An Analysis of changes in liquidity around share splits

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I certify that that this report is my own work and that, where appropriate, all sources have been adequately referenced.

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Abstract

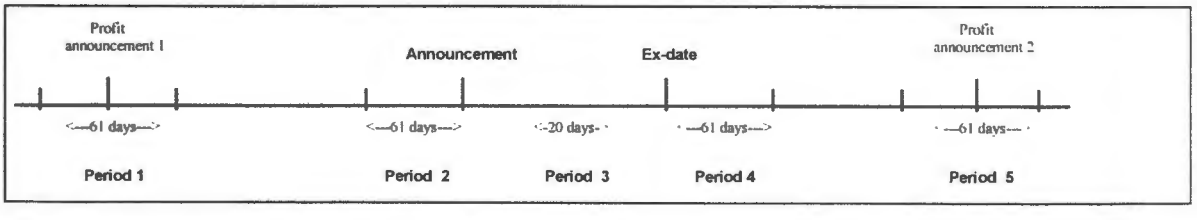
Surveys of U.S. market participants reveal a belief that liquidity improves following a share split. Contrary to this, empirical studies on U.S. markets generally conclude that liquidity worsens. These contradictory views have as yet not been reconciled. Furthermore, there is little evidence as to the change of liquidity on the Johannesburg Stock Exchange ("the JSE").

The primary objective of this study is to understand how liquidity, as measured by trading volumes, changes around a share split on the JSE. The study also seeks to gain a more precise understanding of the nature of any change in liquidity in order that it may be related to the effect that a split has on volatility and returns.

Twenty-three share splits were selected from the period between December 1990 and June 1996. These splits were screened to ensure that no contemporaneous events were present which may have influenced the results. Five study periods were then defined around each split. These periods were as follows:

Period	Description
Period 1	A period of 61 trading days set around the first profit announcement occurring at least three months prior to the split announcement date.
Period 2	A period of 61 trading days immediately prior to the day on which the split was announced.
Period 3	A period of 20 days falling a similar number of days after the announcement date as before the ex-date.
Period 4	A period of 61 trading days immediately following the day on which the ex-date of the split occurred.
Period 5	A period of 61 trading days set around the first profit announcement occurring at least 3 months after the split ex-date

Seen graphically,



These separate periods allowed the analysis of the timing of any change in trading volumes to be made with more precision.

The daily adjusted trading volumes (actual number of shares traded adjusted for the share split) were obtained for each share in each period. A comparison was then made between each of the periods using a matched sign test to determine if there was a change in trading volumes between consecutive periods. This was done by comparing the proportion of days where the volumes in one period exceeded the volumes in the comparison period. So for example, day 1 in the period 1 for the first share in the sample was compared to day 1 in period 2 for the same share. Day 2 was then compared to day 2 and so on.

The results showed that that there were two distinct increases in trading volume around the split:

- the first occurred prior to the announcement of the split; and
- the second occurred following the ex-date.

To determine exactly when these changes occurred the matched sign test was repeated using narrower study periods. Based on these revised periods the results showed that the first increase occurred immediately prior to the announcement date and that, given its timing, this increase was probably in anticipation of the split announcement. The ex-date increase occurred immediately after the ex-date.

Further analysis was then conducted to determine whether the increases in trading volumes were associated with:

- an increase in trading frequency (i.e. an increase in the proportion of days within a period on which trade occurred); and/or
- an increase in total trading volumes.

The results of this analysis demonstrated that the announcement date was characterised by a significant increase in total volumes but no significant change in trading frequency. The period between the announcement and ex-date showed a decline in total volumes. The increase at the ex-date was characterised by a significant increase in both total volumes and in trading frequency.

These results were different to those from U.S. studies which tend to find a decrease in trading volumes following a share split. On closer examination there are certain similarities between the current findings and those from U.S. studies.

The increase in total trading volumes immediately prior to the announcement and the decline in total volumes in the period between the announcement date and the

ex-date are consistent with findings from U.S. markets. The only difference therefore appears to be the increase in trading volumes following the ex-date.

Yet even in terms of this increase similarities may be found as U.S. studies have noted an increase in the number of transactions following a share split. It appears from other evidence on the JSE that the change in trading frequency, identified in the current study, is related to an increase in the number of transactions and therefore is consistent with the change on U.S. markets.

The question is then why U.S. markets do not show a corresponding increase in total volumes even though they experience an increase in the number of transactions. In all probability the answer to this question lies in differences in the underlying levels of liquidity present on the markets prior to the split. In other words, the JSE is so thinly traded that a change in the number of transactions has a significant impact on total trading volumes as even small trading volumes may be significant when measured against the low base. Conversely, U.S. markets are already fully traded and therefore any increase in the number of transactions following a split does not lead to a significant increase in total volumes.

If the above hypothesis is correct, then the results are consistent with the hypothesis that the split results in an influx of smaller investors into the market as these investors could have the effect of increasing the number of transactions without causing a significant increase in total trading volumes. Such an influx may also account for the sustained increase in volatility noted after the ex-date of a split.

In summary, the present study finds that there is a sustained increase in trading volumes following a split. The study however, also suggests that the increase in liquidity conceals a number of separate effects - an increase in total trading volumes prior to the announcement date (which is followed by a decrease) and an increase in total trading volumes and in the frequency of trade following the ex-date. The conclusion drawn as to how a share split effects trading volumes therefore depends on considerations such as when that change is measured and on whether the effect of the split on smaller investors is considered. These considerations are the likely source of the conflict between the views of the market participants and the evidence from empirical studies.

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Chapter 1: Introduction

Share splits should have no economic effect as they merely divide the value of the firm into smaller units with no changes in cash flows or assets. Nevertheless, firms persist in splitting their shares and empirical studies have repeatedly shown that splits are associated with changes in value.

Changes in value may be seen in the positive returns around the split event or in increased return volatility. These changes are not only contradictory but they have not been adequately explained in the literature. The difficulty in formulating an explanation is that different answers may be found depending on whether the changes are measured around the announcement date or the ex-date (the date on which the split actually happens), and whether they are measured over short or long periods.

Traditional theories attribute these changes in value to changes in liquidity brought about by the split. These theories, while popular amongst market participants, have not found support in studies on U.S. markets which have tended to show that, contrary to expectations, liquidity worsens following a split. Despite its apparent simplicity the effects of a share split, both empirically and analytically, remains unclear and therefore a subject for further study. This is particularly relevant in South Africa where the fundamental changes brought about by a split have not been clarified.

Empirical work on share splits may be divided into three main areas:

- changes in returns;
- changes in volatility/risk; and
- changes in liquidity.

While liquidity has not been the subject of much empirical research the effects of a split appear to be inter-linked. Understanding the change in liquidity is therefore fundamental to understanding the causes behind the changes in both returns and volatility (this will be expanded upon later).

Of these, changes in returns have received the most attention both internationally and in studies based on the Johannesburg Stock Exchange ("the JSE"). The objective of this dissertation is to determine the effect of a share split on the liquidity of a share, as measured its trading activity.

This objective may be analysed into the following sub-objectives:

1. To determine based on the relevant literature, what the effects of a split are, how may they be explained and in what way are these effects and explanations inter-related.

2. To determine the role played by liquidity and how it is affected by a split.

3. Given the findings in the literature, to determine whether there is a change in liquidity following a split on the JSE.

