

**THE DESCRIPTIVE ANALYSIS**  
**OF THE**  
**BOTSWANA STOCK EXCHANGE**

**BY**

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degree of MSOCSC in Economics.**

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## **ABSTRACT**

The thesis has the modest objective of supplying a descriptive analysis of the Botswana Stock Exchange (BSE). The motivation is that little work has been done and relatively little is known about it. It is felt therefore that basic knowledge of BSE is important. This knowledge could be of interest to an investor who is uninformed about the BSE.

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## INTRODUCTION

This research centers on one of the world's fastest growing stock markets, the Botswana Stock Exchange (BSE). The aim of the study is to provide potential investors with some background information on the Botswana share market, given that for many little is known about the market.

Therefore, the study presents a detailed descriptive analysis of the BSE, with the emphasis on the 12 locally listed shares. A comparison is also made with the Johannesburg Stock Exchange (JSE).

Chapter 1 looks at the historical development of the BSE. Also outlined in the chapter is the descriptive summary of the pertinent information of the individual companies, containing individual company profiles. The company by company analysis was done using the weekly share price information obtained from Stockbrokers Botswana. Some of the shares underwent stock splits and necessary adjustments in the price series were necessary. It was discovered, as expected, that most of the shares were thinly traded. This is a common feature in emerging stock markets. The criteria used to determine how a share performed was the use of weeks open for trade as opposed to the number of times in those weeks that trade actually took place. Volume was also taken into consideration in making conclusions that thin trading was a problem.

Chapter 2, reviews the literature on market efficiency. A theoretical discussion on the efficiency tests, namely autocorrelation test and the runs test is also presented. Central to this chapter is the weak-form efficiency test conducted on the BSE.

Due to time constraint, autocorrelation is the only efficiency test employed. The findings of the efficiency test are also stipulated. The Q-statistic test was used as the testing criteria, thereby comparing the calculated Q- statistic to the critical Q-statistic value obtained from the statistical tables.

Chapter 3 investigates the performance of the BSE, and contrasts its performance with the JSE. Prices as well as the returns on the market indices of the two stock markets are considered. A detailed analysis with regard to the companies listed is also considered. All these comparison and analysis is done with the help of statistical manipulations to the market index price series as well as individual share prices. The main aim in this chapter was to calculate the risk and return associated with the companies listed in the exchange as well as the risk associated with the whole market. An analysis of the time series of prices and returns was done primarily using Excel.

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## CHAPTER ONE

### Overview of the Botswana Stock Exchange

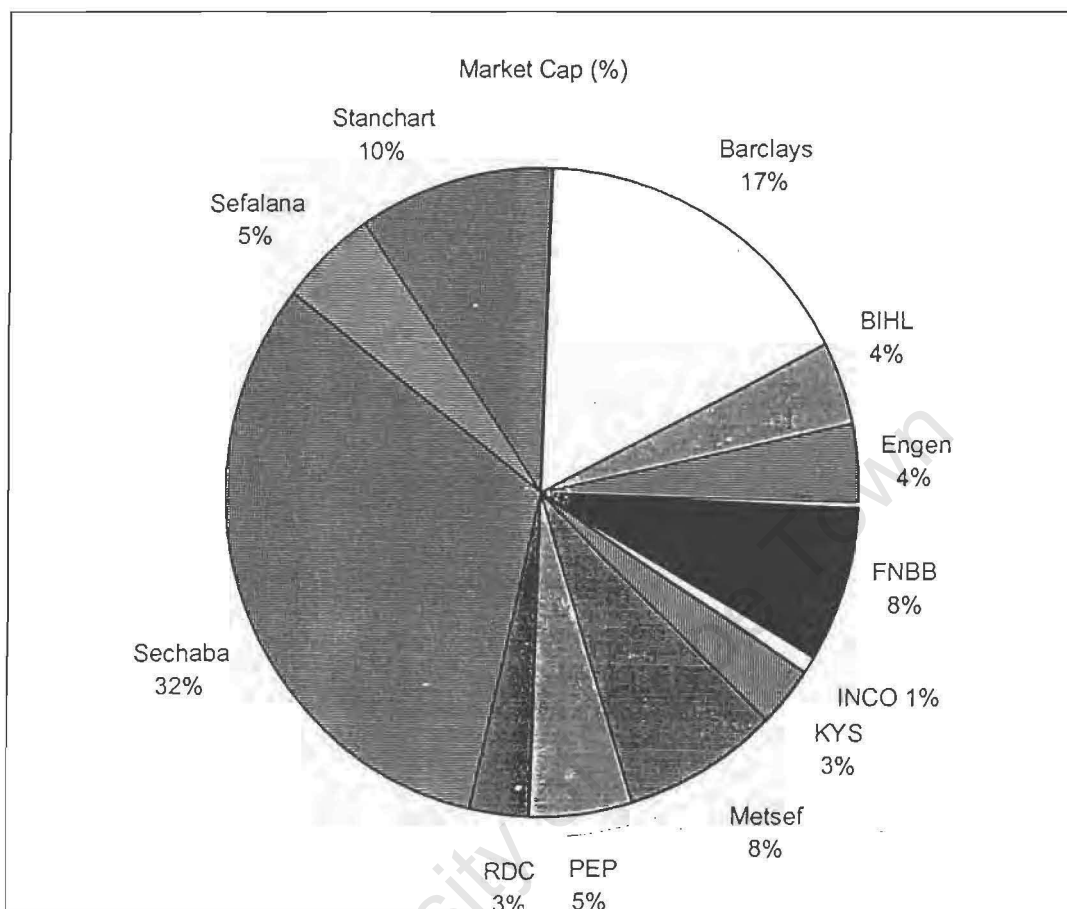
#### 1.1 Introduction

The Botswana Share Market (BSM) was established in June 1989, as part of the government's effort to diversify, as well as to expand, the financial sector. The BSM became the Botswana Stock Exchange (BSE) on November 1 1995, after the Parliament passed the Botswana Stock Exchange Act in August 1994. Stockbrokers Botswana (SBB) is the sole brokerage on the exchange. SBB is responsible for all aspects of trading i.e. it matches buy and sell orders.

There are 12 domestic companies listed on the BSE, which had a market capitalisation of P1722m in 1996 (US\$482m). (Where 'P' stands for pula which is the local currency). The listed companies cover a limited range, with five of the twelve companies in the financial sector (banking and insurance). Other sectors represented include trade, property, and brewing. Not represented in the BSE are companies in the Botswana's active mineral industry, whose ownership is outside Botswana.

Figure 1.1 shows capitalisation by companies listed in the Botswana Stock Exchange. As shown by the pie chart depicted in Figure 1.1, Sechaba makes up a large part of the stock exchange's capitalisation at 32%. This is followed up by Barclays at 17% and Stanchart at 10%. The remaining companies make up 41% of BSE capitalisation.

*Figure 1.1: Market Capitalisation by Company as at end of 1996*

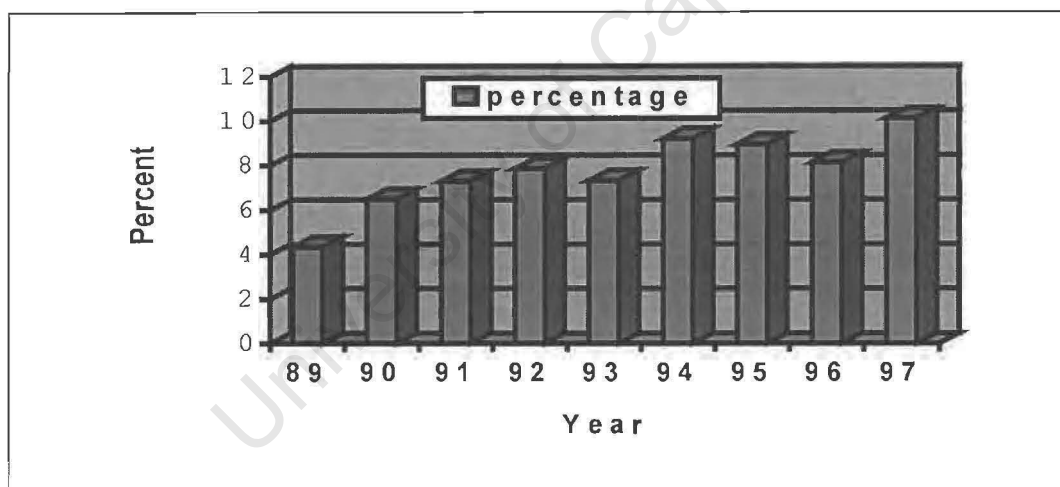


Positive economic developments, such as those outlined in the 1997 National Budget, have given rise to increased investor interest on the BSE. Also, the potential value in investing in shares was realised, and forecasts of average corporate earnings growth of 20% in 1997 boosted investor interest in BSE. Progress of the whole market is measured by a single all-share index (the Botswana Share Market Index), which is computed as a weighted average of relative prices of all listed shares. Despite the fact that trading takes place daily, the index is only calculated on a weekly basis, possibly because of the thin trading problem.

The BSE has grown rapidly since its establishment in 1989. At the time, there were only five listed companies capitalised at a total of P120m. Capitalisation grew by 900% from 1989 to 1996 in local currency terms, and 409% in US dollar terms.

Within the same period, the number of listed companies grew to twelve. Considering the sub-periods 1989-93 and 1994-96<sup>1</sup>, average annual growth rates of market capitalisation were 47% and 21% in local currency terms, and 37% and 8% in US dollar terms respectively (Jefferis, Okeahalam and Matome 1997). Although the lower growth rates in dollar terms result from the depreciation of the pula (linked to the rand)<sup>2</sup> against the dollar, this encouraged foreign buying, especially in the second sub-period, as shares on the BSE were viewed by foreign fund managers as being undervalued. An average annual growth rate of 17% in pula terms, and 7% in US dollar terms, by the market index was realised over both sub-periods. Growth rates were higher in the period 1989-93, with the index rising at an annual rate of 23% and 15% in pula and dollar terms, respectively. Figure 1.2 shows the graph of annual market capitalisation as a percentage of GDP over the period 1989 to 1997<sup>3</sup>.

**Figure 1.2: Market Capitalisation as a Percentage of GDP**



<sup>1</sup> The sub-periods are actually employed to evaluate whether there have been changes in the stock market performance over the period 1989 through to 1996. This break point was chosen due to reasons relevant to Southern African markets. These included: i) South Africa's first general election was held in 1994, and this year marked the full return of South Africa to international economic acceptability; and ii) Botswana undertook exchange control liberalisation on the capital account, beginning in 1994.

<sup>2</sup> The Botswana pula is pegged to a basket of currencies that includes the rand.

<sup>3</sup> Data obtained from "Investment in Botswana" by Stockbrokers Botswana.

It is at this point that one needs to look at other stock market(s) in comparison to the BSE. In particular, it is useful to examine the Johannesburg Stock Exchange (JSE) which is one of the oldest stock markets in Africa, established in 1887 after the discovery of gold on the Witwatersrand. In 1989, there were 748 listed shares, as opposed to 626 listed at the end of 1996. At the end of 1996, the JSE shares had capitalisation of R1130 billion (US\$242 billion), and it was ranked as the 16th largest stock market in the world in terms of market capitalisation, and the third largest emerging stock market after Malaysia and Taiwan, in 1996. Its market capitalisation grew by 240 per cent in rand terms, and 84 per cent in US dollar terms during the 1989-96 period, as opposed to 900 per cent in pula terms and 409 per cent in US dollar terms in the case of the BSE. This highlights the very high growth in the BSE.

However, market capitalisation can be a misleading indicator of the size of the market. The best measure to use will be the value of business transacted (Jefferis, Okeahalam and Matome [1997]), in which case the JSE is seen to rank lower, at 26th in the world, and 10th among emerging markets. Total trade turnover was 10.9 per cent of market capitalisation in 1996 as opposed to 1.6 per cent realised in 1989. By contrast the BSE turnover was 1.4 per cent in 1989 and 8.4 percent in 1996, which is relatively low by world standards.

Below is an outlined summary of the trading conditions on the BSE.

## **1.2 Trading conditions and regulations**

*(Source: Botswana Research - "Investment in Botswana" June 1997)*

- The Botswana Stock Exchange trading times are as follows:
  - Monday to Thursday, 9 a.m. to 4 p.m.
  - Friday, 9 a.m. to 12noon.
  
