1.20	6%	14%
SLM	7.15%	0.55	6%	10%
Average				**12%**
Consumer goods and services				
NPN	7.15%	0.91	6%	13%
WHL	7.15%	0.71	6%	11%
Average				**12%**
Oil and Gas				
SOL	7.15%	1.18	6%	14%
Telecommunications				
TKG	7.15%	0.59	6%	11%

Note: (1): This is the yield on the R157 as at 7 December 2010 converted into an effective annual yield.

Source: own deductions

7.4.2 Calculation of the global cost of equity for the remaining sample shares

Table 7.4 (below) shows that using a multi-factor global CAPM, with rands as the pricing currency, Metorex Limited *(MTX)* has the highest global cost of equity (i.e.,

38%). Telkom SA Limited *(TKG)* and *OML* have the lowest global cost of equity (i.e., 15%) amongst the remaining sample shares.

When the results of the multi-factor global CAPM are analysed by sectors, the consumer goods and services as well as the telecommunications sectors have the lowest global cost of equity estimates. The basic materials and industrials sectors have the highest average global cost of equity estimates.

Table 7.4: Cost of equity for the remaining sample shares using the multi-factor global CAPM

Share	Beta (MSCI World Index)	Global market risk premium	Beta (R:US$)	Foreign exchange risk premium	Multi-factor global CAPM
Basic materials					
AGL	2.00	8.21%	-0.85	-5.21%	28%
BIL	1.24	8.21%	-0.64	-5.21%	21%
IMP	1.49	8.21%	-1.07	-5.21%	25%
MTX	2.46	8.21%	-2.03	-5.21%	38%
SAP	1.94	8.21%	-1.25	-5.21%	30%
Average	**1.83**		**-1.17**		**28%**
Industrials					
BAW	1.32	8.21%	-1.01	-5.21%	23%
Technology					
DDT	0.90	8.21%	-0.87	-5.21%	19%
Financials					
INL	1.26	8.21%	-0.73	-5.21%	21%
NED	0.61	8.21%	-0.78	-5.21%	16%
OML	0.54	8.21%	-0.68	-5.21%	15%
SLM	1.48	8.21%	-1.30	-5.21%	26%
Average	**0.97**		**-0.87**		**20%**
Consumer goods and services					
NPN	0.72	8.21%	-0.89	-5.21%	18%
WHL	0.62	8.21%	-0.68	-5.21%	16%
Average	**0.67**		**-0.78**		**17%**
Oil and Gas					

SOL	1.19	8.21%	-0.62	-5.21%	20%
Telecommunications					
TKG	0.69	8.21%	-0.44	-5.21%	15%

Source: own deductions

7.5 COMPARISON OF COST OF EQUITY CALCULATED USING LOCAL AND MULTI-FACTOR GLOBAL CAPITAL ASSET PRICING MODELS

In Table 7.5 (below) the basic materials sector has the highest average absolute difference between the cost of equity calculated using the local CAPM compared with that calculated using the multi-factor global CAPM.

The telecommunications sector has the lowest absolute difference in the cost of equity calculated using the local CAPM as compared with that calculated using a global CAPM, i.e., 4%. However, this sector only consists of a single dual-listed company. Furthermore, *TKG*, the telecommunications company, has a relatively low beta against both the ALSI and the MSCI World Index i.e. 0.59 and 0.69 respectively.

Table 7.5: Comparison of cost of equity resulting from local and multi-factor global CAPMs

Share	**Local CAPM (a)**	**Multi-factor global CAPM (b)**	**Absolute Difference (a-b)**	**Foreign exchange risk premium**
Basic materials				
AGL	17%	28%	11%	4%
BIL	15%	21%	6%	3%
IMP	16%	25%	9%	6%
MTX	16%	38%	22%	11%
SAP	16%	30%	14%	7%
Average	**16%**	**28%**	**12%**	**6%**
Industrials				
BAW	13%	23%	10%	5%
Technology				
DDT	12%	19%	7%	5%
Financials				
INL	13%	21%	8%	4%
NED	11%	16%	5%	4%
OML	14%	26%	12%	7%