This dissertation is organised as follows: In chapter 2 and 3 the available literature concerning the effect that a split has on returns and risk is reviewed. Chapter 4 examines the question of information and the models which attempt to explain the effects of a split. Finally, chapter 5 examines the change in liquidity itself. This circuitous approach is adopted as it is necessary to examine each effect in the context of the other effects to gain an understanding of their inter-relationship.

Given this holistic direction, the literature review will not merely provide an outline of the relevant literature, but will attempt to provide theoretical development to serve as a basis for the empirical work which follows.

The empirical work is set out is chapter 6 and measures the change in trading volumes across a number of periods set around the split event. The use of these periods allows the change in trading volumes to be measured with more precision than has been done previously. This in turn allows the changes in trading volume to be matched to the changes observed in returns and volatility. The timing of these changes then forms the basis for the conclusions in chapter 7.

Chapter 2: Changes in returns around a share split

1. Introduction

Empirical studies provide consistent evidence, supporting the commonly held view, that share splits are associated with positive returns. These returns fall within three distinct periods, namely the period prior to the announcement of the split, the period around the announcement and the period around the ex-date (the date on which the number of shares actually increases). These periods are often not clearly distinguished in the studies which is unfortunate as it adds to the confusion surrounding the effects of a split. Furthermore, the existence of distinct periods suggests the presence of different causes and hence different relationships between each period's returns and the split. This chapter will examine, by means of a review of the available literature, the behavior of returns in each of these three periods. It will also consider whether the returns in each period are caused by the split, or whether the returns have another source.

2. Changes in returns

Changes in returns may be measured in different ways depending on the nature of the study in which they are found. This makes comparison between the studies more complicated. For simplicity, the measures of returns may be divided into one of two categories:

Raw- Returns measured as the change in price from one period to the next, which may be adjusted for dividends.

Adjusted- Raw returns adjusted by a normal return. The normal return provides a benchmark. This benchmark may be an average of previous returns of the share or returns in the market, or may be risk adjusted (normally using a variation of the market model).

The comparison of returns across different studies is further complicated by the use, in some studies, of screens intended to counter the influence of simultaneous events. While the presence of such events, coinciding with the split, may influence returns it is important to note that different screens may themselves influence the results such that the correction of a distortion causes a distortion itself.

Studies of returns often include both share splits and share dividends. While similar in some respects, share dividends and share splits have a number of important differences, amongst these:

- share dividends are often declared in lieu of cash dividends and so impact on dividend signaling;
- share dividends reduce distributable reserves and hence affect future dividends; and
- share dividends may be recognised as accounting income by the recipient whereas share splits may not.

These differences suggest that share splits and share dividends have a different impact on returns which would influence the results obtained from a joint sample. Taking these complications into account the following sections explore the change in returns across each of the three periods.

3. Pre-announcement period

The pre-announcement period is the period prior to the announcement of a share split. As such, it is open ended and may stretch from weeks to years prior to the announcement. Figure 1 sets out the findings from a number of studies relating to returns over this period.

Figure 1: Findings on pre-announcement returns

Study	Measure used	Share splits / dividends	Result (returns)
Fama, Fischer, Jensen and Roll (1969)	Risk adjusted	Split	Positive
Asquith, Healy and Palepu (1989)	Market adjusted, risk adjusted	Split	Positive
Maloney and Mulerin (1992)	Raw	Split	Positive
Manan and Uliana (1994) (JSE)	Risk adjusted	Split	Positive

It is immediately noticeable from Figure 1 that all studies find positive returns in the pre-announcement period whether using the raw or risk adjusted measures.

As to the cause of these returns Fama, Fischer, Jensen and Roll (1969) suggest that they arise in anticipation of the split. The problem with this suggestion is that these

returns are observed up to two and a half years prior to the event when it is doubtful that even management had decided to undertake a split. Consequently, unless the market is clairvoyant, such an explanation seems unlikely. (The problems with this suggestion are dealt with in more detail in chapter 3, section 4.1.)

A more plausible explanation is that the pre-announcement returns are driven by growth in the splitting firm's earnings. Consistent with this explanation is evidence that the largest increases in returns and earnings coincide in the year immediately preceding the split (Lakonishok and Lev (1987)). This not only makes it unlikely that the split is the cause of the pre-announcement returns, but also suggests that the reverse may be true. Specifically, that the split is caused by the pre-announcement returns as management uses the split to adjust the share price to "normal" levels following a period of substantial equity appreciation.

4. At announcement

The announcement period falls immediately around the announcement date itself and differs from the pre-announcement period in that it is usually restricted to a few days. The results from studies of returns over this period are set out in Figure 2.

Figure 2: Findings on announcement returns

Study	Measure used	Screened	Share splits / dividends	Result (returns)
Grinblatt, Masulis and Titman (1984)	Mean adjusted	Yes	Both	Positive
Lamoureux and Poon (1984)	Risk adjusted (market model)	Yes	Split	Positive
Asquith, Healy and Palepu (1989)	Market adjusted, risk adjusted	Yes	Split	Positive
Biger and Page (1992) (JSE)	Risk adjusted, market adjusted	No	Split	Positive
Maloney and Mulherin (1992)	Raw	No	Split	Positive

Again all studies are consistent and find that the split announcement is associated with positive returns. It is interesting that screening the sample for simultaneous events does not change this finding. Asquith, Healy and Palepu for example found that the full sample showed a mean market adjusted return of 3.7% for the two days round the announcement (with 76% of the sample having positive returns), while the

screened sample had a return of 4.4 % (with 78% of the sample having positive returns).

The most common explanation advanced by the literature is that these announcement returns are due to a revision in expectations resulting from information conveyed by the split. This possibility is the subject of chapter 3, *Information Based Models*.

5. At the ex-date

The ex-date period falls immediately around the ex-date of a split and as with the announcement period is typically restricted to a few days. The results from studies covering this period are set out in Figure 3.

Figure 3: Findings on ex-date returns

Study	Measure used	Screened	Share splits / dividends	Result (returns)
Grinblatt, Masulis and Titman (1984)	Mean adjusted	Yes	Both	Positive
Lamoureux and Poon (1984)	Risk adjusted (market model)	Yes	Split	Positive
Asquith, Healy and Palepu (1989)	Market adjusted, risk adjusted	Yes	Split	Positive
Biger and Page (1992)	Risk adjusted, market adjusted	No	Split	Not significant
Maloney and Mulherin (1992)	Raw	No	Split	Positive
Kryanowski and Zhang (1993)	Market and risk adjusted	Yes	Split	Positive
Kryanowski and Zhang (1993)	ARCH process (see below)	Yes	Split	Not significant

As can be seen in Figure 3, the group of studies around the ex-date generally show positive returns but contain two exceptions.

The first relates to work done by Biger and Page on the JSE. Considering that they made use of a standard methodology the source of their different finding appears to lie in differences which exist between the JSE and U.S. markets. The only other study which was based on a non-U.S. market was by Kryanowski and Zhang but

even this study found that positive returns accompanied the ex-date when using a standard methodology.