- Brokerage rates (fees, commissions and taxes):

Dealing costs are a percentage of total considerations (purchases and sales);

- \* P0 to P50,000 = 2%
- \* P50,000 to P100,000 = 1.5%
- \* P100,000 and above = 1%

Stock exchange handling fees are as follows:

- \* P15 is charged per bought note.
- \* P10 is charged per sold note.

A withholding tax of 15% is levied on dividends.

There is no capital gains tax.

- Settlement: The current period given to local, overseas and custodian clients to settle a deal is the trading date plus five working days. However, due to special circumstances clients may be accommodated for those periods outside the legal time frame of settlement.

### **1.3 Facts on foreign investment and ownership regulations**

A foreigner may not own more than 5% of the issued capital of any one publicly quoted company.

Foreigners who wish to own more than 49% of the capital of a public company not in the hands of a controlling shareholder will have to acquire exchange control permission.

Withholding tax of 15% is levied on interest earned by non-residents.

There are no foreign exchange repatriation controls.

Table 1.1 gives an overall summary of statistics of the BSE from 1989 to 1997.

**Table 1.1: Summary of the Botswana Stock Exchange's Key Statistics:**

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997*
Index (Calendar Year End)	149	231	272	274	279	313	332	351	589
Quoted (excluding dual listings)	6	7	9	12	12	12	12	12	12
Volume of shares traded (million)	0.7	2.2	5.2	9.9	17.7	29.6	44.9	42.8	23.6
Value traded (Pm)	0.2	4.3	6.3	32	48.4	82.1	106.8	99.3	62.4
Value traded (US\$m)	0.1	2.3	3.0	14.1	18.9	30.4	37.4	26.8	17.5
Market Capitalisation (Pm)	254	424	545	657	669	1,024	1,120	1,190	1,723
Market Capitalisation (US\$m)	135	225	262	289	261	379	392	321	482
Turnover to Market Cap. (%)	1.4	1.8	3.1	4.8	7.2	8.0	9.5	8.4	4.5
P/E Ratio (Calendar Year End)	9.2	10.6	16	9	8	9.3	9.9	7.3	8.6
Net Div. Yield (Calendar Year End)	6	4.6	4.8	5.4	5.8	5.6	6.8	7.5	5.8

\* Upto June 1997

Source: *Stockbrokers Botswana Research Bulletin (June 1997)*

It is evident from Table 1.1 that the Botswana Stock Exchange is growing at a fast rate, as shown in the growth of market capitalisation between the period June 1989 to June 1997.

An abbreviated description of the listed companies of the BSE follows:

#### **1.4 A brief insight of the shares listed on the Botswana Stock Exchange**<sup>4</sup>

**Name:** Metro Sefalana Cash and Carry Ltd

**Abbreviation:** METSEF

**Organisation type:** Company

**Registered:** Botswana

**Nature of Business:** A wholesale distributor of food, liquor, household goods and building materials. It was created in 1995 as a merger between Metro Cash and Carry and Sefalana.

**Business Sector(s):** Wholesale and Retail industry

<sup>4</sup> This information is from the Botswana Stock Exchange internet web page.

**Name:** Barclays Bank Botswana Ltd  
**Abbreviation:** BARC.BT  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** Provides a wide range of banking services.  
**Business Sector(s):** Financial Services (Banking)

**Name:** Botswana Insurance Holdings Ltd  
**Abbreviation:** BIHL  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** Involved in life and short-term insurance.  
**Business Sector(s):** Financial Services (Insurance)

**Name:** Engen Botswana Ltd  
**Abbreviation:** ENGEN  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** Fuel marketing company  
**Business Sector(s):** Chemicals and Oils

**Name:** First National Bank of Botswana Ltd  
**Abbreviation:** FNBB  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** Provides banking services.  
**Business Sector(s):** Financial Services (Banking)

**Name:** INCO Holdings Ltd  
**Abbreviation:** INCO  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** Provides security equipment and personnel.  
**Business Sector(s):** Financial Services (Holding companies)

**Name:** Kgolo Ya Sechaba Ltd  
**Abbreviation:** KYS  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** An investment trust with a wide range of investments in South Africa and Botswana.  
**Business Sector(s):** Financial Services (Investments)

**Name:** PEP Botswana Holdings Ltd  
**Abbreviation:** PEP  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** A retailer of clothing, footwear and soft and hard household goods.  
**Business Sector(s):** Textiles Manufacturing (Made-Up Textile Products)

**Name:** Real-Estate Development Company Ltd  
**Abbreviation:** RDC  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** Involved in real estate development and the management of commercial buildings.  
**Business Sector(s):** Real Estate

**Name:** Sechaba Investment Trust Company  
**Abbreviation:** SECH  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** A holding company with interests in Kgalagadi breweries and Botswana breweries.  
**Business Sector(s):** Financial Services (·Holding companies -- food, beverage, tobacco; ·Beverage industry)

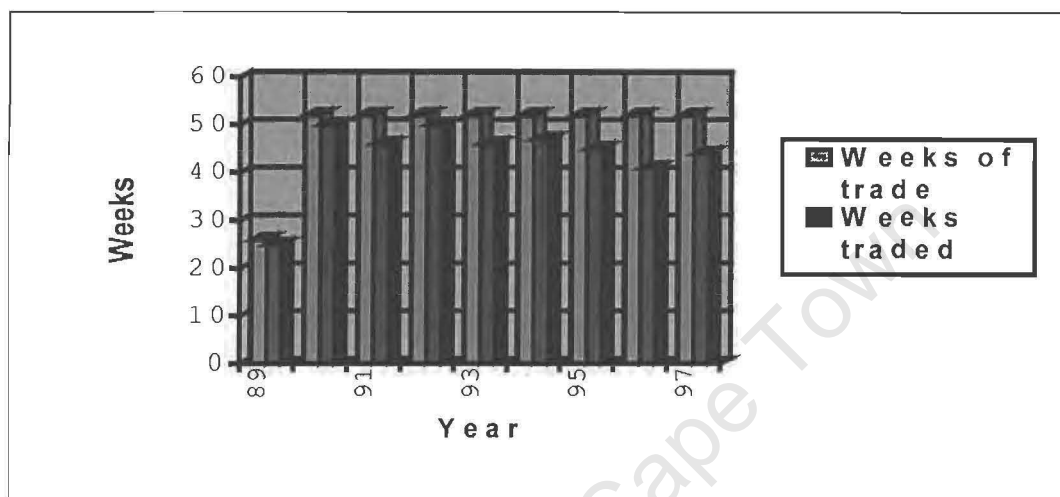
**Name:** Sefalana Holding Company Ltd  
**Abbreviation:** SEFA  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** A holding company of property, manufacturing, wholesaling and milling operations.  
**Business Sector(s):** Wholesale and Retail industry (Wholesaling and retailing)

**Name:** Standard Chartered Bank of Botswana Ltd  
**Abbreviation:** STANCHART  
**Organisation type:** Company  
**Registered:** Botswana  
**Nature of Business:** Provides retail banking services.  
**Business Sector(s):** Financial Services (Banking)

A detailed company by company summary of trading statistics follows:

### 1) Barclays

*Figure 1.3: Barclays Trade trend*



For Barclays, trading activity has taken place for almost 90 per cent of the time available for trade since trading began in June 1989. However, what is of great importance is the volume that was traded. Table 1.2, shows trading volume (in millions) in each year as well as average volume (in millions) per week of trade.

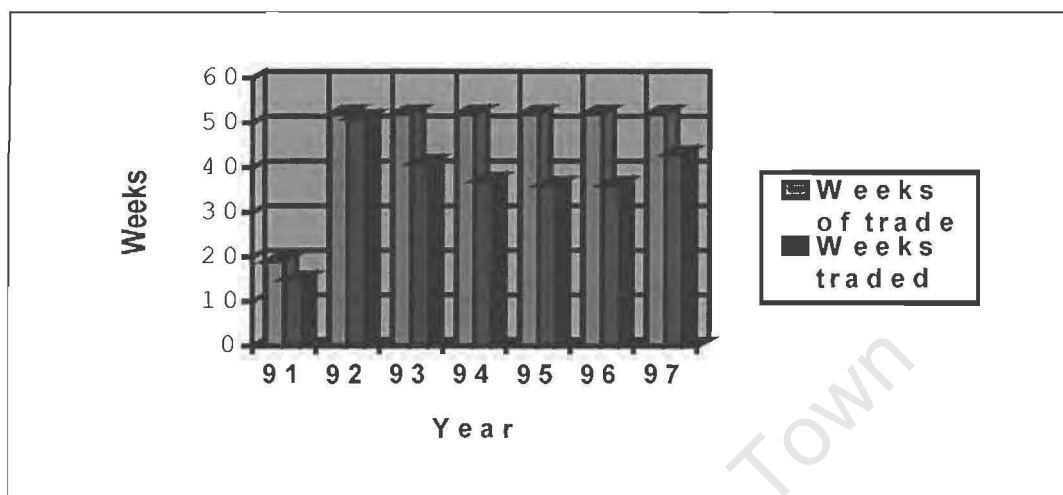
*Table 1.2: Barclays Trade Summary*

Year	06/89	1990	1991	1992	1993	1994	1995	1996	1997
Wks of trade	26	52	52	52	52	52	52	52	52
Wks traded	25	50	46	50	46	47	45	41	44
Total Vol.(m)	48	239	1548	467	870	795	397	282	2014
Avg Vol.(m)	1.8	4.6	29.8	8.9	16.7	15.3	7.6	5.4	38.7

Judging by the statistics in Table 1.2, it would seem Barclays shares are subject to a fairly high level of trading. As observed from Table 1.2, Barclays volumes increased dramatically in 1997, supposedly due to the positive economic outlook conveyed in the 1997 National Budget.

## 2) BIHL

*Figure 1.4: Botswana Insurance Holdings Limited Trade trend*



For BIHL, trade has taken place for almost 80 per cent of the time. This share started trading in August 1991.

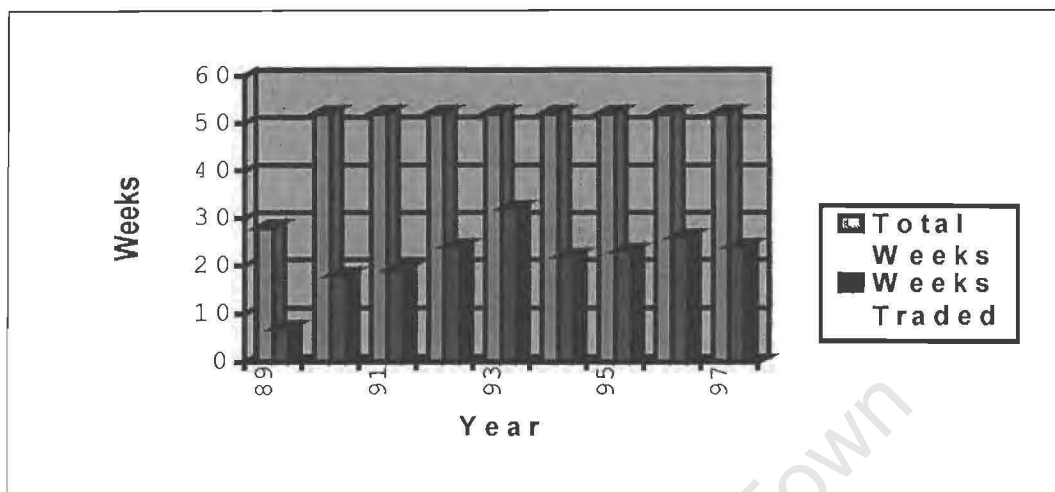
*Table 1.3: BIHL Trade Summary*

Year	1989	1990	08/91	1992	1993	1994	1995	1996	1997
Wks of trade	-	-	19	52	52	52	52	52	52
Wks traded	-	-	15	51	41	37	36	36	43
Total Vol.(m)	-	-	442	609	396	2621	5664	440	779
Avg Vol.(m)	-	-	23.3	11.7	7.6	50.4	108.9	8.5	15

As shown in Table 1.3, it is evident that a fair amount of trade has taken place.

### 3) Engen

*Figure 1.5: Engen Trade trend*



Engen showed a poor performance in terms of trade. Out of all the weeks available for trade, trade took place only 44 per cent of the time.