SLM	10%	15%	5%	4%
Average	**12%**	**20%**	**8%**	**5%**
Consumer goods and services				
NPN	13%	18%	5%	5%
WHL	11%	16%	5%	4%
Average	**12%**	**17%**	**5%**	**5%**
Oil and Gas				
SOL	14%	20%	6%	3%
Telecommuni-cations				
TKG	11%	15%	4%	2%

Source: own deductions

7.5.1 Foreign exchange risk premium

Column 5 of Table 7.5 (above) reflects how much the additional foreign exchange risk premium in the multi-factor global CAPM adds to the total estimated global cost of equity. The basic materials sector has the highest absolute average foreign exchange risk premium (i.e., 6%) and the telecommunications sector has the lowest (i.e., 2%). This is the additional risk premium, from the perspective of a global investor, of investing in rand denominated assets.

7.6 CONCLUSION

The basic materials sector reflected the highest absolute difference between the cost of equity calculated using the local CAPM compared to the cost of equity calculated using the multi-factor global CAPM. The sector with the second highest difference between the local and global cost of equity was the financial sector.

The average global cost of equity of the basic materials sector was strongly influenced by the high global market beta coefficients of shares such as *AGL*, *MTX* and Sappi Limited *(SAP)*. Each of these shares had a beta coefficient that was very close to or above two against the MSCI World Index. As a result, the global cost of equity is 28%, 38% and 30% respectively for each of the shares versus the local cost of equity averaging 17%. The basic materials sector also had the highest average foreign exchange risk premium, which further explains its relatively higher global cost of equity compared to the local cost of equity.

An explanation for this result is that each of the shares making up the basic materials sector has global operations and trades in basic materials whose market prices are usually denominated in foreign currencies other than rands. The demand and supply of the basic materials produced by these companies is determined globally and tends to be influenced by global macro-economic and political factors as well as foreign currency movements and a myriad of other global risk factors.

8 CHAPTER 8 – CONCLUSION AND RECOMMENDATIONS

8.1 INTRODUCTION

In the previous chapter the cost of equity using the local as well as the multi-factor global CAPMs was calculated and discussed. This chapter summarises the motivation for, the aims of, and the contribution of the study. It presents limitations of the study, draws a conclusion and makes recommendations for further research.

8.2 MOTIVATION FOR THE STUDY

This study was motivated by the continual expansion of South African companies internationally, wishing to diversify their earnings streams and become globally competitive. It has become common for companies that were originally established in South Africa to have a listing on the local stock exchange, as well as in one or more foreign countries. There is evidence of increased participation by foreign investors in the South African listed equities market, which leads to the conclusion that South African equity markets are integrated with global capital markets. Dual-listed companies are seen to be even more integrated with global capital markets as they are most likely to have foreign operations and attract foreign investors. This gave rise to the question: What valuation methods should be applied to shares traded in globally integrated capital markets?

8.2.1 Valuation of shares in a globally integrated market

Stulz (1995:14) argued that the equity risk of shares that are traded in integrated global markets should be determined using a global market portfolio and O'Brien and Dolde (2000:7) also accept that a global CAPM, also using a global market portfolio, was most appropriate.

This study questioned whether the market index used in the CAPM should be a domestic or global market index, especially when valuing shares traded in globally integrated markets.

The following section summarizes the study composition and results.

8.3 SUMMARY OF THE STUDY

The overarching research question was: Does the cost of equity of South African dual-listed companies derived using a local CAPM differ from the cost of equity derived using a global CAPM?

The following sub-questions were investigated:

- What is the correlation between the monthly movements of the local market portfolio and the monthly movements of the global market portfolio?
- Are there differences or similarities with regard to the resulting local and global cost of equity estimates for South African dual-listed companies within different market sectors?
- How do the results of this study compare with the results of previous similar studies?

Twenty six dual-listed companies made up the final sample of shares, which were subjected to descriptive data analysis, single regression analysis and multiple regression analysis. Using single regression analysis, the ALSI was used to calculate the local beta coefficient of each sample share. Using multiple regression analysis the MSCI World Index and the R/US$ exchange rate were used to calculate the global beta coefficient and the exchange rate beta coefficient of each sample share. Finally, the single and multiple regression equations were analysed for validity and accuracy using economic, statistical and econometric evaluation techniques.