However, when Kryanowski and Zhang applied a different methodology they found that the positive returns were no longer apparent. The basis for this alternative methodology was evidence which they cited showing that the Ordinary Least Squares ("OLS") models, such as the market model which was used in their first result, were sensitive to the presence of heteroscedasticity. Heteroscedasticity exists where the variance of the error terms in the OLS model is not constant. The result is that the OLS estimation process places more weight on the observations with larger error variances than on those with smaller error variances. Consequently, the variances of the estimated parameters are not the minimum variances.

To compensate for this an alternative model, based on an Auto Regressive Conditional Heteroscedastic (ARCH) process, was used which allowed "the conditional variances of the market model error terms to change over time as a function of past error terms, the squared relative bid-ask spread and/or raw trading volume, and to change to a new regime on the split ex-dates" (page 79). So by taking into account the effect on volatility of the increased bid-ask spread and trading volume following the split, they could determine whether there was a true increase in returns, or whether the observed increase was due to estimation problems.

Their findings suggested that the ex-date return observed under the OLS models was due to a change in the share characteristics such as volatility and bid-ask spread. Of these the change in the bid-ask spread following a split has been identified by other studies as a possible source of the ex-date returns and is the subject of the following section.

5.1. Microstructure effects

The closing price, against which changes in returns are measured, is sampled from a distribution of possible closing prices. As the closing price typically falls within the bid-ask spread, the spread is often seen as a proxy for this distribution. The mean of this distribution (which is assumed to be equivalent to the mid-point of the spread) is seen as the equilibrium price and it is expected that the closing price will fall randomly around this price. It follows that a change in price and hence returns would occur when there is a shift in the entire distribution or spread over the measurement period.

Yet returns may also be observed under other circumstances. For example, a return may be observed where the distribution becomes skewed causing the mean of the distribution to change i.e. the mean of the distribution changes but its median has remains constant. The return would then not be caused by a movement in the entire distribution but by a change in the shape of the distribution. In terms of the spread this may be seen as a clustering of orders at either extreme of the spread possibly leading to an asymmetric widening of the spread towards either the bid or the ask quote.

Such effects have been identified as the cause of the apparent arbitrage opportunities in options markets, and the year-end and day-of-the-week seasonality in share returns (Lease, Masulis and Page (1991), Phillips and Smith (1980), Keim (1989), Porter (1989)). These effects, caused by movements in and within the spread are referred to as microstructure effects.

The importance of these effects is highlighted by Lease, Masulis and Page (1991) (page 1535) as follows: "Our analysis indicates that when systematic order flow imbalances are anticipated, due to institutional or regulatory influences, or due to shifts in aggregate demand or supply, average event day stock returns can be significantly biased. Also, when information releases trigger a preponderance of buy or sell orders, average stock reactions can be exaggerated by the effects of the bid-ask spreads.".

It appears from work done by Maloney and Mulerin (1992) that the returns observed at the ex-date may be due to similar effects. To establish whether this was the case they tested whether the closing prices congregated at the mid-point of the spread as was expected or whether they moved towards the ask quote, particularly around the ex-date. To do this they used an order flow balance or ratio calculated as follows:

$$\frac{\text{Closing Ask Quote - Closing Transaction Price}}{\text{Closing Ask Quote - Closing Bid Quote}}$$

For any given share, a ratio equal to zero would mean that the closing transaction price was at the closing ask quote. If the closing price was at the bid quote then the ratio would be equal to 1. When averaged across all firms it was expected that the ratio should be around 0.5, indicating that shares traded at the mid-point of the bid-ask spread.

When this was used for their sample of share splits they found that up until 20 days before execution the average order flow ratio was 0.511 (not significantly different from the expectation of 0.5). However, from 10 days before the ex-date the ratio dropped significantly indicating a relatively large number of trades near the ask

quote. This lower ratio persisted for 20 days after the ex-date. This provided a clear indication that closing prices were clustering at the ask quote.

Maloney and Mulerin then went further and examined the movements in the quotes themselves by comparing the returns calculated separately on the bid and the ask. They argued that if the bid and ask moved in tandem then the returns based on either quote should be similar. Any significant difference in the returns would indicate a change in the symmetry of the spread.

They found that the movements in the two returns were similar across the announcement date. However, for the three days around the ex-date the return calculated on the ask quote was significantly higher (2% compared to only 0.6% for the bid), and persisted for 10 days afterwards.

This indicated that the ex-date return was due to a widening of the spread which was probably due to an imbalance of orders.

6. Summary

A split is associated with positive returns. Yet it is important to identify that there are distinct sets of returns as each seems to relate to a different cause. The pre-announcement return appears to be due to an increase in earnings following similar growth in the splitting firm's industry. The returns observed at the announcement date appears to be due to information conveyed by the split, though the nature of this information is uncertain (the nature of this information is dealt with in more detail in the following chapter). Finally, the returns at the ex-date appear to relate to microstructure effects relating to changes in and within the bid-ask spread. This is summarised in the following table.

Figure 4: Summary of findings on changes in returns

Period	Return	Probably attributable to
Pre-announcement	Positive	Earnings growth which may be observed across the entire industry
Announcement	Positive	Information conveyed by the split
Ex-date	Positive	Microstructure effects

Chapter 3: Information based models

1. Introduction

The positive returns observed at the announcement of a share split are normally attributed to positive information which the split conveys. The difficulty is in identifying the nature of this information.

It could be argued that a split conveys information concerning improved liquidity, which is consistent with management's stated motivation for undertaking a split (Baker and Gallagher (1980), NYSE (1980)). Yet most of the information based models discussed in this chapter have evolved in the light of evidence that liquidity actually worsens following a split, which implies that the announcement return must be related to other information (Copeland (1979), Lamoureux and Poon (1987), Lakonishok and Lev (1987), Conroy, Harris and Benet (1990)).

This chapter will examine whether the announcement of a split carries information other than the potential improvement in liquidity. In doing so it will need to answer the following questions:

- does the split convey any information;
- is the information conveyed as a deliberate signal from management;
- what is the nature of the information; and
- can management adjust its level or intensity.

2. The presence of information

The first question concerns whether the split conveys any information. In order to recognise information it is necessary to understand how information impacts on the market, firstly at an investor level and then on the market in aggregate.

When new information arrives an investor must evaluate:

- what courses of action he may take, and
- their likely outcomes.

The range of likely outcomes constitutes the information structure or outcome probability distribution for that investor. This structure is not static, and the arrival of any new information, previously unincorporated by the investor, will cause it to change. A new structure is then formed which is a combination of the previous structure and the information received, and based on this the investor will act appropriately in order to maximise his expected utility.

As the market is a collection of individual investors it may be assumed that the market's information structure is a composite of the information structures of all its individual investors. Therefore, if the arrival of information results in portfolio changes at an investor level, the effect of these changes may be recognised at an aggregate level by the changes they bring about in the share's characteristics, such as its returns or trading volumes.

This principle was applied by Beaver (1968) in developing two separate measures which he used to determine whether an event was informationally significant. These measures were the "Trading Volume Activity" ("TVA") and the share's "Security Return Variability" ("SRV").

The TVA measured the change in the relative trading volume around the event:

$$TVA = \frac{\text{Number of shares of firm traded at a point in time (t)}}{\text{Number of shares of firm outstanding at a point in time (t)}}$$

The SRV measured the change in abnormal returns around the event:

$$SRV = \frac{\text{The abnormal return of that security at a point in time (t)}}{\text{The volatility of the returns in a non-announcement period (t-x)}}$$

When applying these measures to earnings announcements, Beaver found that there was a dramatic increase in both the Trading Volume Activity (33%) and Security Return Variability (67%) during the announcement week, which he interpreted as confirming the presence of information. These results have been confirmed by other researchers including Foster (1981) and Firth (1981).