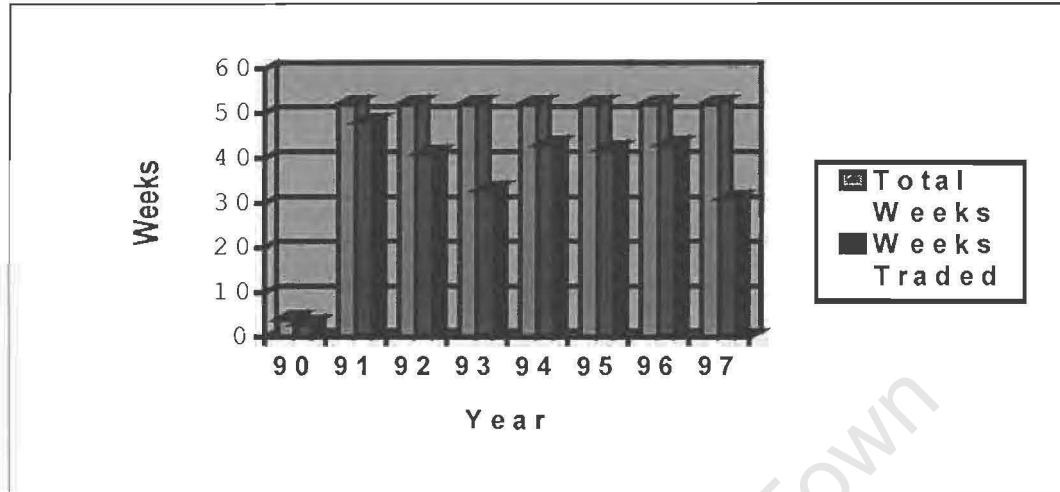
*Table 1.4: Engen Trade Summary*

Year	06/89	1990	1991	1992	1993	1994	1995	1996	1997
Wks of trade	26	52	52	52	52	52	52	52	52
Wks traded	5	18	19	24	32	22	23	26	24
Total Vol.(m)	297	331	81	2414	547	417	279	178	1209
Avg Vol.(m)	11.4	6.4	1.6	46.4	10.5	8	5.4	3.4	23.3

In most years from 1989 to 1997 trade took place less than half the total amount of weeks open for trade. Despite this, the volumes of shares traded over the period are substantial.

#### 4) FNBB

*Figure 1.6: First National Bank of Botswana Trade trend*



FNBB started trading in December 1990. The above figure shows that the share is fairly heavily traded, at 77 per cent of the time. Volumes are given in Table 1.5 below.

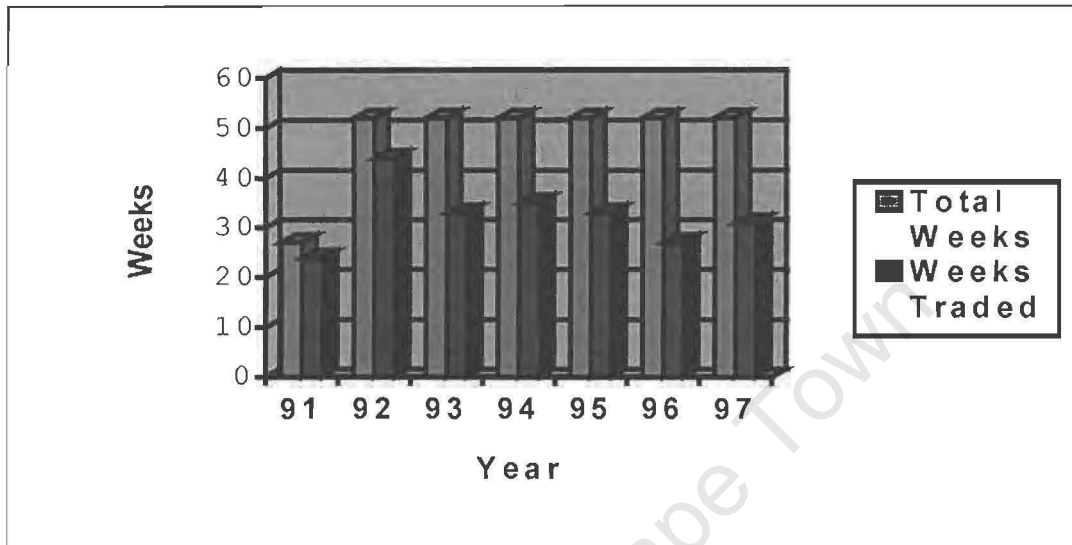
*Table 1.5: FNBB Trade Summary*

Year	1989	12/90	1991	1992	1993	1994	1995	1996	1997
Wks of trade	-	4	52	52	52	52	52	52	52
Wks traded	-	3	48	41	33	43	42	43	31
Total Vol.(m)	-	75	410	361	278	4903	561	165	634
Avg Vol.(m)	-	18.6	7.9	6.9	5.3	94.3	10.8	3.2	12.2

It is evident from Table 1.5 that FNBB is doing well. FNBB is growing rapidly throughout the country, with a substantial customer base.

## 5) INCO

*Figure 1.6: INCO Holdings Ltd (INCO) Trade trend*



INCO experienced a fair amount of trade since it began trading in June 1991, trading at 67 per cent of the time open for trading.

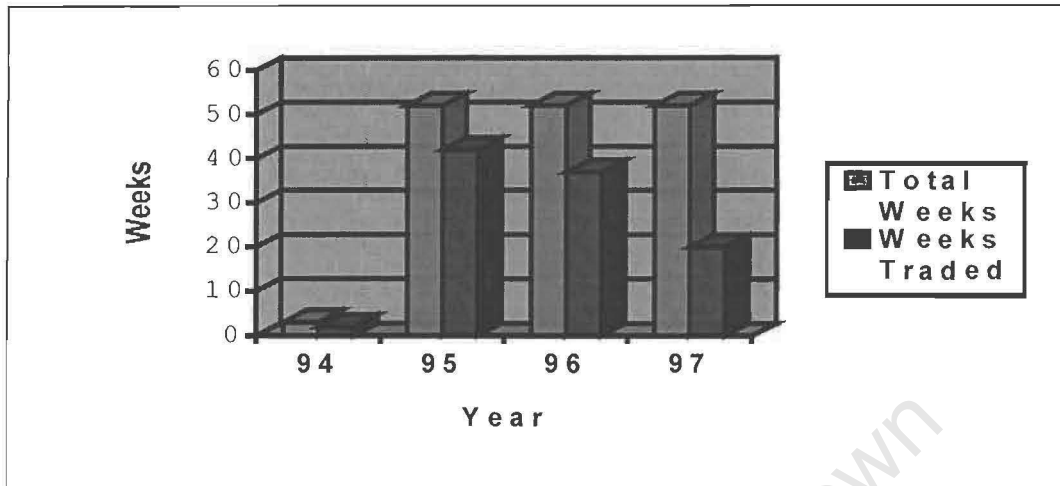
*Table 1.6: INCO Trade Summary*

Year	1989	1990	06/91	1992	1993	1994	1995	1996	1997
Wks of trade	-	-	27	52	52	52	52	52	52
Wks traded	-	-	24	44	33	35	33	27	31
Total Vol.(m)	-	-	391	483	1770	430	607	85	1049
Avg Vol.(m)	-	-	14.5	9.3	34	8.3	11.7	1.6	20.2

Table 1.6 shows volumes corresponding to the trading period, together with average volumes.

6) KYS

Figure 18: *Kgolo Ya Sechaba (KYS) Trading trend*



KYS was listed in December 1994. It traded very well in the first two years following its listing, but, trading activity fell below half in 1997. Overall, KYS has been traded for more than 60 per cent of the time. Table 1.7 below shows trade and volume statistics on KYS.

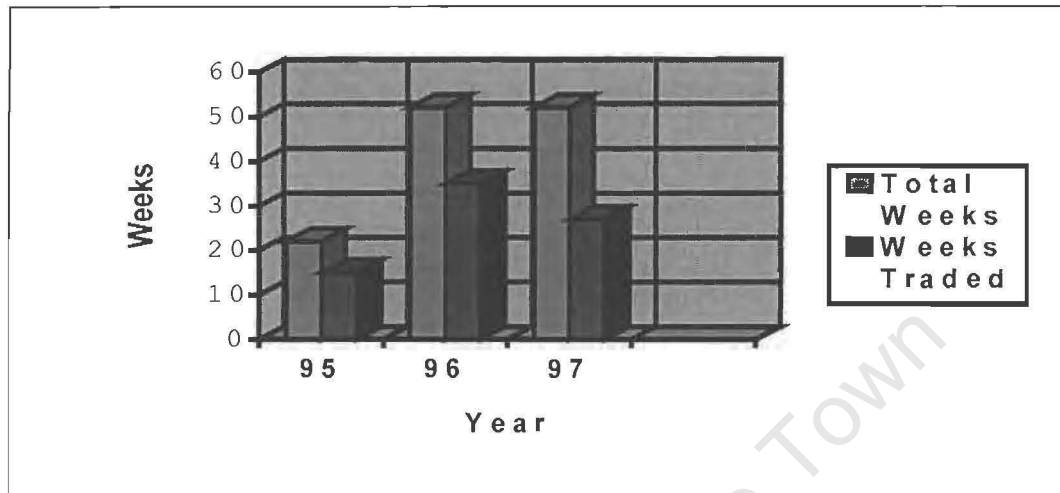
Table 1.7: *KYS Trade Summary*

Year	1989	1990	1991	1992	1993	12/94	1995	1996	1997
Wks of trade	-	-	-	-	-	4	52	52	52
Wks traded	-	-	-	-	-	3	42	37	20
Total Vol.(m)	-	-	-	-	-	1548	4043	1676	8657
Avg Vol.(m)	-	-	-	-	-	387	77.8	32.2	166.5

The data in Table 1.7, indicates that volume wise, KYS shares were fairly traded. The high volume in 1997 can be explained by the fact that, during that time the share price was significantly lower than the price the share began trading at in 1994.

## 7) METSEF

*Figure 1.9: Metro Sefalana Cash and Carry Ltd (METSEF) Trading trend*



METSEF was listed in July 1995. Trading activity for this share has been low, with trade taking place only 61 per cent of the time. Refer to Table 1.8 for the summary statistics on trade and volume.

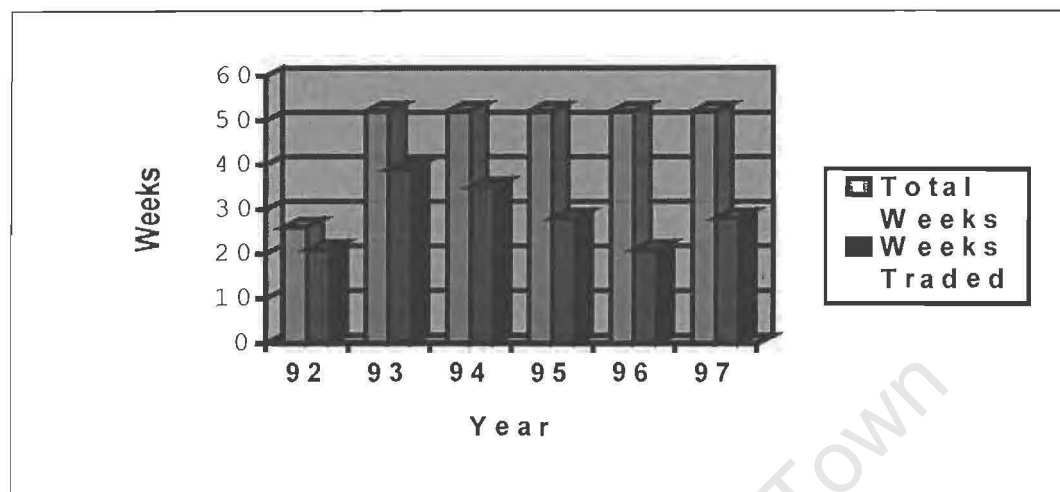
**Table 1.8: METSEF Trade Summary**

Year	1989	1990	1991	1992	1993	1994	07/95	1996	1997
Wks of trade	-	-	-	-	-	-	22	52	52
Wks traded	-	-	-	-	-	-	15	35	27
Total Vol.(m)	-	-	-	-	-	-	392	170	600
Avg Vol.(m)	-	-	-	-	-	-	17.8	3.3	11.5

Since August 1995, the volumes of shares traded have been reasonably high for a newly listed company.

## 8) PEP

**Figure 1.10: PEP Botswana Holdings Ltd (PEP) Trading trend**



PEP was listed in June 1992. Trade for this share has been low over the period, with trade hitting a low of 21 weeks out of 52 in 1996.