8.4 MAIN FINDINGS OF THE STUDY

The following are the main findings of the study.

8.4.1 Findings of detailed data analysis

From the data analysis, it was found that each of the 26 sample shares had a positive correlation coefficient against the ALSI, and 25 were positively correlated with the MSCI World Index. The signs of the correlation coefficients of each of the sample shares against the R/US$ exchange rate were mixed and all were relatively low. The financial sector shares had the highest average absolute correlation coefficient against the R/US$ exchange rate. The oil and gas sector shares had the lowest absolute correlation coefficient against the R/US$ exchange rate.

Each of the 26 sample shares were found to have a linear relationship with the ALSI. The initial results of testing for a linear relationship between each of the sample shares and the MSCI World Index and the R/US$ exchange rate, respectively were inconclusive.

8.4.2 Correlation between the local market portfolio and the global market portfolio

The level of comovement between the local South African equity market and the global equity market was measured using the correlation coefficient between the ALSI and the MSCI World Index over the sample period. The correlation coefficient between the ALSI and the MSCI World Index was 0.55 over the sample period. Using the MSCI emerging markets index, the correlation coefficient with the ALSI was 0.6, slightly higher than that of the MSCI World Index.

The MSCI emerging markets index is made up of indices from 21 emerging markets, including South Africa. On the other hand the MSCI World Index consists of indices from 24 developed markets and excludes South Africa. It is therefore plausible that the ALSI has a slightly better level of comovement with the MSCI emerging markets index as opposed to the MSCI World Index.

8.4.3 Findings between different market sectors

*8.4.3.1 **Correlation***

It was found in this study that the oil and gas sector had the highest correlation coefficient against the ALSI. The industrials sector had the lowest correlation coefficient against the ALSI. The basic materials and oil and gas sectors reflected the highest average absolute correlation with the MSCI World Index, and the financials and industrials sectors the lowest absolute correlation. The financials sector had the highest average absolute correlation coefficient with the R/US$ exchange rate, and the oil and gas sector the lowest average absolute correlation coefficient.

*8.4.3.2 **The local and global beta coefficients***

All of the 26 sample shares were found to have a positive beta coefficient against the ALSI, the basic materials and oil and gas sectors having the highest. All of the sample shares had a positive beta coefficient against the MSCI World Index with the basic materials and oil and gas sectors having the highest global beta coefficients. However, the exchange rate beta coefficient was positive for some

sample shares and negative for others. The financials and industrial sectors had the highest absolute average beta coefficient against the R/US$ exchange rate.

8.4.3.3 ***Comparisons of local cost of equity to global cost of equity***

The results of comparing the cost of equity calculated using a local CAPM to the cost of equity calculated using a global CAPM were as follows:

- The basic materials sector had the highest average absolute difference between the cost of equity calculated using the local CAPM and that calculated using the multi-factor global CAPM (12%).
- It was significant that the basic materials sector had the highest average local cost of equity as well as the highest average global cost of equity. This was mainly due to the high local and global beta coefficients of the shares amongst this sector.
- The sector with the second highest average absolute difference between the local and global cost of equity was the financial sector (8%).
- The telecommunications sector had the lowest average absolute difference between the cost of equity calculated using the local CAPM and that calculated using the multi-factor global CAPM (4%).
- The basic materials sector had the highest average foreign exchange risk premium (6%), whereas the telecommunications sector had the lowest (2%). This further explains the large differences in the global cost of equities of the two sectors.
- Some of the sample shares making up the basic materials sector had a beta coefficient that was very close to or above two against the MSCI World Index. As a result, the average global cost of equity was 28% and the average local cost 16%.

8.5 PRACTICAL IMPLICATIONS OF THIS STUDY

Each of the 15 remaining sample shares whose cost of equity was calculated using the local CAPM as well as the global CAPM reflected a difference of 400 basis points or more between the local and global cost of equities. This illustrates that using a global instead of local market index does indeed make a difference to the estimated cost of equity.