Studies of share splits, in which these characteristics have been examined, have noted changes in both returns (chapter 2) and trading volumes (chapter 5). This evidence indicates that the split is an informational event, but provides no indication as to the nature of the information conveyed.

3. Deliberate and unintentional signal

Given that information is conveyed the next question is whether management deliberately intended the split as a signal or whether the information was an unintentional by-product of the splitting process. For a split to be a deliberate signal it would need to meet the following requirements (Grinblatt, Masulis and Titman (1984))

- management must have a motivation to send the signal;
- management must have information to convey; and
- some barrier should prevent other firms from mimicking the signal and achieving the same positive results.

As outlined in the introduction to this chapter the first requirement is the most difficult to satisfy as the surveys by Baker and Gallagher (1980) and the NYSE (1980) have shown that managers undertake splits to improve liquidity. Therefore, a signaling model where management undertakes a split for reasons other than liquidity contradicts this stated intention[1] . None of the signaling models address this problem directly as they start from the premise, supported by empirical evidence, that liquidity actually worsens following the split. From here, the inevitable conclusion is drawn that the information conveyed cannot be concerned with improved liquidity.

This represents a serious shortcoming in the deliberate signaling model but the remainder of this chapter will continue on the basis that a share split meets this requirement.

The next requirement, concerning the existence of asymmetric information, may be more easily addressed. Asymmetric information may exist prior to the split as management is privy to company facts of the market is unaware of. Alternatively, the information conveyed may not necessarily be tangible but may concern management's beliefs which have not been previously communicated to the market. In both cases management would have information to impart to the market.

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[1] This assumes that management's attitudes have not changed over the long period since these studies were conducted. Such a change may well have occurred, particularly in light of the contradictory evidence, discussed above, which showed that trading volumes declined following a split. In the absence of direct evidence to the contrary however, the findings of Baker and Gallagher's and the NYSE's studies are assumed to have remained valid.

The final requirement states that if the signal is being sent to elicit a positive effect some barrier is needed to prevent other firms from mimicking the signal and gaining the same positive effect for themselves. In identifying this barrier, signaling models conveniently point to the evidence of lower post-split liquidity and argue that as management knows that a split would result in lower liquidity, only those with positive information would willingly undertake a split (Grinblatt, Masulis and Titman (1984), McNichols and Dravid (1990)). The problem once again is that this is contrary to management's stated intention.

Alternatively, signaling models identify the barrier as management reputation (Heinkel (1984)). This model holds that management relays information to the market based on their reputation and standing, which not only depends on their position in the organisation but also on the quality of the information they have relayed in the past. A false signal would risk their reputation and thereby lessen their ability to relay information in the future.

Finally, the assumption that other firms would be able to mimic the signal ignores the fact that the market reaction depends not only on the signal but also on the market's pre-existing expectations. Where a signal is inappropriate in the context of these expectations a positive reaction would not result. In the case of a split, the appropriate expectations may be related to any number of characteristics, including the growth in earnings and returns in the pre-announcement period. If the positive returns at the announcement of a split are dependent on these characteristics, their absence would serve as a barrier preventing the signal from being mimicked by other firms.

On these grounds, the relevant literature holds that the split is a deliberate signal. There do appear to be some problems with this view particularly regarding management's intentions, but these problems have so far not been addressed.

Even if a split was to fail in terms of the requirements for a deliberate signal it is still possible that it may serve as an unintentional signal. This possibility could accommodate the problem of management's intention, as an unintentional signal would allow a dichotomy to exist between management's' intentions and the market's interpretation. For example, the market may interpret the split as a transaction which may, or may not, improve liquidity, but which management would only undertake if they felt confident about the firm's prospects. Management's confidence is conveyed through its choice of transaction and it is this choice which constitutes the signal.

Another possibility is referred to as the attention hypothesis (Grinblatt, Masulis and Titman (1984)). This holds that the announcement of a split increases interest in the

share. Assuming positive information had been previously unappreciated by the market, the increased interest could bring the information to the market's attention and prompt investors to reassess the share resulting in a positive revision in its price. The split would then not introduce information into the market but instead would allow existing information to be more widely appreciated.

4. Nature of the information conveyed

The third question concerns the nature of the information conveyed. This question will be answered by reviewing the relevant literature dealing with the signaling models themselves. In the main, these models view the split as a signal of either:

- increases in future or near term dividends;
- changes in earnings (either increases in future or near term earnings or the continuance of pre-split earnings).

4.1. Increases in future or near term dividends

Fama, Fischer, Jensen and Roll (1969) were the first to introduce a signaling model with regard to share splits. They proposed that the returns observed in the pre-announcement period were due to revised expectations of near term dividend increases.

Using data from 940 splits over the period from 1927 to 1959 they calculated the cumulative abnormal returns for 60 months around the split announcement date. This revealed a steady increase over the 30 months up to the split announcement, following which the cumulative abnormal returns remained constant. Fama, Fischer, Jensen and Roll interpreted this as showing that the growth in abnormal returns was in anticipation of the split, and so continued up to the point when the split was announced; hence, the abnormal returns were caused by the share split, or more particularly by the information it conveyed.

They then linked the information conveyed to near term dividend increases. This link was established by dividing the splits into those which had experienced post-split dividend increases above the market average (71.5% of the firms), as opposed to those which had not. In the group where the post-split dividends were below the market average the pre-announcement abnormal returns reversed by the end of the

first post-split year, whereas the returns for the group with increases in dividends above those for the market did not.

In effect, this model rests on two premises: first, that there are significant increases in dividends following the split and second, that these are the cause of the abnormal pre-announcement returns.

The first premise was confirmed in a later study by Lakonishok and Lev (1987). Using a sample of 1015 split events drawn over a 20 year period they matched each firm in the sample group with another firm of similar size which operated in the same industry. When they compared the dividend growth of the two groups they found that following the split:

- the growth in dividends in the post-split period tended to be significantly higher for the splitting group than for the control group (the splitting group outperforming the control group by 13.25% over the five years after the split), and
- the largest increase in dividends for the splitting group was during the first quarter after the split where dividends increased by 7.4% compared to no growth for the control group.

While this confirms the first premise, the second premise, linking these dividend increases to the pre-announcement abnormal returns, is more difficult to support. Fama, Fischer Jensen and Roll's test is indirect and merely shows that a firm experiences negative abnormal returns where its dividend growth is below that of the market.

Their use of pre-announcement returns also raises a number of problems. Firstly, it seems unlikely that the market would anticipate or assign value to an event two and a half years into the future. Secondly, the assumption that the split causes the pre-announcement returns ignores the possibility that the split is the outcome of those returns i.e. management undertakes the split to adjust for the increase in the share price prior to the split. Thirdly, it ignores evidence that the pre-announcement returns are caused by increases in earnings (Lakonishok and Lev (1987), Asquith, Healy and Palepu (1989)). These earnings are not firm specific and are observed across each firm's industry which again weighs against the possibility that the split has any causal role.