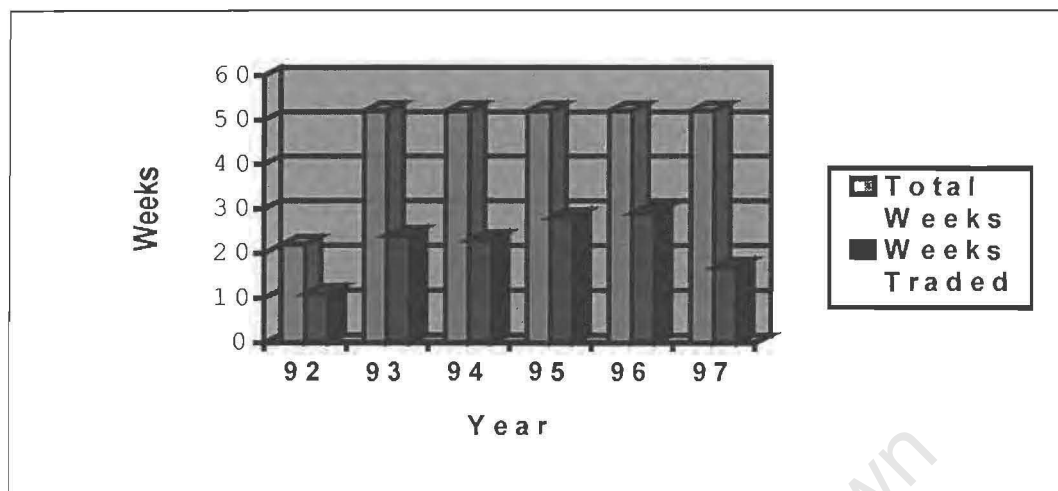
**Table 1.9: PEP Trade Summary**

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997
Wks of trade	-	-	-	26	52	52	52	52	52
Wks traded	-	-	-	21	39	35	28	21	28
Total Vol.(m)	-	-	-	1296	359	999	612	375	1220
Avg Vol.(m)	-	-	-	49.8	6.9	19.2	11.8	7.2	23.5

Table 1.9 provides summary statistics on total volume and average volume and, the corresponding period of trade.

## 9) RDC

*Figure 1.11: Real-Estate Development Company (RDC) Trade trend*



RDC trade performance has been poor since its listing in July 1992. Trade has taken place 47 per cent of the time, with the share hitting its lowest trade time in 1997.

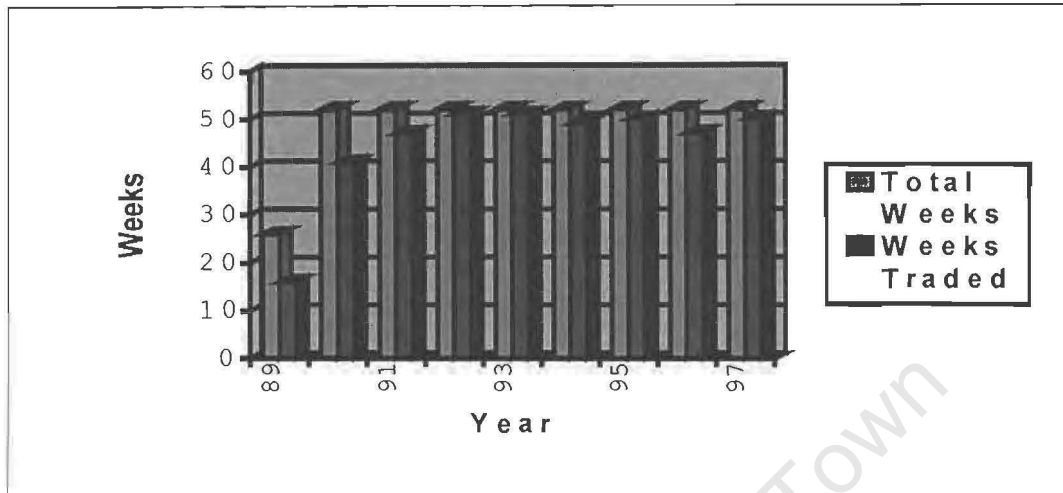
*Table 1.10: RDC Trade Summary*

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997
Wks of trade	-	-	-	22	52	52	52	52	52
Wks traded	-	-	-	11	24	23	28	29	17
Total Vol.(m)	-	-	-	73	159	862	211	445	1411
Avg Vol.(m)	-	-	-	3.3	3.1	16.6	4.1	8.6	27.1

Table 1.10 gives summary statistics on volume and period of trade.

## 10) SECH

**Figure 1.12: Sechaba Investment Trust Company (SECH) Trade trend**



SECH was listed in June 1989. Since that time, this share has been doing well in terms of trading activity. It has been traded 90 per cent of the time that was open for trade.

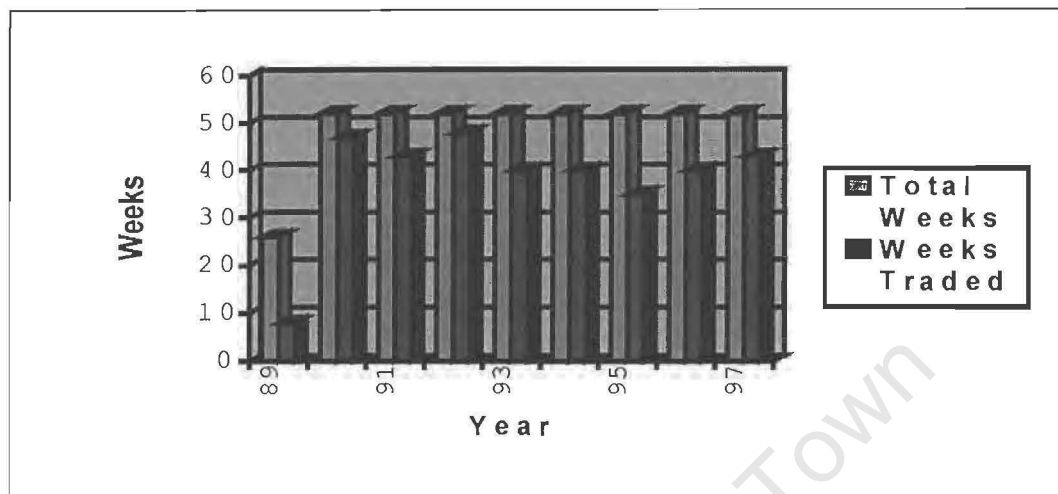
**Table 1.11: SECH Trade Summary**

year	06/89	1990	1991	1992	1993	1994	1995	1996	1997
Wks of trade	26	52	52	52	52	52	52	52	52
Wks traded	16	41	47	51	51	49	50	47	50
Total Vol.(m)	134	23	766	1106	3615	13397	26894	36526	35396
Avg Vol.(m)	5.2	0.4	14.7	21.3	69.5	257.6	517.2	702.4	680.7

The heavy volumes of trade given in Table 1.11 by themselves are a strong indication of how well the share is performing.

## 11) SEFA

*Figure 1.13: Sefalana Holding Company Ltd (SEFA) Trading trend*



SEFA has been doing reasonably well since it was listed in June 1989. It has actively been traded for almost 80 per cent of the time. Table 1.12 shows the statistics on volume and average volume corresponding to the period 1989 through to 1997.

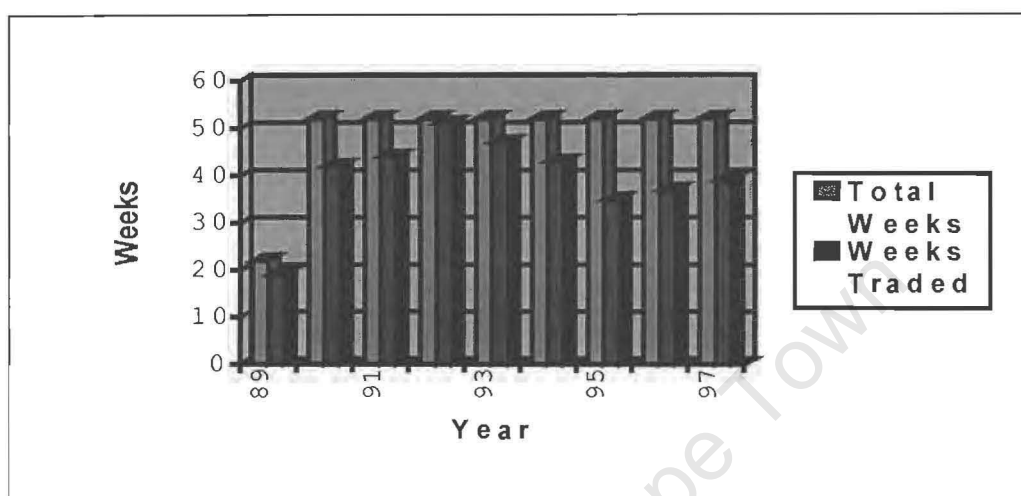
*Table 1.12: SEFA Trade Summary*

Year	06/89	1990	1991	1992	1993	1994	1995	1996	1997
Wks of trade	26	52	52	52	52	52	52	52	52
Wks traded	8	47	43	48	40	40	35	40	43
Total Vol.(m)	108	1579	861	1922	944	1438	1796	2205	3246
Avg Vol.(m)	4.2	30.4	16.6	37	18.2	27.7	34.5	42.4	62.4

Judging by the volumes after 1995, Sefalana shares are performing very well. This is so, despite the merger with Metro South Africa.

## 12) STAN

**Figure 1.14: Standard Chartered Bank of Botswana (STAN) Trade trend**



STAN, as with other financial sector shares, has done reasonably well in terms of trading activity. It has actively been traded for almost 82 per cent since it was listed in July 1989.

**Table 1.13: STAN Trade Summary**

Year	07/89	1990	1991	1992	1993	1994	1995	1996	1997
Wks of trade	22	52	52	52	52	52	52	52	52
Wks traded	19	42	44	51	47	43	35	37	39
Total Vol.(m)	41	53.2	374	361	721	820	211	166	1962
Avg Vol.(m)	1.9	1	7.2	6.9	13.9	15.8	4.1	3.2	37.7

Table 1.13 gives a summary of volume and trading period statistics.

## CHAPTER TWO

### MARKET EFFICIENCY

#### *2.1 Review of literature*

When examining the literature on emerging stock markets, a key issue in the literature is that of market efficiency. In financial economics, efficiency relates to the use of, or response to information, in the formation of stock prices. There are various factors that affect the price of commodities. They include taste, physical location and industrial operation. However, with regard to securities, the only aspect that influences the investors' preferences is the level of risk associated with a security. The highly organised information machinery and the rapidity of information dissemination in the securities market, separates it from other markets. These characteristics are not enough, in themselves, to ensure an efficient market, but they do sufficiently distinguish the securities market from other markets to cause it to come closest to the economist's concept of the perfectly competitive market.

In its ordinary sense, the term efficiency might suggest that market efficiency relates to the organisational and administrative efficiency of the securities market. However, in this paper, the term is used in a much narrower sense. It is concerned specifically with how successful the market is in establishing security prices that reflect the 'worth' of the securities, success being defined in terms of whether the market incorporates all new information in its security prices in a rapid and unbiased manner.

Efficiency, therefore, refers to the two aspects of a price adjustment to new information, the speed and quality (direction and magnitude) of the adjustment. These two aspects of price reaction are equally important. It is obvious that if the market were deficient in terms of the speed or quality of its reaction, the informed and alert observer would have little difficulty in profiting from the situation.

According to Fama (1970), an “efficient market” is a market that is “informationally efficient”, implying that prices reflect all known information. Under the “Efficient Market Hypothesis” (EMH) the three conditions necessary for a market to be informationally efficient are:

- information must be costless and must be available to all participants at the same time.
- there can be no transaction costs.
- prices cannot be affected by the trading of a single person or institution.

However, all three conditions are not always valid in the real world. Some participants have access to information earlier than others. Therefore, the proposition by EMH that security prices should reflect all available information is an extremely stringent requirement.