It is recommended that:

- Users of financial information must carefully consider what market index to use as a proxy for the market portfolio when applying the CAPM
- Users of financial information must also consider whether foreign exchange rate risk would affect the cost of equity of a particular company when applying the CAPM
- If foreign exchange risk is regarded as significant for a particular company, then a foreign exchange rate premium must be included in the total cost of equity calculation.

8.6 CONTRIBUTION OF THE STUDY

From the findings of this study it appears that it is possible to apply the CAPM for South African companies using market indices other than just the ALSI. This study also contributed methods for calculating a foreign exchange risk premium as well as a global market risk premium for South African companies.

8.7 LIMITATIONS

The study did not provide an answer to the question: which CAPM is the most correct model to use in valuing all or certain South African companies? Nor did it evaluate the validity of the CAPM or the theoretical assumptions thereof, or compare the CAPM to other methods for calculating cost of equity. However, it did offer a contribution to the body of research on applying the CAPM to shares traded in globally integrated capital markets.

8.8 RECOMMENDATIONS FOR FUTURE RESEARCH

The study can be extended to South African companies that are not dual-listed but are seen to be global in the sense that they have operations around the world and/or have foreign investors. The study can be applied using other global market indices as a proxy for the global market portfolio, for example the MSCI Emerging Market Index. South Africa forms part of the MSCI Emerging Market Index and therefore some of its companies may statistically have a better relationship with it compared to the MSCI World Index. Lastly, the rand tracked against a basket of foreign currencies may be used as proxy for foreign exchange risk. The sample shares had relatively low correlation coefficients against the R/US$ exchange rate and an alternative such as a basket of foreign currencies may be more appropriate.

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Annexure 1

Table 6.1: Sample shares

Name	JSE Limited short name	Brief description	Primary share listing	Secondary share listing/s
Basic materials				
Anglo American Plc.	*AGL*	Diversified mining company	LSE	JSE Limited
AngloGold Ashanti Limited	*ANG*	Mining, marketing and selling of gold products	JSE Limited	Ghana Stock Exchange, LSE, Euronext Paris
BHP Billiton Plc.	*BIL*	World's largest diversified natural resources company	LSE	JSE Limited
DRD Gold	*DRD*	Mid-tier gold producer with South African assets + exploration programmes	JSE Limited	Nasdaq Capital Market
Goldfields Limited	*GFI*	Gold mining company	JSE Limited	NYSE Dubai International Financial Exchange Euronext Brussels Swiss Exchange
Harmony Gold Mining Company Limited	*HAR*	Gold mining company	JSE Limited	LSE
Impala Platinum Holdings Limited	*IMP*	Producer + supplier of platinum group metals to industrial economies	JSE Limited	LSE

Metorex Limited[1]	*MTX*	Mid-tier mining company focusing on base metals	JSE Limited	LSE
Sappi Limited	*SAP*	Pulp + fine paper products producer with manufacturing facilities in 4 continents	JSE Limited	NYSE
Technology				
Dimension Data Holdings Plc.[2]	*DDT*	Specialist IT services company	LSE	JSE Limited
Financials				
FirstRand Limited	*FSR*	Integrated financial services	JSE Limited	Namibian Stock Exchange
Investec Limited	*INL*	International specialist bank and asset manager	JSE Limited	Namibian Stock Exchange Botswana Stock Exchange
Metropolitan Holdings Limited[3]	*MET*	Provider of long-term insurance, asset management, employee benefits and health administration	JSE Limited	Namibian Stock Exchange
Nedbank Group Limited	*NED*	Bank holding company	JSE Limited	Namibian Stock Exchange

Old Mutual Plc.	*OML*	International financial services group focused on long term and short term insurance, asset management and banking	LSE	JSE Limited Malawi Stock Exchange Namibia Stock Exchange Zimbabwe Stock Exchange
Sanlam Limited	*SLM*	Financial services company focusing on insurance, asset management and private equity	JSE Limited	Namibian Stock Exchange
Standard Bank Group Limited	*SBK*	Financial services company operating in 17 countries in Africa and 16 countries in other continents	JSE Limited	Namibian Stock Exchange
Industrials				
Barloworld Limited	*BAW*	Provider of integrated rental, fleet management, product support and logistics solutions using international brands	JSE Limited	Brussels Stock Exchange Frankfurt Stock Exchange LSE Namibian Stock Exchange Swiss Exchange