While this excludes the pre-announcement returns, it is still possible that the announcement return itself may be related to near term dividend increases. This possibility however, has not found support in more recent studies of share splits.

Grinblatt, Masulis and Titman (1984) found that of a subsample of 176 share splits, where the firms did not pay a cash dividend in the three years prior to the split, only 11% initiated a cash dividend in the year after the split. These non dividend paying firms, however, still experienced abnormal announcement returns which led the authors to conclude that these returns could not be explained by forecasts of near term increases in dividends.

Similar results were obtained by Asquith, Healy and Palepu (1989). Of their sample of 121 non dividend paying firms only 40 initiated a dividend after the split and only 11 of those within the first post-split year (which was a similar ratio to dividend initiations across the market as a whole). Despite this, the pattern of returns was similar to that experienced by the dividend paying firms which again suggested that dividends were not the driving force behind the announcement returns.

4.2. Changes in earnings

As with increases in near term dividends, Lakonishok and Lev (1987) studied the pattern of earnings changes around the share split. Their findings can be summarised as follows:

Before the split.

- Over the four years prior to the split both the median and mean earnings growth rates were significantly higher for the splitting group than for the control group.
- The difference between the growth rates widened closer to the announcement date from 5.8% four years prior to the split to 12.4% one year prior to the split.
- The mean growth rate for the splitting group was significantly higher than its median growth rate which suggested that the splitting group contained some exceptional performers.

After the split.

- The differential between growth rates persisted for the first year after the share split, though the differential was smaller than in the years before the split. The differential was not statistically significant over the next three years (whereas the higher differential for dividend growth was significant).

- The difference between the mean and median growth rates disappeared by the second year after the split suggesting that the splitting group no longer contained any exceptional performers.

This pattern of earnings was confirmed by Asquith, Healy and Palepu (1989) who determined that the mean earnings changes were significant and positive in the four years prior to the split with the largest increase occurring the year immediately prior to the split. After the split the earnings increased for the first year but then remained constant relative to the market.

This pattern of earnings suggests two possibilities. First, the announcement return is related to the post-split increase in earnings. These increases may not be as large as the increases in pre-split earnings or post-split dividends, but they may not have been anticipated by the market and so could have informational value. Second, the announcement return is related to the larger increase in pre-split earnings, particularly in the year immediately prior to the split.

4.2.1. Post-split earnings

The possibility that the increase in post-split earnings was signaled by the split was investigated by Asquith, Healy and Palepu (1989). They selected a sample of share splits, with split factors greater than 25%, covering the period from 1970 to 1980, excluding shares which had paid a cash dividend immediately prior to or at the announcement date. They then tested whether there was a cross-sectional relationship between the announcement returns, measured by the market adjusted return at the announcement date, and the change in post-split earnings using both the Pearson and Spearman correlation coefficients.

This revealed that no relationship existed between the announcement return and the post-split earnings changes. Instead the correlation coefficients were only significant for the two years prior to the announcement suggesting that announcement returns were related to pre-split earnings.

Different results however, were obtained by McNichols and Dravid (1990) who also examined the relationship between the announcement return and future earnings. Whereas Asquith, Healy and Palepu (1989) found no correlation McNichols and Dravid found that the announcement returns and post-split earnings were correlated. The different results provided by these studies may be ascribed to a number of methodological differences, including use by McNichols and Dravid of unexpected earnings (the change in raw earnings adjusted by the change in earnings predicted by market analysts), and the inclusion of both share splits and share dividends in their sample.

McNichols and Dravid went on to concede that their evidence was weak and that it appeared that other attributes were also signaled by the split. Considering this and considering the contrary finding by Asquith, Healy and Palepu it appears that the future earnings model is at best incomplete.

4.2.2. *Pre-split earnings*

The second possibility is that the announcement return is linked to pre-split earnings. The problem with this possibility is that by definition a signal must convey information that is not known to the market which would seem to disqualify pre-split earnings. To solve this problem an assumption can be made that shareholders expect the pre-split earnings to reverse in which case the split could then serve as a signal contradicting this expectation.

The assumption that investors expect earnings to reverse is based on findings from two separate sets of studies. The first shows that firms which undertake share splits experience large increases in earnings prior to the split (Lakonishok and Lev (1987) Asquith, Healy and Palepu (1989)). The second shows that large earnings increases tend to be transitory and are usually followed by large earnings decreases (Brooks and Buckmaster (1980), Beaver, Lambert and Morse (1980) and Freeman, Ohlson and Penman (1982)).

Based on the assumption that the pre-split earnings will reverse Asquith, Healy and Palepu's model proposed the following:

> firms experience above average earnings growth over a number of years which results in an increase in the share price as these earnings are capitalised. Because of the unusually large growth in earnings investors are uncertain as to their durability and discount them more heavily. Managers become aware of this and attempt to remedy the situation through a share

split. The shareholders then interpret the split as a positive signal by management and revise their expectations as to the durability of these earnings.

To establish the validity of this reasoning Asquith, Healy and Palepu had to consider whether:

1. there was a positive relationship between the size of the announcement return and the size of the pre-split earnings increases, and

2. the relation between the annual abnormal returns and the contemporaneous earnings changes was lower than normal in years prior to the split. In other words, the market does not incorporate changes in earnings to the same degree as it did in "normal" times. This rests on work done by Ball and Brown (1968) and Beaver et al (1980) which indicated that there is a positive relationship between unexpected returns and contemporaneous earnings changes.

The first point was confirmed by Asquith, Healy and Palepu (1989) who found a positive cross sectional relationship between the announcement return and earnings increases in the two years prior to the split using both the Pearson and Spearman correlation coefficients. This was also supported by the results of a regression of the announcement return against the earnings changes over the two years prior to the split which showed that the regression coefficients were significant.

The second point, concerning the decline in pre-split earnings elasticity, was tested by measuring the coefficient of the abnormal returns, calculated on a yearly basis by the excess of the firm's returns over a weighted market index, to earnings changes around the split announcement. In terms of their hypothesis, this coefficient should have been negative in years which experienced large earnings increases showing that these increases did not have as positive an effect on the share price as increases in normal years. Consistent with this they found that the coefficient was significantly positive in normal years while it was significantly negative in the two years prior to the announcement.

Corroborating evidence was provided by Lakonishok and Lev (1987) who compared the price to earnings ratio ("P/E") for a sample of share splits to a control group. As with Asquith, Healy and Palepu's test, a lower P/E in the years prior to the split would imply that the market was being more cautious in capitalising the splitting firm's earnings. Consistent with this they found that the average pre-split P/E for the splitting group was 12.67 compared to 13.19 for the control group. This difference

was significant but only at a level of 15% using a two-tailed t-test. After the share split the gap between the average P/E ratios disappeared suggesting that the market was no longer as cautious.

While this evidence supports the pre-split earnings model, it should be remembered that this model rests on the unproved assumption that investors hold negative expectations regarding the durability of earnings increases prior to the split. Although studies support the contention that large earnings increases are transitory, this does not necessarily mean that managers or investors hold this view.

Furthermore, their suggestion that managers undertake the split to confirm the durability of earnings contradicts the findings, mentioned earlier, that the split is undertaken to improve liquidity. The evidence of declining earnings elasticity could also be interpreted by managers as characteristic of a decline in liquidity, thus prompting them to undertake the split for their stated reasons. Asquith, Healy and Palepu's evidence may therefore, equally support the liquidity model.