As such, the theory has been divided into three forms of efficiency, each considering a different type of information. To go together with these forms of efficiency is the concept of intrinsic worth of a share. If the market correctly ‘sets the odds’, the price of a share will represent its worth. Therefore this denotes the best valuation of a share in relation to available information. This does not signify that an investor is assured of any particular given return from the security, only that the price fully reflects all the risks associated with the company’s future, and that the expected return (the average of all possible returns) is commensurate with those risks. A share can be truly worth one price today and totally different price tomorrow if the future outlook changes in the meantime. Therefore, at any given point in time, a security is worth its market price if, after allowing for any differences in risk, the price is consistent with the prices of all other securities. It is clear from the definition that worth is distinguishable from value. Hence the share price represents the market value and is the markets’ estimate of worth. It is not necessarily equal to the worth of the share if the market is inefficient. Indeed, it is the essence of the traditionalists case that market value frequently differs from a share’s

worth. This intrinsic worth concept is discussed below, together with the three forms of efficiency.

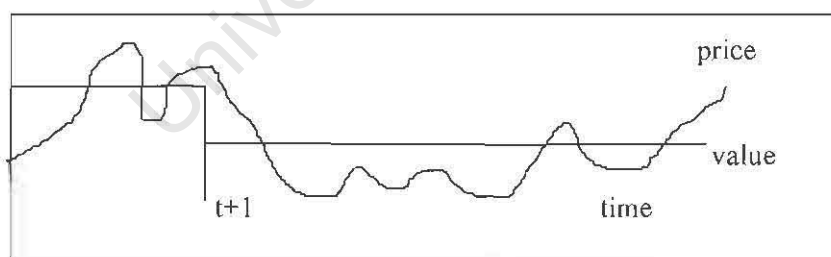
### **2.1.1 Weak-form efficiency**

Weak-form efficiency holds that stock prices already reflect all information that can be derived by examining market trading data, such as the history of past prices, trading volume or short interest. This version of the EMH implies that trend analysis is fruitless. Past stock price data are publicly available and virtually costless to obtain. The weak-form hypothesis holds that if such data ever conveyed reliable signals about future performance, all investors would have learned already to exploit the signals. Ultimately, the signals lose their value, as they become widely known because a buy signal, for instance, would result in an immediate price increases.

In the weakly efficient form market, stock prices are therefore expected to differ or diverge substantially from the stock's intrinsic value.

This is illustrated by Figure 2.1:

**Figure 2.1: Weak-form pricing efficiency**



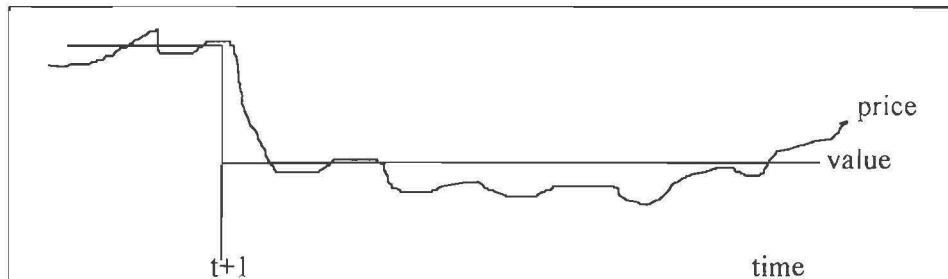
Source: Francis J. C. 1993, page 403

### **2.1.2 Semi-strong form efficiency**

Semi-strong efficiency holds that all publicly available information regarding the prospect, for a firm are already reflected in the stock price. Such information includes, in addition to past prices, fundamental data on the firm's product line, quality of

management, balance sheet composition, earnings forecasts, etc. Again, if any investor has access to such information from publicly available sources, one would expect it to be reflected in stock prices. In this market one would expect less significant departures of price from the intrinsic value of a share, as illustrated by Figure 2.2;

**Figure 2.2: Semi-strong form pricing efficiency**

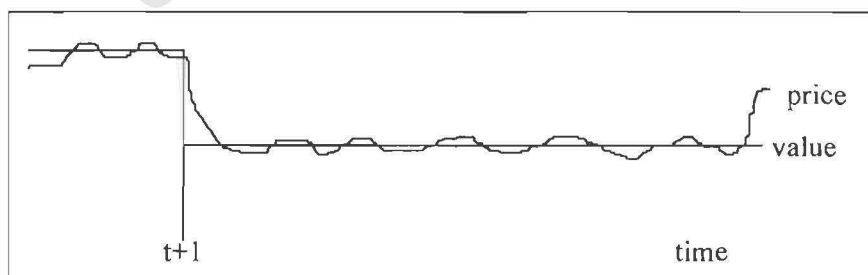


Source: Francis J. C. 1993, page 403

### **2.1.3 Strong-form efficiency**

Strong-form efficiency states that stock prices reflect all information relevant to the firm, even including private information, information available only to the company insiders, i.e., insider information (insider information is information that is not officially published by the company, but is available to the company's employees through their work). The price in this market is expected to fluctuate closely around its intrinsic value. This is illustrated in Figure 2.3:

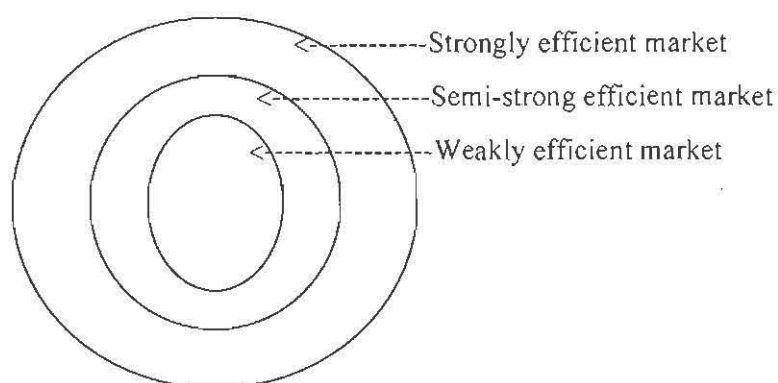
**Figure 2.3 : Strong-form pricing efficiency**



Source: Francis J. C. 1993, page 403

Francis (1993), also shows the three levels of information that might be reflected in stock prices by the use of a Venn diagram below;

**Figure 2.4: Three levels of information**



Source: Francis J.C. (1993)

From the above discussion of stock prices, given the various forms of markets, one can say that the market is least efficient in the weak form. In its weak form, the market tends to display unpredictable price movements, hence the random walk theory of price movements.

#### **2.1.4 The Random Walk Model**

The random walk theory has its origins in 1900, when a French mathematician named Louis Bachelier wrote a scientific paper suggesting that the day-to-day security price fluctuations were random. The term random walk describes the movements of a variable whose future changes cannot be predicted (are random) because, given today's value, the variable is just as likely to fall as to rise. An important implication of efficient markets theory is that stock prices should approximately follow a random walk; that is, future changes in stock prices should, for all practical purposes, be unpredictable.

There are many ways in which this model may be stated, but the most natural form is:

$$\text{Price at time } t = \text{Price at time } t+1 + \text{Residual at time } t;$$

where the residual series has zero mean and is uncorrelated with all previous terms in the residual series. In symbols the model becomes:

$$P_t = P_{t-1} + \varepsilon_t \quad (2.1);$$

where  $E[\varepsilon_t] = 0$ ,  $\text{cov}[\varepsilon_t, \varepsilon_{t-s}] = 0$ ,  $s \neq 0$ ,  $P_t$  price and  $\varepsilon_t$  the residual series. If this model is true, it immediately follows that the best predictor of tomorrow's price is today's price or, put another way, price changes cannot be predicted from previous prices.

Due to the problems associated with the interpretation of the residuals by researchers, various names were given to the possible forms of the random walk model.

For instance, if :

$$P_t = P_{t-1} + \varepsilon_t ;$$

and (i) if  $\varepsilon_t, \varepsilon_{t-s}$  are uncorrelated, then  $P_t$  is a second order martingale. But, if

(ii)  $\varepsilon_t, \varepsilon_{t-s}$  are independent, then  $P_t$  is a strict random walk, or

or (iii) if  $\varepsilon_t, \varepsilon_{t-s}$  are independent,  $\varepsilon_t$  are all identically normally distributed, then  $P_t$  is a Wiener process.

Of the above three options, the martingale form is the one usually used for empirical investigations, as they concentrate on the observed correlation between  $\varepsilon_t$  and  $\varepsilon_{t-s}$ ,  $s \neq 0$ . This form is all that is required, since as far as the investor is concerned a lack of correlation implies that one series cannot be predicted from the other by means of a linear relationship.

A further complication in stating the model is the uncertainty of whether stock prices or the logarithms of these prices obey a random walk. It may look like the logarithmic transformation changes the model fundamentally, but this is not so except at low frequencies. Given the following equations:

$$P_t = P_{t-1} + \varepsilon_t ;$$

$$\log P_t = \log P_{t-1} + \eta_t \quad (2.2);$$

where both residual series have zero means and are uncorrelated with earlier values. Assuming that the percentage change in price,  $\varepsilon_t / P_{t-1}$  is small, as is usually the case in practice, then the two models are approximately the same.

This can be shown by writing equation (2.1) as:

$$P_t / P_{t-1} = 1 + \varepsilon_t / P_{t-1} \quad (2.3);$$

and the two models would be identical if;

$$\log (1 + \varepsilon_t / P_{t-1}) = \eta_t \quad (2.4).$$

Expanding the right hand series as a power series, and ignoring terms of higher order, one has:

$$\varepsilon_t / P_{t-1} \approx \eta_t \quad (2.5);$$

for the two equations to be essentially the same,

$$\varepsilon_t = (P_{t-1}) (\eta_t) \quad (2.6).$$

If it is assumed that  $P_{t-1}$  is independent of  $\eta_t$ , then if  $\log P_t$  obeys Equation 2.2 it follows that  $P_t$  will approximately obey Equation 2.2. The residual series  $\varepsilon_t = (P_{t-1}) (\eta_t)$  will have zero mean and will be uncorrelated with earlier values, as:

$$E[\varepsilon_t] = E[P_{t-1}] E[\eta_t] = 0 \quad (2.7);$$

and,

$$\text{cov}(\varepsilon_t, \varepsilon_{t-s}) = E[\varepsilon_t, \varepsilon_{t-s}] \quad (2.8);$$

$$= E(\eta_t, \eta_{t-s}) \cdot E[P_{t-1}, P_{t-s-1}] \quad (2.9);$$

$$= 0, s \neq 0;$$

from the properties of  $\eta_t$ .

## **2.2 Test of the weak-form efficiency on the BSE**

Efficient market theorists, such as Fama (1965) and Alexander (1961), have provided substantial evidence in support of the hypothesis that capital markets are weak form efficient. The task here is to do the same.

The first test is to examine whether current prices are a complete reflection of the information derived from past price changes. Consequently, the best predictor of a current price should be the previous price. On the assumption that new information

arrives randomly in the market and is instantaneously incorporated into prices, subsequent price changes should be independent of each other. In such a market, historical price data would be of no benefit to investors who would be unable to consistently outperform a buy-and-hold strategy.

Since Botswana is a relatively small market, it is expected to be affected by thin trading. As such, one would expect share price changes to display some dependence, since they are expected to be lacking the liquidity to ensure instantaneous reaction to relevant information. The empirical evidence, however, has been contrary to expectations. Almost unanimously, the findings of tests on smaller markets<sup>5</sup> have concurred with those on larger, more sophisticated markets. Stock markets tend to be weak form efficient. Therefore, an attempt in this section is made to determine whether the Botswana stock market is such a market.

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<sup>5</sup> See for example Praetz (1969), Errunza (1979), Hong (1978), Gilbertson and Rouz (1977) and Sharma and Kennedy (1977). See Prendergast (1988) Vol. 2, p. 8, for a summary on small market studies.

A number of tests are adopted in the detection of serial dependence, namely the autocorrelation test and the runs test. What follows is a synopsis of these tests.

### 2.2.1 Autocorrelation Test

Test for autocorrelation measure the extent of the relationship between the value of a random variable at period  $t$  and its value  $k$  periods earlier (the lag). If the resulting correlation coefficient is not significantly different from zero, then the values being compared are assumed to be independent of each other. Such independence would imply conformity with the random walk hypothesis. How correct the results of this test are, depends on the nature of the underlying data. Since statistical measures of correlation assume a constant mean, stationary data are required for the execution of accurate tests. Many time series, and particularly series of security prices, display submartingale trends, and thus have increasing means over time<sup>6</sup>. If no correction is made for this non-stationarity, a test of the null hypothesis of zero correlation will be biased towards rejection. A typical transformation of the data to achieve stationarity is the use of percentage price changes. Another transformation of the data would be by the first differences of the natural logarithms of the values<sup>7</sup>. However, in most cases this result yields the same results to those obtained using percentage price changes. As Osborne (1959) noted:

“...percentage changes of less than +/-15 percent, expressed as fractions from unity, are very nearly logarithms of the same ratio.