Pretoria Portland Cement Company Limited	*PPC*	Manufacturer of cementious and aggregate products, lime and limestone in Southern Africa	JSE Limited	Zimbabwe Stock Exchange
Consumer goods and services				
Naspers Limited	*NPN*	Provides pay television and related products as well as internet and instant messaging services	JSE Limited	LSE
SABMiller Plc.	*SAB*	Producer of over 200 different brands and sells over 213 million hectares of lager per year	LSE	JSE Limited
Shoprite Holdings Limited	*SHP*	Largest retailer of fast moving consumer goods on the African continent	JSE Limited	Namibian Stock Exchange Zambian Stock Exchange
Truworths International Limited	*TRU*	Retailer of fashion apparel and related merchandise operating mainly in South Africa	JSE Limited	Namibian Stock Exchange
Woolworths Holdings Limited	*WHL*	Owner of retail stores supplying clothing, food, home ware, beauty and financial services in South Africa through Woolworths (Proprietary) Limited and in Australia through Country Road Limited	JSE Limited	Australian Securities Exchange

Oil and gas				
Sasol Limited	*SOL*	The Sasol Group comprises diversified fuel, chemical and related manufacturing and marketing operations. The company is also involved in coal mining as well as oil and gas exploration and production.	JSE Limited	NYSE
Telecommunications				
Telkom SA Limited[4]	TKG	One of the largest communications companies registered in South Africa offering bundled data, voice, broadband and internal services	JSE Limited	NYSE

Notes:

(1) Metorex Limited delisted from the LSE with effect from 9 March 2009

(2) Dimension Data Holdings Plc. was delisted on 13 December 2010

(3) Metropolitan Holdings Limited merged with Momentum Group Limited with effect from 1 December 2010 to form MMI Holdings Limited which is listed on the JSE Limited only.

(4) Telkom SA Limited voluntarily delisted its American Depositary Receipts listed on the New York Stock Exchange on 27 August 2009

Source: Bloomberg and www.moneyweb.co.za/mw/view/mw/en/page

Table 6.2: Correlation coefficients of the sample shares against local and global market risk factors