5. Information and intensity

In all of the models presented above managers are unable to adjust the intensity of the signal. The signal is the split announcement and once it occurs the share price adjusts by an inherently predetermined amount. In Asquith, Healy and Palepu's (1989) model for example, the adjustment is related to a pre-existing level of disbelief as to the sustainability of pre-split earnings: the more disbelief the greater the adjustment. There is no scope in such a model for managers to signal how confident they feel about the firm's prospects as their action is limited to a binary choice of whether to split or not.

For managers to have control over their signal a more intricate model is needed, one which allows for an explicit signaling mechanism. This section will focus on the fourth question namely, how this mechanism could operate.

5.1. Signaling equilibrium

The only formal application of such a model was presented by McNichols and Dravid (1990) in which managers could adjust the intensity of their signal by changing the size of their split factor. They assumed that as trading costs were inversely related to

the share price[2], larger split factors would result in relatively higher costs for investors. They further assumed that managers and investors knew this, and so managers would only choose to impose these higher costs if they had more positive information to convey. This trade-off would then allow investors to make inferences as to the strength of management's private information, and to respond appropriately.

Stated more formally, the existence of an information/cost trade-off achieves a signaling equilibrium which McNichols and Dravid describe as follows:

- The level of the signal (the split factor) corresponds to the "unobservable attribute" (usually defined as future dividends or earnings).
- Shareholders infer the level of the unobservable attribute from the level of the signal (the split factor).
- The combination of the two previous points results in the shareholders' beliefs corresponding to the level of the attribute.

Unlike the other models discussed investors aren't responding directly to the unobservable attribute but rather to management's assessment of it.

5.1.1. Evidence

In order to support this equilibrium model McNichols and Dravid set about to measure its component parts and the relationship between them.

First, the unobservable attribute was defined as the unexpected future earnings i.e. those earnings which had not been anticipated by the market and could therefore be

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[2] Evidence discussed in chapter 5 shows that lower share prices are associated with wider bid-ask spreads. Consistent with this evidence shows that the bid-ask spread is relatively wider following a share split. Consequently, the assertion is made that a larger split factor leads to a relatively larger spread and hence a relatively higher liquidity cost. Other studies, also discussed in chapter 5, hold that direct trading costs such as brokerage commissions are lower as a percentage of the value traded for higher priced shares. A larger split factor, which causes a larger decrease in the absolute price of the share, would therefore cause the relative size of these costs to increase.

signaled. These were calculated by subtracting the market analysts' forecasts of earnings from the actual earnings achieved after the split.

Next, the level of the signal was defined as the unexplained split factor. They held that the split factor could be influenced by a number of characteristics including the size of the firm and its absolute share price. Only once these possible influences were removed could the unexplained split factor, which related to the unobservable attribute (the future earnings), be identified.

5.1.2. Findings

They found that the split factor was correlated with the unexpected earnings, implying that managers did adjust the split factor for private information concerning future earnings. They admitted though, that this evidence was weak as the other possible factors such as the size of the firm and its absolute share price were far stronger in explaining the choice of split factor.

They then found a strong correlation between the signal (as measured by the unexplained split factor) and the abnormal announcement return. This was interpreted as showing that investors did base their revisions of firm value on the level of the signal provided by the unexplained split factor.

Finally, they found that while the announcement return was correlated to unexpected future earnings it appeared that other attributes were also signaled. Consequently, the signaling explanation of the abnormal announcement returns was incomplete.

5.2. Normal trading range

Another possible signaling mechanism involves the concept of a normal or ideal trading range. In concept this model holds that managers use the split to return the share price to the normal range and send a signal by choosing where they place the post-split share price relative to the normal range. If managers expect above average growth it is assumed they would choose a price near the bottom of or below the normal range thereby allowing for this growth. Alternatively, if managers expect average growth it is assumed they would choose a price near the mid-point of the normal range. Investors would notice this and interpret the signal accordingly.

The greatest difficulty is in actually defining the normal range for a share. At best it is a concept broadly understood by both managers and investors. It would be over

optimistic to assume that were able to distinguish where the normal range should be well enough to be able to adjust and interpret the strength of a signal based on it.

6. Conclusion

This chapter set out to answer the following questions as to whether a share split is a signal:

- does the split convey any information;
- is the information conveyed as a deliberate signal from management;
- what is the nature of the information; and
- can management adjust its level or intensity.

In answer to the first question, it appears, from the literature, that a split does convey information.

In answer to the second question, as to whether a split constitutes a deliberate signal of information other than liquidity, it seems unlikely as the split does not meet the requirement regarding management's motivation. Management undertakes the split to improve liquidity. The fact that a number of empirical studies have shown that liquidity worsens after a split cannot change this.

In answer to the third question, it appears that if the split is a deliberate signal of information other than liquidity then the information conveyed concerns either future dividends or earnings (be they the increase in future earnings or the continuance of pre-split earnings). Of these, the continuance of pre-split earnings appears to have the strongest support.

The answer to the fourth question remains uncertain as, in theory, it is possible for management to adjust the intensity of the information conveyed but this has so far remained unproved. Most models view the announcement return solely as an outcome of the market's existing expectations and do not allow for an adjustment to the intensity of the signal.

These questions and their answers are summarised in Figure 5 below.

Figure 5: Summary of questions regarding information based models

Question	Answer	Reason
Does the split convey any information	Yes	The announcement reaction is consistent with those observed at other informational events.
Is the information conveyed as a deliberate signal from management	No	For the split to be a deliberate signal management must have a motivation to send the signal, it must have information to convey and a barrier is needed to prevent other firms from mimicking the signal. Of these the split fails in that management's stated motivation is to improve liquidity and not to signal other information.
What is the nature of the information	Pre-split earnings	The information could concern dividends or changes in pre or post-split earnings. It is difficult to prove these models as they attempt to infer the nature of information from the change in share characteristics such as returns or earnings elasticity. On balance though it would appear that the information would relate to pre-split increases in earnings.
Can management adjust its level or intensity	Maybe	In theory it would be possible for management to adjust the intensity of the information. Given its intricate nature such a signaling mechanism is difficult to prove.

Chapter 4: Share splits and risk

1. Introduction

As with returns, risk should be unaffected by a split as it has no impact on the firm's underlying operations and cash flows. Evidence however, suggests otherwise as measures of risk based on the volatility of share price returns consistently show significant increases after share splits.

This chapter will start by examining the increase in volatility following a split, as documented in the relevant studies. It will then assess the evidence as to whether this represents a distortion in the measurement process or whether it represents a genuine increase in volatility. Assuming that there is a genuine increase in volatility it will attempt to determine its source. It will then consider the possible link between any genuine increase in volatility and the positive returns which accompany a split to determine whether they are related. Finally, it will examine the change in systematic risk following a split.

2. Changes in volatility

Ohlson and Penman (1984) found discrete increases in volatility at both the announcement and ex-date of a share split. The increase at the announcement, while substantial, proved to be temporary and the volatility soon settled back to pre-announcement levels. The increase at the ex-date on the other hand, proved more lasting and persisted for more than a year after the split. The authors were surprised at both the size and duration of the increase as the ex-date was not considered to be an informationally significant event.