Thus  $\log_e[(100 + 15) / 100] = + 0.15$ .”

For difference intervals of a month or less, percentage price changes are usually lower than 15 percent thus ensuring virtual equivalence.

Despite this similarity, the use of natural logarithms is more common in econometric research, owing to the statistical advantages of a normal distribution. Early published

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<sup>6</sup> “Security prices are a submartingale since they drift upward over time”.

<sup>7</sup> See Fama, (1965), pp. 45-6 for an explanation of the use of natural logarithms.

serial correlation studies by Kendall (1953), Alexander (1961) and Fama (1965), collectively covering various difference intervals and various markets, all failed to detect any significant correlations. Based on these studies, Fama concluded:

“Specifically, there is no evidence of substantial linear dependence between lagged price changes or returns. In absolute terms the measured serial correlations are always close to zero.”

### **2.2.2 Runs Test**

This is a non-parametric test that takes into account only the signs of changes in prices in periods  $t-1$  and  $t$ . A run is defined as a consecutive occurrence of the same sign. Long runs of “+” sign indicate consecutive price increases, while on the other hand long runs of “-” sign indicate consecutive price declines. Statistically it is possible to determine how many positive, negative or zero runs may be expected to occur in a given series of truly random numbers of any size. This number of runs is then used as a standard against which actual price changes are compared. A series of price changes for a security containing either too many, or too few runs, relative to what would be expected in a series of random numbers, is evidence of some kind of non-randomness.

In conclusion of his 1965 research, Fama found that the run test revealed a very weak association between one day lagged price changes, and a zero association for lags longer than one day. Evidence from his study hence suggests that short-run traders looking for various types of non-random trends from which to earn a profit will not be able to beat a naive buy-and-hold strategy.

Below we conduct empirical tests of market efficiency on the BSE.

### 2.2.3 Results on the BSE

The test used for weak-form efficiency for the BSE is the autocorrelation test. Weekly returns lagged from one period to five periods were used. Table 2.1 shows the summary of the results obtained for all twelve shares over their respective shares trading periods.

**Table 2.1: Summary of Autocorrelation Tests**

#### AUTOCORRELATIONS

Lags in periods of 1 week

Share	Name	1	2	3	4	5	SD	Q-stat
1	Barc	-0.4423	0.0655	0.0015	0.0013	0.0132	0.047	91.61
2	BIHL	0.1078	0.0543	0.0656	0.1260	0.0815	0.054	14.21
3	Engen	-0.1252	0.0202	0.0186	0.0113	0.0628	0.047	9.40
4	FNBB	-0.2985	0.0365	0.0708	-0.0263	0.0186	0.052	35.6
5	INCO	-0.0964	-0.0028	-0.0032	0.0010	-0.0019	0.054	3.22
6	KYS	-0.1426	0.0017	-0.0014	-0.0011	0.0024	0.078	3.34
7	Metsef	0.0310	-0.1921	0.0183	0.0109	-0.0857	0.088	6.08
8	Pep	0.0400	0.0505	0.1437	0.0699	0.1401	0.058	14.93
9	RDC	-0.0754	0.0003	0.0155	-0.0978	0.0472	0.059	5.13
10	SECH	-0.0092	-0.0022	-0.0022	-0.0024	-0.0022	0.047	0.057
11	SEFA	-0.0970	0.1246	0.1205	0.0474	0.0650	0.046	21.90
12	STAN	0.2673	0.1370	0.1240	0.0360	0.1137	0.047	54.88
<b>Ave- rage</b>		<b>-0.0700</b>	<b>0.0245</b>	<b>0.0476</b>	<b>0.0147</b>	<b>0.0379</b>	<b>0.73</b>	<b>21.70</b>

*Note: Standard Deviations differ due to different sample sizes.*

The resulting coefficients of correlation between successive price changes of each stock are shown in the columns labelled 1 to 5, in Table 2.1. It is always possible for successive price changes to be unrelated, but for lagged changes to exhibit some dependence. The results of comparing each week's price change with the change two

week's later are therefore shown in the second column. Column three presents a lag of three weeks, and so on. The standard deviation of the returns is in the column labeled SD, which has been computed using the formula given by Anderson (1942):

$$\text{Var}(r_s) = (n-1) / (n-2)^2 \quad (2.10)$$

This formula is based on normality and constant variance in the series, although these two assumptions may not necessarily hold. However, this may not be a serious disadvantage as the results are only meant to serve as an indication of how the true autocorrelation might behave.

The last column is the Q-statistic, which is a test that is based on the empirical autocorrelation coefficients at various lags. This test statistic is computed by the following formula given by Box and Pierce (1970):

$$Q = n \sum_{k=1}^h r_{s(k)}^2 \quad (2.11);$$

where  $r_{s(k)}$  is the empirical autocorrelation coefficient computed using Equation 1, and  $k = 1, 2, \dots, h$ . For a sufficiently large  $h$ , Box and Pierce shows that  $Q$  is distributed as chi square distribution with  $k$  degrees of freedom. This test statistic is used to test the joint hypothesis that all autocorrelations are zero.

Therefore, the basis of whether the null hypothesis is rejected, or accepted, will depend on the calculated value of the Q-statistic and the critical value from the chi square table.

**As such, if the calculated value of the Q-statistic is greater than the critical value at the 5 percent level of significance (used in this study), one can, with 95 percent confidence, say that the true autocorrelation coefficients are not equal to zero.** In the context of this study, this means that, the price of shares today have historical roots of past prices (i.e., they are not randomly determined).

The critical Q-stat value in this study at 5 percent level of significance is 9.488. By using this test statistic, the number of shares that fall below and above this value is 6. This implies that the price of Engen, Inco, KYS, Metsef, RDC and Sech shares are randomly determined. On the other hand, the prices of Barclays, BIHL, FNBB, Pep, Sefa and Stan shares are not found to be randomly determined. Since efficiency implies that there should be no discernible systematic behaviour of the autocorrelations, the results on the shares on the BSE show that a certain amount of systematic behaviour is evident, implying that there is slightly more non-random behaviour than would be expected if the market were totally efficient.

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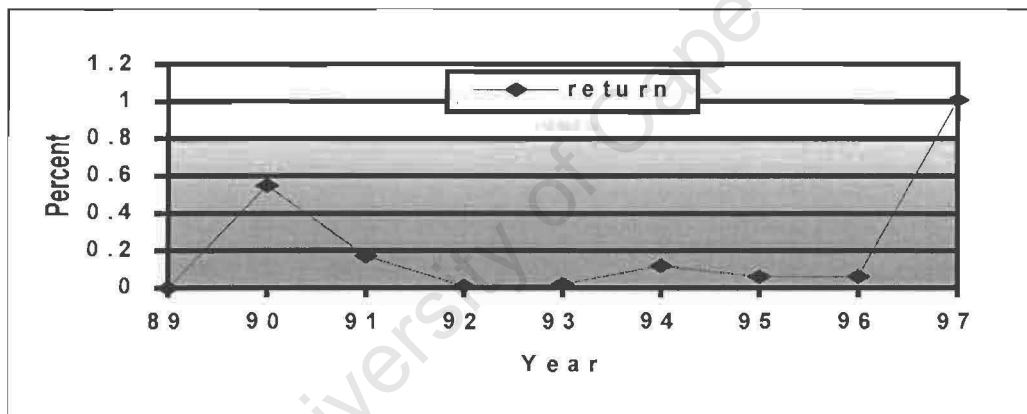
## CHAPTER THREE

### PERFORMANCE OF BSE

#### 3.1 Risk and Return

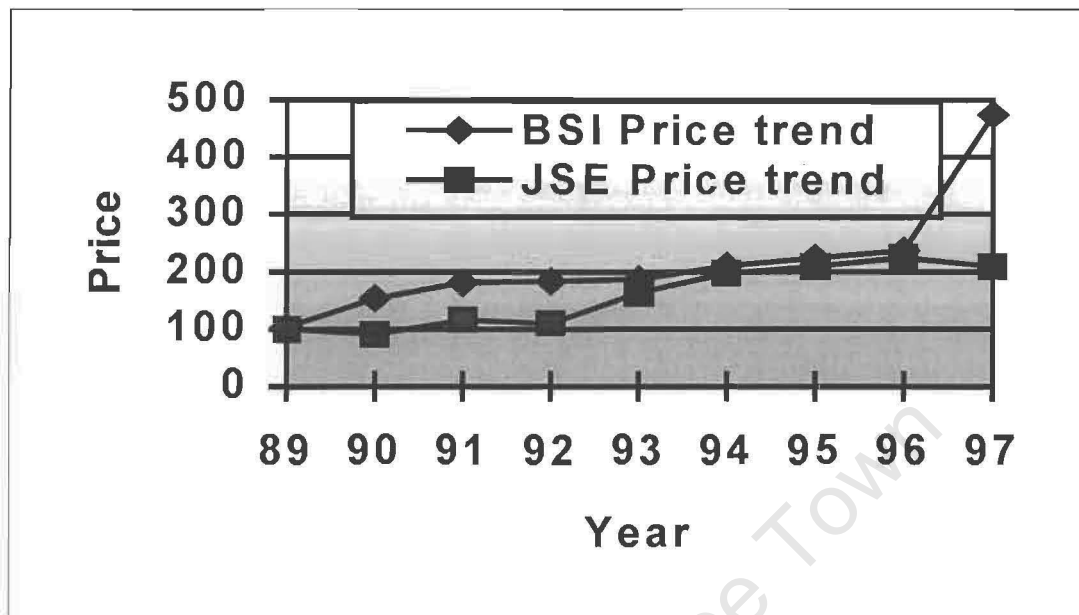
The performance of any stock market can be measured by the returns that investors obtain from their various investments. The overall index can be used as a barometer to show how the whole market is performing. However, it is also crucial to analyse individual returns of each and every share traded in a market.

*Figure 3.1: Botswana Share Index Annual Return Series June 1989 - December 1997*



It is clear from Figure 3.1 that returns on the BSE have never been negative. However, the lowest returns experienced were in 1992 and 1993, with rates of 1 per cent and 2 per cent, respectively. On the other hand, in 1997 the all share index (BSI) showed an increase of almost 101 per cent. But it is also useful to compare the performance of the Botswana Stock Exchange with other markets, especially the JSE. Therefore, a comparison is made in terms of the prices of the market indices, excluding dividends and other returns. An adjustment was made to both market indices so that they could start at the same index level point of 100. For each index, the starting price in 1989 was used as a dividing factor, i.e., the values that followed were all divided by this number and then multiplied by 100. Figure 3.2 shows the graph of the adjusted market price indices.