	ALSI	R/US$	MSCI world index	MSCI emerging market index	AGL	BIL	ANG	DRD Gold	GFI	HAR	IMP	MTX	SAP	BAW	PPC	DDT	FSR	INL	MET	NED	OML	SBK	SLM	NPN	SAB	SHP	TRU	WHL	SOL	TKG
ALSI	1																													
R/US$	-0.33	1.00																												
MSCI world index	0.55	0.38	1.00																											
MSCI emerging market inc	0.60	0.32	1.00	1.00																										
Basic materials																														
AGL	0.83	-0.12	0.61	0.65	1.00																									
BIL	0.79	-0.16	0.43	0.48	0.70	1.00																								
ANG	0.40	-0.03	0.12	0.14	0.26	0.42	1.00																							
DRD Gold	0.18	0.29	0.25	0.26	0.19	0.24	0.46	1.00																						
GFI	0.32	0.06	0.18	0.20	0.24	0.29	0.77	0.53	1.00																					
HAR	0.31	0.13	0.15	0.18	0.23	0.26	0.64	0.55	0.77	1.00																				
IMP	0.69	-0.28	0.35	0.40	0.55	0.62	0.48	0.36	0.39	0.28	1.00																			
MTX	0.46	-0.37	0.33	0.36	0.40	0.27	0.00	0.01	0.04	0.06	0.32	1.00																		
SAP	0.64	-0.28	0.44	0.47	0.57	0.35	0.09	-0.00	0.17	0.30	0.37	0.40	1.00																	
Average	**0.51**	**-0.09**	**0.32**	**0.35**																										
Industrials																														
BAW	0.57	-0.34	0.35	0.39	0.40	0.33	0.00	-0.23	-0.05	0.05	0.27	0.47	0.44	1.00																
PPC	0.33	-0.37	0.00	0.03	0.12	0.09	-0.08	-0.10	-0.09	0.01	0.25	0.22	0.24	0.39	1.00															
Average	**0.45**	**-0.36**	**0.18**	**0.21**																										
Technology																														
DDT	0.57	-0.37	0.23	0.27	0.51	0.36	0.15	0.03	0.11	0.04	0.43	0.16	0.38	0.33	0.24	1.00														
Financials																														
FSR	0.50	-0.41	0.04	0.07	0.23	0.19	-0.00	-0.14	0.09	0.09	0.22	0.17	0.39	0.31	0.52	0.37	1.00													
INL	0.58	-0.21	0.40	0.42	0.44	0.33	0.14	-0.01	0.08	-0.06	0.28	0.26	0.35	0.41	0.26	0.34	0.41	1.00												
MET	0.47	-0.41	0.05	0.08	0.19	0.19	0.02	-0.15	-0.03	-0.01	0.19	0.21	0.39	0.34	0.40	0.27	0.56	0.36	1.00											
NED	0.48	-0.42	0.13	0.16	0.19	0.11	-0.10	-0.25	-0.05	-0.10	0.19	0.36	0.37	0.49	0.57	0.25	0.74	0.49	0.63	1.00										
OML	0.69	-0.47	0.36	0.41	0.55	0.43	0.03	-0.19	0.03	-0.03	0.40	0.40	0.56	0.51	0.25	0.51	0.52	0.51	0.58	0.57	1.00									
SBK	0.51	-0.45	0.02	0.06	0.21	0.25	-0.04	-0.19	-0.02	-0.03	0.37	0.23	0.31	0.36	0.55	0.33	0.83	0.44	0.44	0.75	0.52	1.00								
SLM	0.47	-0.43	0.13	0.16	0.13	0.21	0.12	-0.17	0.04	0.01	0.24	0.26	0.41	0.41	0.26	0.29	0.50	0.47	0.63	0.64	0.60	0.51	1.00							
Average	**0.53**	**-0.40**	**0.16**	**0.19**																										
Consumer goods & services																														
NPN	0.64	-0.45	0.15	0.19	0.44	0.39	0.09	-0.05	-0.08	-0.04	0.25	0.34	0.35	0.43	0.41	0.48	0.49	0.47	0.52	0.50	0.51	0.45	0.41	1.00						
SAB	0.59	0.01	0.54	0.56	0.54	0.37	0.22	-0.02	0.20	0.16	0.17	0.13	0.48	0.42	0.03	0.39	0.30	0.38	0.27	0.21	0.42	0.10	0.29	0.39	1.00					
SHP	0.38	-0.28	0.03	0.06	0.17	0.19	-0.05	-0.07	-0.13	0.08	-0.06	0.19	0.37	0.35	0.46	0.12	0.36	0.23	0.45	0.52	0.36	0.30	0.33	0.50	0.19	1.00				
TRU	0.26	-0.29	-0.09	-0.08	0.06	-0.01	0.01	-0.04	-0.01	0.02	-0.05	0.08	0.19	0.26	0.44	0.29	0.57	0.50	0.52	0.61	0.27	0.43	0.43	0.53	0.06	0.46	1.00			
WHL	0.46	-0.31	0.14	0.17	0.18	0.11	-0.00	-0.09	0.04	0.11	0.10	0.21	0.36	0.39	0.55	0.40	0.72	0.50	0.60	0.67	0.47	0.53	0.50	0.60	0.43	0.53	0.67	1.00		
Average	**0.46**	**-0.26**	**0.15**	**0.18**																										
Oil & gas																														
SOL	0.77	-0.17	0.43	0.47	0.62	0.72	0.43	0.28	0.34	0.33	0.56	0.28	0.47	0.29	0.04	0.29	0.21	0.30	0.29	0.19	0.43	0.22	0.20	0.43	0.43	0.28	-0.02	0.09	1.00	
Telecommunications																														
TKG	0.46	-0.18	0.27	0.29	0.31	0.32	0.03	0.09	-0.09	-0.15	0.28	0.30	0.19	0.24	0.28	0.33	0.30	0.45	0.44	0.39	0.34	0.24	0.27	0.57	0.21	0.22	0.38	0.44	0.22	1

Source: own deductions