This pattern however, has been confirmed by other researchers including Dubofsky (1991), Lamoureux and Poon (1987), Dravid (1987), Sheikh (1989), Conroy, Harris and Benet (1990), and Biger and Page (1992). Of these, Dubofsky, Dravid and Sheikh followed Ohlson and Penman and used a cross sectional measure to track the volatility for each day across the split period and were thus able to confirm that there was a persistent increase in volatility on the ex-date. The others, including Biger and Page in South Africa, compared a period before and after the split, and so, while they confirmed the increased volatility, they were unable to confirm whether there was a persistent increase and whether this increase occurred at the ex-date.

In addition to these studies, which measured the change in volatility directly, Sheikh (1989) used quoted call option prices and a standard call option pricing formula to calculate the implied standard deviations "ISD's". He then compared the ISD's for each share in his splitting sample to those for a control group to determine whether the split resulted in an increase in volatility and whether the options market recognised this increase at the announcement or ex-date. As with findings from the direct measures of volatility he confirmed that there was a persistent increase in volatility and that this increase occurred on the ex-date.

3. Causes of increased volatility

Having established that there is an increase in volatility the next question concerns its cause. One possibility suggested by a number of researchers including Ohlson and Penman (1984) and Dubofsky (1991), is that the increase in measured volatility does not represent an actual change in risk but represents a distortion in the measurement process following the sudden change in the share price. Another possibility is that there is a genuine increase in volatility as the result of circumstances brought about by the share split.

These two groups of possible sources of the increased volatility, while independent, are not mutually exclusive. The sources of the increased volatility may therefore be represented as follows:

Increased Volatility	=	**Possible measurement effects**	+	**Genuine increase in volatility**

The next sections will examine these two groups of possibilities in more detail.

4. Possible measurement effects

The first possibility is that the increase in volatility is the outcome of measurement effects. Ohlson and Penman (1984), who were the first to identify the increase in volatility following the ex-date, identified no less than seven potential statistical problems which may have distorted their results. These included the possibilities that:

1. their results were distorted by a few outliers;

2. their results were distorted by general secular trends and/or cyclical calendar time trends;

3. their z-statistic (used to measure the significance of their matched 'cincmia' statistic) was significantly overstated due to non-independence;

4. volatilities were temporarily low in the period between the announcement and the ex-date;

5. the variances in the post-split period were temporarily high;

6. the effect of the split on the volatility obscures an effect on the mean return; or

7. their results were distorted by measurement effects relating to discreteness in price changes and possibly the bid-ask spread.

Their subsequent tests led them to conclude that their findings were robust as regards all of these potential problems, except for the last where they conceded that measurement effects could have accounted for part of the increase in volatility.

These effects are the subject of this section, which begins by identifying the nature of the possible measurement effects including the discreteness of price changes and the bid-ask spread, then examines the related literature to determine whether such measurement effects are present.

4.1. Price changes

The sensitivity of a share's volatility to the absolute price of the share rests on the assumption that a share changes price in discrete multiples or increments. An increase in volatility following a split could result if these increments did not fully adjust to the change in share price leaving them relatively higher. For example: a R10 share which changed price in increments of 10c (1%), would after a 10:1 split, change price in increments of say 2c (2%). The same information which would have resulted in a 1% price change would then result in a 2% price change, which would be measured as an increase in volatility.

It has been suggested that a similar effect may exaggerate volatility on the NYSE which trades in 8ths and not decimals (Ohlson and Penman (1984), Dubofsky (1991)). This would particularly apply to lower priced shares where the difference in

the change increment (1.125c as opposed to 1c on a decimal exchange) may be significant.

4.2. Bid-ask spread

The measurement of volatility may also be sensitive to the bid-ask spread which has been shown to widen following a split (Copeland (1979), Conroy, Harris and Benet (1990), Maloney and Mulerin (1992)).

Changes in price (and hence volatility) are not measured against the equilibrium or true price of a share but are instead measured against an estimate of the equilibrium price such as the closing price. The closing price is in turn sampled from a distribution with a variance which may be proxied by the bid-ask spread. As the spread widens the implication is that the variance of this distribution increases causing an increase in measured volatility. Had volatility been measured against the true or equilibrium price however, an increase in volatility might not have been observed. It is only the estimate of the equilibrium price (i.e. the closing price) which has become more volatile and consequently the observed increase in volatility does not represent a genuine increase in risk.

4.3. Empirical evidence

Considering the magnitude of the increase in volatility, Ohlson and Penman were skeptical that measurement effects were responsible. Furthermore, they considered that their use of the paired binomial test was conservative and should not have been distorted by such effects. Despite their skepticism they performed additional tests to determine whether such distortions were present.

In the first of these tests they stratified their sample in terms of their post-split share price. They argued that as any measurement effects would be larger relative to the lower priced shares and so lower priced shares would include a higher proportion of shares with increased volatility. When they performed the test they found that this was not the case which suggested that measurement effects were not responsible for the increase in volatility.

In the second of these tests they argued that any measurement effects should be more exaggerated over shorter measurement intervals such as a day, and less exaggerated over longer intervals. Therefore, if measurement effects were present, the volatility measured over daily intervals would exceed that measured over weekly

intervals. To test this they compared the results from their original test using daily intervals to results from weekly and monthly intervals. They found that the results were weaker when measured over the longer intervals but that they were still significant. Based on the results of this second test they conceded that measurement effects were present but that they did not provide a complete explanation for the increase in volatility.

Dubofsky (1991) also examined the change in volatility following a split but started from the position that by comparing the results from AMEX and the NYSE he would be able to identify the factors which caused the increase in the post-split volatility. He suggested that if the different exchanges exhibited differing changes in volatility then the difference would be attributable to one or more of the following characteristics:

- Attributes of the share or company. Shares listed on AMEX tend to have lower share prices and market capitalisations than shares listed on the NYSE. These differences may influence volatility directly or through their link to trading volumes and the bid-ask spread.

- Specialist behaviour. The behaviour of specialists may be due to undefined structural factors or due to differing rules by which the exchanges operate.

- Ownership clientele factors. Trading on the NYSE is dominated by institutions while this is not so for AMEX. This together with differences in trading volumes and orders flows may also lead to differences in volatility.

Using a methodology similar to that employed by Ohlson and Penman, Dubofsky found that there was an increase in daily return variance on AMEX but that this increase was smaller than that observed on the NYSE. Interestingly, he found that daily return variances on AMEX were higher than the NYSE both before and after the split.

He then stratified his sample of AMEX shares by post-split share price and split factor to determine whether differences in share prices and split factors were responsible for the lower increase in volatility as compared to the NYSE. Comparisons of the strata showed that the increase in post-split volatility was still lower on AMEX even after controlling for the split factors and for the lower price levels.

This test was then refined by the use of a multiple regression with the ratio of the mean post-split standard deviation to the mean pre-split standard deviation as the dependent variable. The independent variables included the exchange (NYSE or

AMEX), the split factor, the post-split share price and the size of the firm (as measured by market capitalisation). He found that the post-split increase in volatility depended primarily on the exchange but that the market value of the firm and its post-split share price were also significant. From this he contended that as the latter two variables were related to the measurement effects[1], their significance raised the possibility that such effects were present.