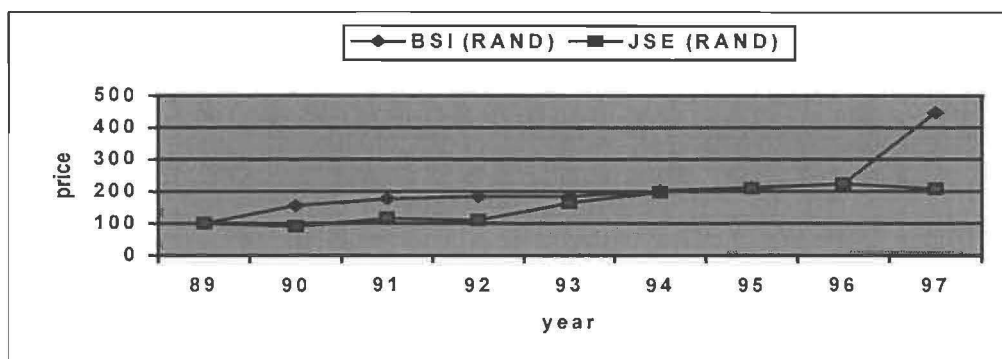
**Figure 3.2: *BSI and JSE price series***



*Note: The BSI is represented in pula while the JSE price index is in rand.*

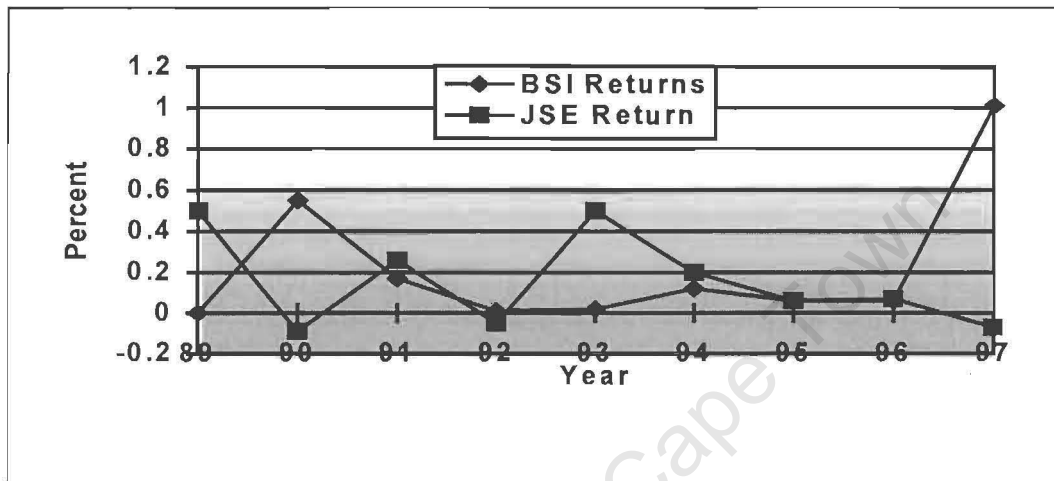
From Figure 3.2, it is clear that BSI out-performed the JSE, but part of this result may simply be due to the difference in exchange rate valuations. Therefore, it is necessary to make a comparison of market index prices by using the same currency. To do this, the pula index was converted to rand by using the end of year pula/rand exchange rates from 1989 to 1997. Figure 3.3 shows the same graph as the one in Figure 3.2, but this time in the same currency denomination, rand.

**Figure 3.3: *BSE and JSE Indices in Rand***



It is at this point again that a comparison is made with regard to the returns and the price index on the BSE with those on the JSE. To make the comparison clearer, Figure 3.4 have been drawn based on the data on the two stock markets for the period 1989 to 1997.

**Figure 3.4: Annual returns on the BSI and JSE Overall Index**



*Note: The returns for both indices are represented in their respective currencies.*

Figure 3.4 shows that returns on the JSE overall index were negative in 1990, 1992 and 1997. On the other hand, as already noted the BSI (Botswana Share Index) never realised negative returns. Does this mean the market is doing well? To the local Botswana investors, yes.

What they are concerned about is earning some return from their investments. But on the other side, the riskiness of the market as a whole has to be considered. The riskiness of the market can be determined by looking at the pattern that returns follow. Observation on the returns on the JSE overall index is that they tend to be decreasing over time. This implies that the market is becoming less risky, Bradfield and Ardington (1997). In contrast, returns on the BSE seem to be fluctuating too much and, show no tendency of decreasing over time. Based on this observation one can conclude that the Botswana market at this stage is "slightly risky" despite the high rate of returns. This is confirmed by the results on Table 3.1, based on annual data of the period 1989 to 1997.

***Table 3.1: Analysis of Risk and Return on the BSE and JSE (1989 to 1997)***

Market Index	Total Return	Total Risk	Risk Adjusted Return
BSI	0.84	0.35	2.40
JSE	0.22	0.17	1.29

Table 3.1 shows that BSE is riskier than the JSE, as given by the column headed 'total risk'. This is so despite the fact that BSE experiences higher positive total return. Also another interesting observation is the trend of the two returns. There seems to be a negative relationship between the returns on the two markets over most of the period. This may be of interest to fund managers from Botswana and South Africa, in the sense that they may diversify their portfolios across borders. To fully justify this point, the correlation between the annual returns in both markets was calculated and, and this was found to be  $-0.22470$ .

Table 3.2 shows the value of returns converted into US dollars. This was done to leave out the exchange rate translation risk. The conversion has led to both returns going down, more especially in the case of the BSE. Despite converting the returns into US dollars, the returns on the BSE remained positive and higher than that of the JSE. This is coupled by a slight increase in total risk for both indices. The correlation between the two returns remained negative ( $-0.09754$ ), but it weakened substantially from  $-0.22470$ , the figure of unconverted returns.

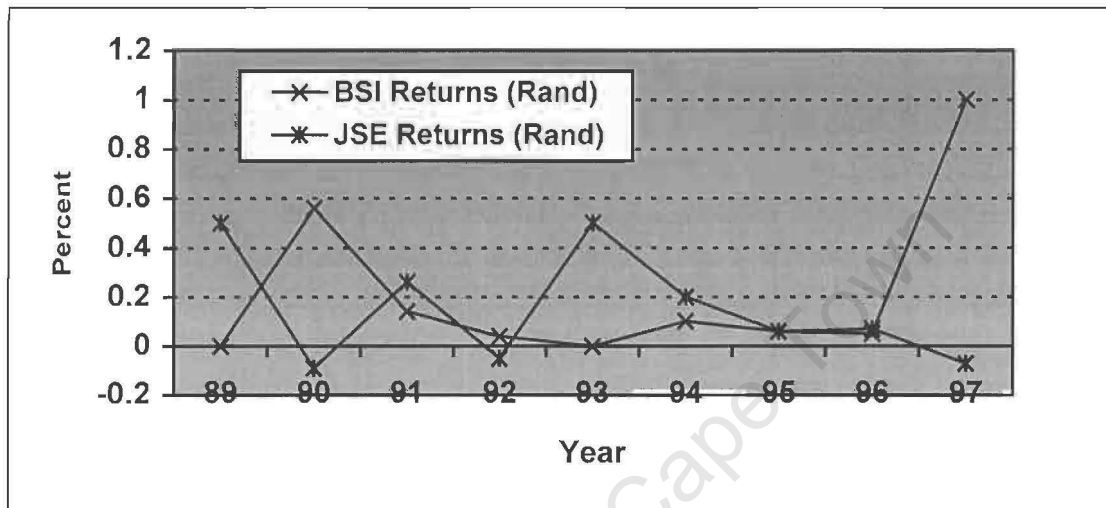
***Table 3.2: Analysis of Risk and Return on the BSE and JSE - US Dollar Returns (1989 to 1997)***

Market Index	Total Return	Total Risk	Risk Adjusted Return
BSI	0.16	0.38	0.42
JSE	0.05	0.21	0.23

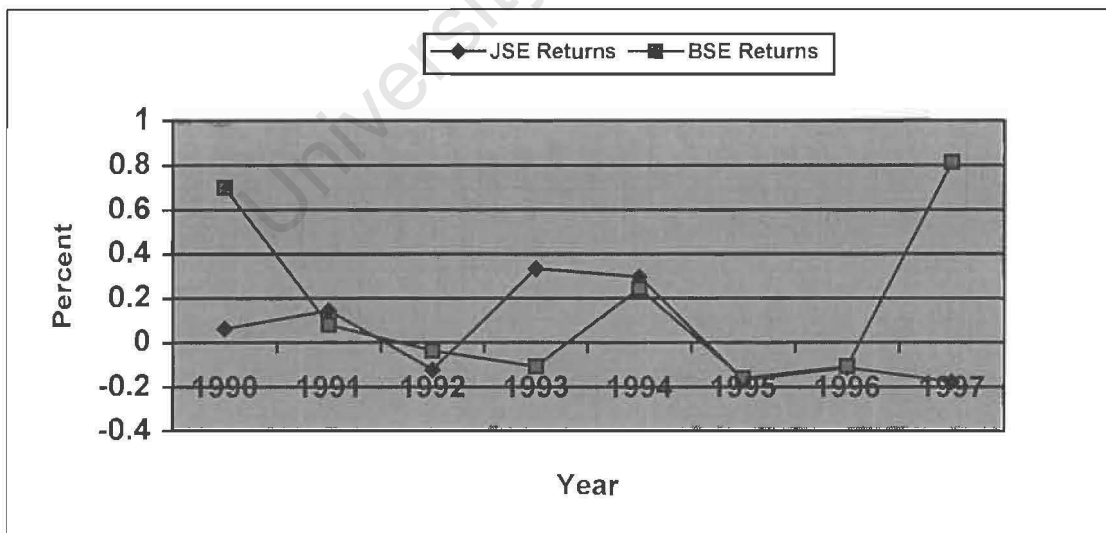
According to the literature on diversification, it is this negative correlation between assets that can earn investor, a good return if they diversify their portfolio. To further confirm this negative relationship, it is necessary to express the two annual returns in the

same currency as shown in Figure 3.5. The negative relationship between the two indices is still experienced even when the two indices are expressed in the same currency.

**Figure 3.5: *BSE and JSE Returns in Rand***



**Figure 3.6: *BSE and JSE Returns in US Dollar Terms***



An interesting observation in Figure 3.6 is that returns on the BSE became negative, for the years 1992, 1993, 1995 and 1996, when converted into US dollar returns. This differ from the results charted on Figures 3.4 and 3.5, which did not take into account the

exchange rate translation risk between the two market indices. As such the presentation in Table 3.2 and Figure 3.6 seem to be more useful in presenting the level of returns to investors.

"The primary motivation for investors is assumed to be to secure a return commensurate with risk", Keane (1983). Put differently, this says that the returns on individual securities vary according to their inherent risk. If it is true that investors dislike incurring risk, they will only invest if they are compensated for it. The fact that securities have tended, over a long period of time, to give higher rate of return than bonds supports this belief. On that note, a rational investor aims to satisfy two things:

- i) to earn the highest possible return on his investment; and
- ii) to ensure that the degree of uncertainty on the return is as low as possible.

The concept of risk relates much to expected, rather than realised returns on a given investment. An investor purchasing a security expects a positive return in future.

If the expected return is not realised, this will mean that there was risk associated with the security in which the individual invested on. Central to the discussion on risk is the concept of uncertainty. These two concepts are not the same and, hence a clear-cut distinction should be made at this stage. The individual who is faced with a risk problem does not know the final outcome, but does know the exact probability that any given outcome will occur. This means that the individual can determine the probability distribution associated with that problem. The best example with regard to risk will be the one of throwing a die. Williamson (1970) goes on to say that:

"The individual faced with a problem in uncertainty, however, has no objective knowledge about the probability distribution associated with the outcome. The investor buying a share of stock is faced with a problem of uncertainty".

Levy and Sarnat (1972) believe that the distinction between risk and uncertainty is not that difficult, since one can always convert uncertainties to risks by simply introducing subjective probabilities. As such, this renders it possible for the two terms, risk and uncertainty, to be used interchangeably. Therefore, the risk associated with a security or a portfolio can be thought of as a measure of uncertainty of the expected return.

In considering returns, it is important to look at the relationship between the return on individual shares as opposed to the return on the market. The model, which helps to look at this relationship, has been termed the 'market model' by various researchers. This model asserts that the relationship between returns on individual shares and returns on the market portfolio is linear.

### 3.2 The Market Model

Mathematically, the relationship between the returns on an individual share and the return on the market from period t-1 to t is stated as follows:

$$R_{it} = \alpha_i + \beta_i r_{mt} + e_{it}, \quad (3.1)$$

where  $R_{it}$  is the return on the  $i$ th share in the  $t$ -th period;

$\alpha_i$  and  $\beta_i$  are the parameters unique to share  $i$ ; and

$r_{mt}$  is the return on the market index.

The prices of shares in this study were converted to returns by taking percentage changes, as shown below:

$$\text{Return} = (P_t - P_{t-1}) / P_{t-1}, \quad (3.2)$$

where (the closing price for the day/week/month/year) minus

(the closing price for the previous day/week/month/year) all divided by

(the closing price of the previous day/week/month/year)

Also in calculating the returns, necessary adjustments were made for those shares which under-went stock splits. The adjustments were done as follows:

$$\text{Return} = [(P_t * n) / P_{t-1}] - 1, \quad (3.3)$$

Where, n is the number of new stocks created by splitting one share, e.g., in a 4:1 split, n = 4.

The technique of least squares regression is the most popular method used to fit a line to a set of data, and is the most widely used method of computing long term trend of a given data set, such as the earnings growth of a firm.

This is the criterion used to measure what is called goodness of fit, by fitting the line of best fit. In the investment world, the line used to approximate the average variability of the security's return relative to the market rate of return is called the characteristic line.

To be able to tell how the security's returns move in relation to the market returns, three important statistical tools are employed. These are beta, alpha and the error term. Beta is the slope of the characteristic line and remains unchanged over the entire range. Most importantly, beta measures the average variability of a stock's rate of return relative to the market return. Hence beta measures what is known as the systematic return of a stock. A security with beta of less than one ( $\beta < 1$ ) is said to be a slow moving stock. This means that in a rising market the security will rise more slowly than the market, and in a falling market will fall less than the market. A fast moving stock will have beta greater than one ( $\beta > 1$ ). In this case, when the market rises, the return on the security will rise more rapidly than the return on the market. Whereas as the market falls, the return on the security will fall more rapidly than the return on the market. However, a security with beta equal one ( $\beta = 1$ ) will be equally volatile to the market. Therefore, securities with beta's greater than one are regarded as being more volatile, and hence more risky than the market. On the other hand, securities having beta's less than one are regarded as being less risky than the market, and hence less volatile.

Changes in a security's return can also occur due to changes in the industry or in other factors unique to the company. These factors form what can be termed as the unsystematic return associated with a security. This is the sum of two variables, namely, alpha ( $\alpha$ ) and the error term. Alpha measures that part of movement in a security's return that is not explained by the overall movement of the market. Alpha is commonly known as the Y-intercept. As such, if the market returns are zero, then the stock will generate the return equal to the value of alpha. Alpha's can be highly unstable for a given stock over time. Also stocks with similar characteristics can have different alphas. The error term, on the other hand, is part of the unsystematic return. This measures the deviation between the actual and expected return of a security. Put differently, it is the vertical distance between the actual return and the characteristic line. Hence the error terms are said to represent the residual portion of a stock's unsystematic return. Of importance are the standard deviations (standard errors) of beta and alpha. Basically, the standard error is a statistical measure of the potential error in the estimate of coefficients. The lower the value of the standard error relative to the coefficient estimated, the more reliable will be the estimate of the beta or alpha.

The concept of an individual security return may then be stated as follows:

$$\text{Security Return} = \text{Systematic Return} + \text{Unsystematic Return.}$$

In summing up, the systematic return of a security is correlated with the market return and is determined by multiplying the security's beta by the market return. The unsystematic return depends on those factors that are unique to the company's industry and to the company itself.

By virtue of looking at the market model equation, it is clear that the variance of a security's returns stems from two things:

- i) the variance of the return on the market index,  $r_m$ ; and
- ii) the variance of the random error term,  $e_i$ .

These two factors make up the two forms of risk commonly known as market, or systematic risk, and unique or unsystematic risk.

Mathematically these components can be expressed as follows:

$$\text{var} ( r_i ) = \text{var} ( \alpha_i + \beta_i r_m + e_i ) \quad (3.4)$$

$$= \text{var} ( \alpha_i ) + \text{var} ( \beta_i r_m ) + \text{var} ( e_i ) \quad (3.5)$$

Knowing that  $\alpha_i$  is a constant, then  $\text{var} ( \alpha_i ) = 0$ ,

$$\text{hence } \text{var} ( r_i ) = \text{var} ( \beta_i r_m ) + \text{var} ( e_i ) \quad (3.6)$$

$$= \beta_i^2 \text{var} ( r_m ) + \text{var} ( e_i ) \quad (3.7)$$

This equation can also be written as:

$$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{e_i}^2 \quad (3.8)$$

where;  $\sigma_i^2$  is the variance of the returns on share  $i$ ;

$\sigma_m^2$  is the variance of returns on the market index; and

$\sigma_{e_i}^2$  is the residual variance.

In words, this equation can be translated to read as follows:

$$\text{Total risk} = \text{Market risk} + \text{Unique risk.}$$

Market risk is the risk in a share associated with general economic conditions affecting the whole market. Investors are exposed to this risk no matter how well diversified their portfolios are. Unique risk is risk entirely embodied in individual companies. This can stem from such things as bad management, strikes, etc.

The concept of risk regarding individual securities can also be carried on to portfolios. In other words:

Total portfolio risk = Market risk of the portfolio + Unique risk of the portfolio.

Mathematically this can be written as follows:

$$\sigma_p^2 = \left( \sum_{i=1}^n X_i \beta_i \right)^2 \sigma_m^2 + \sum_{i=1}^n X_i^2 \sigma^2 e_i \quad (3.9),$$

where;  $\sigma_p^2$  is the variance of returns of the portfolio;

$n$  is the number of shares in the portfolio; and

$X_i$  is the proportion of total capital invested in share  $i$ .

The only difference between this equation and the individual security equation is the inclusion of the proportion of funds invested and the number of securities invested in.

It is argued that the only type of risk associated with a given portfolio is the market risk. The help of statistical applications has proved that unique risk is diversified away as the portfolio grows. This can be justified by manipulation of the above portfolio risk equation. Assuming that equal proportion of funds is invested in each share, that is, the proportion  $X_i$  equals  $1/n$  for each of the  $n$  securities. As  $n$  becomes large the value of  $X_i$  will become smaller, and the value of  $X_i^2$  will become even smaller. The values of  $\sigma^2 e_i$  will not, generally, vary a great deal, and the expression for unique risk in the equation becomes negligible. This then means that the market risk becomes dominant.

### **3.3 Results on the BSE**

The analysis of returns on the BSE is purely based on the market model. Table 3.3 has the results of the twelve shares listed on the BSE. The results are based entirely on weekly returns of both the shares and the market index, from the period the shares started trading through to 1997.

**Table 3.3: Regression results<sup>8</sup>**

Share Name	Beta	Alpha	R-squared	Standard error of beta	Standard error of alpha	Data points
Barclays	1.149	0.002	0.400	0.140	0.006	102
BIHL	0.358	0.003	0.070	0.148	0.007	76
Engen	0.132	0.018	0.042	0.134	0.006	102
FNBB	0.403	0.002	0.080	0.280	0.012	84
INCO	0.429	0.005	0.020	0.329	0.015	78
KYS	0.118	0.013	0.010	0.262	0.016	36
Metsef	0.449	0.013	0.020	0.107	0.007	29
PEP	0.230	0.004	0.080	0.095	0.005	66
RDC	0.310	0.009	0.080	0.200	0.010	64
SECH	0.643	0.006	0.140	0.159	0.007	102
SEFA	0.248	0.008	0.050	0.105	0.005	102
STAN	0.359	0.011	0.010	0.373	0.016	101

*Note: The betas may suffer from downward bias as a consequence of thin trading (documented on the JSE by Bowie and Bradfield (1991)). Excel was primarily used for data manipulation.*

#### Interpretation of the results on Table 3.3:

##### Standard errors of betas and alphas:

The standard error actually measures the potential error in the estimate of a coefficient. By observing Table 3.3, the standard errors of both beta and alpha are very small. This ensures a degree of confidence in the use of beta and alpha estimates in this research.

##### Beta

This measures the sensitivity of the share's price to changes in the market. Barclays is the only share with a beta of greater than one, and as noted earlier, a security with beta of greater than one is said to be aggressive. This basically implies that Barclays share price tends to move more in percentages terms than the market index, and it also means that when the market is in an up-swing, Barclays out performs it. On the other hand, when the market is going down, Barclays share will tend to fall more than the market. However, as shown in Chapter 2, the Botswana Share Index is doing very well, and hence this makes those investors holding Barclays shares not to worry much about

<sup>8</sup> Note that an OLS (Ordinary Least Squares) regression procedure was used. We allude to the fact that the BSE is a thinly traded environment, and consequently remind that the "trade-to-trade" procedure advocated by Bowie and Bradfield rather be used. [Because of data limitations, we were only able to adopt the OLS approach].

making capital losses. Generally these investors are getting good reward for their investment in this share.

All the eleven remaining securities have their beta coefficients less than one. This implies that these securities rise less than the market in an up-swing and, fall by a less percentage than the market in a downswing. These securities will tend to perform better than Barclays share in those periods when the market is going down.

### Alpha

This gives the average return on the share when the market on average does not move. The value of this coefficient is very small for all the shares.

### R - Squared

This is the most important statistic in the table. It is interpreted as the proportion of the share's total risk accounted for by variations in the market risk. The results in Table 3.3 are very interesting in the sense that none of the securities have R - squares greater than fifty percent. This raises the question, what does this mean for BSE shares? By looking at the statistics, it is very clear that most of the risk attached to the shares listed on the BSE is unique risk. This means that most of the risk is associated with the day-to-day running of the companies listed, such as management decisions, balance sheet status, etc. Some of the reason for this must relate to the fact that the BSE is still an up-coming market, and investors are not sure about its future. Some of the companies are also very new, and hence investors are not prepared to take a 'gamble' on them until a good performance record has been realised.

Table 3.4 shows the summary of total return and risk pertaining to individual companies, together with the risk adjusted return as a performance measure similar to the one used by Sharpe (1978). Sharpe's measure divides the returns by their standard deviations (i.e., total risk). Performance figures that are unadjusted for risk tell us how much money the portfolio has earned. They tell us nothing concerning the risks that were taken on the way. Therefore, those shares with the highest risk adjusted returns are the ones to invest in, even if their unadjusted returns are lower.

***Table 3.4: Analysis of Return and Risk***

Company	Total Return	Total Risk	Risk Adjusted Return	Ranking
Barclays	0.87	0.0244607	43.50	6
BIHL	0.80	0.0227110	40.00	7
Engen	3.35	0.0259418	111.67	3
FNBB	3.89	0.0448786	97.25	4
INCO	0.50	0.0597333	0.93	11
KYS	-0.77	0.0785101	-8.56	12
METSEF	0.53	0.0184609	26.50	9
PEP	0.72	0.0163491	36.00	8
RDC	0.90	0.0397707	22.50	10
SECH	6.32	0.0546806	471.05	1
SEFA	3.00	0.0243091	150.00	2
STAN	2.11	0.0392871	52.75	5

*Note: The results are for the period 1989 through to 1997.*

Table 3.4, highlights that Sechaba has the highest positive risk adjusted return. This may not be surprising, considering the fact that Sechaba makes up a greater part of the total market capitalisation. Overall, financial sector shares do very well given their risk-adjusted returns, while Sefalana may also be a share to buy. Only one share KYS showed a negative total return, as well as negative risk adjusted return.

Also the last column shows the ranking of the companies according to their risk adjusted returns, ranked in the order 1 to 12.

## CONCLUSION

The study was predominantly descriptive. The findings of the analysis are consistent with the expectations of an emerging market. To begin with, the phenomenon of thin trading, which one would have expected with regard to the BSE, was confirmed. As outlined in the study, the basis for this observation was the trading activities of the shares listed in the exchange. The thin trading aspect was evident from the observed lack of change in the weekly price series of share prices on several occasions, together with volumes traded.

Another important finding is that BSE does not appear to be an efficient market. This is what one would expect of an emerging stock market, typically characterised by thin trading. This finding was established empirically (i.e., statistically) by the use of autocorrelation test. Some of the shares that were analysed showed some qualities of non-randomness in their price determination. This result, in itself, disqualifies the BSE from being an efficient market. A market is said to be efficient only when non-random behaviour of share prices is absent.

The magnitude of unique risk is also worth commenting on. For all the shares on the BSE, unique risk constituted a greater part of total risk. This was shown by the R-squared of the individual shares, none of which were over 0.50. Also the study has shown that Barclays is an aggressive share, as measured by the beta coefficient. This means that when the market is going up, Barclays share price goes up faster than the market, and when the market is falling, it then falls faster than the market. Beta's for the remaining shares are all less than one. This implies that they rise slower than the market in a bullish phase, and fall slower than the market in a bearish phase. One can therefore conclude by giving a suggestion that it is wise to hold Barclays shares in a time of economic boom, and then hold other shares like Sechaba in periods of sluggish economic growth.

A key aim of the study was to find out how the BSE performs in relation to the JSE. To some, the observation that the BSE has out-performed the JSE may seem surprising.

This conclusion is based on data of the market indices for the period 1989 to 1997. The market index for the BSE recorded high growth as opposed to its counterpart. Even the conversion to the same currency did not change the finding. However, despite high returns, the BSE was found to be riskier than the JSE.

A very important result is the one of negative correlation between the annual returns in the two markets. This may give investors some indication that they can invest across borders. This statement is supported by the fact that when the returns on assets are negatively correlated, an investor can gain by diversifying among them. This can also work in the case of those portfolio managers who may want to diversify their portfolios across borders.

At present, the political and economic stability that Botswana is enjoying can be a reason enough for someone to invest in the BSE. Those investors currently in the market and holding financial institutions shares, as well as Sechaba, are reaping the rewards for doing so. For now, Botswana is a lucrative market for someone to invest in.

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