As a final test he then repeated his initial procedure but based on weekly instead of daily variances. Similar to Ohlson and Penman, Dubofsky found that volatilities on the NYSE still showed a significant increase following the split when measured on a weekly basis. When the weekly measure was repeated on AMEX however, no increase was observed. From this he concluded: "measurement problems caused by the 1/8 effect and bid-ask spreads more fully explain the AMEX results, but the elements that make AMEX and NYSE different from each other prevent this conclusion being drawn for NYSE stocks." (Page 429)

A similar conclusion was reached by Sheikh (1989) using implied standard deviations "ISD's" for each share. At the ex-date, the control group experienced a slight decrease in ISD's while those for the splitting group increased significantly. In addition, the increase in the level of ISD's for the splitting group was significantly correlated to the ex-date change in the standard deviations calculated from daily returns. However, the increase in ISD's was only 7,59%, lower than the increase in volatility as measured by the return standard deviations. Sheikh interpreted this as indicating that part of the increase in return volatility was due to measurement effects.

4.4. Summary

From this it appears that part of the ex-date volatility is due to measurement effects relating either to the discrete change in the share price or to the change in the bid-ask spread following the split. In addition to the measurement effects there appears to be an increase in true volatility which needs to be explained. The relationship between these explanations is set out in Figure 6 overleaf.

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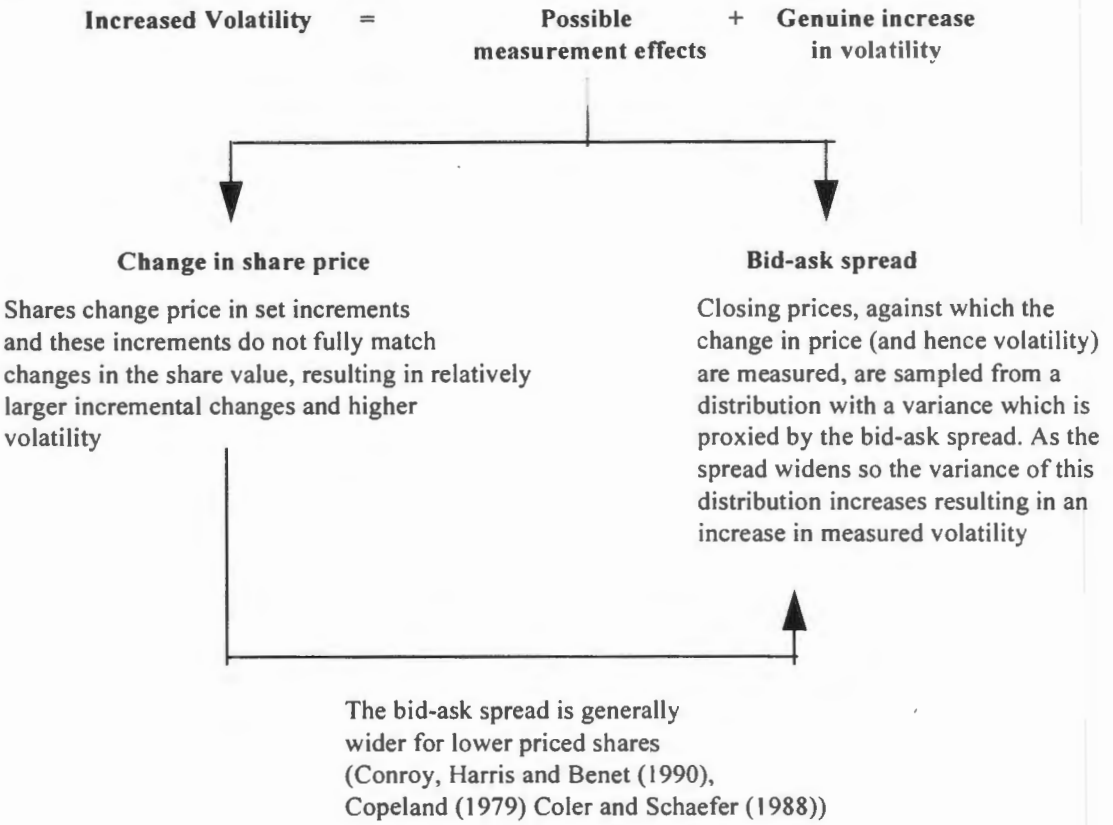
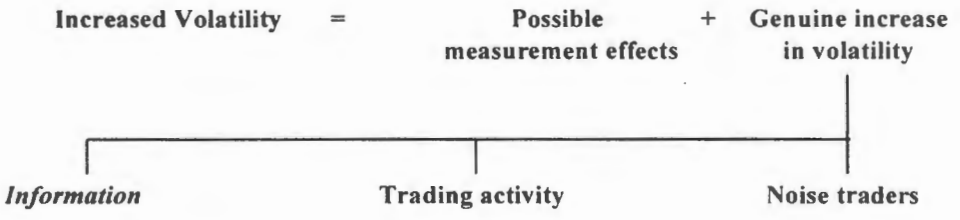
[1] The bid-ask spread has been shown to be a function of the size of the firm and the share price (Conroy, Harris and Benet (1990)).

Figure 6: Increased volatility and measurement effects



5. Information

Given that there is a genuine increase in volatility the question is how this increase comes about. One possibility concerns changes in information and the resultant change in expectations.



The role of information was discussed in chapter 3 which focused on the relationship between information and returns. The focus in this chapter is on the relationship between information and the increase in volatility. In summary, an event may introduce information into the market in two ways: by conveying the information itself (internal information), or by increasing the amount of information available from other sources (external information).

5.1. Internal information

As internal information is introduced by the split event it would logically have to reach the market on the announcement date. Consistent with this, a temporary increase in volatility is observed at the announcement which is similar to that observed around other internal informational events (Beaver (1968)).

The increase on the ex-date, on the other hand, should not be related to internal information as the terms of the split are known and once announced are rarely changed (Grinblatt, Masulis and Titman (1984)). Furthermore, whereas other significant informational events can result in persistent increases in volatility these increases usually decrease over time as the market assimilates the information and adjusts its expectations (Brown, Harlow and Tinic (1993)). The fact that the increase following the split ex-date shows no evidence of abating suggests that the increase may not be caused by internal information.

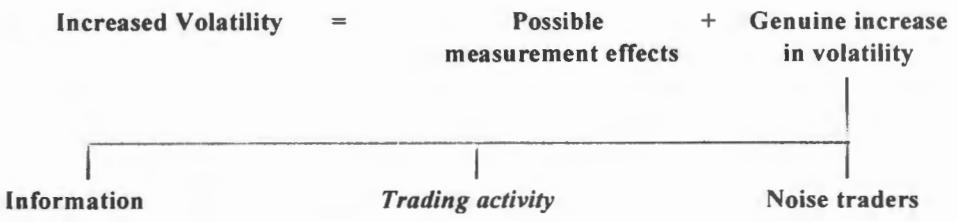
5.2. External information

External information differs from internal information as it is not conveyed by the split but is revealed indirectly through the increased interest which the split generates. A common, though loosely defined, version of an external information model is known as the attention hypothesis (Greenblatt, Masulis and Titman (1984)). A more formal version, presented by Brennan and Hughes (1991), holds that a split presents brokers with a profit opportunity as brokerage commissions are relatively higher on lower priced shares (Copeland (1979), Coler and Schaefer (1988)). They argued that following a split, brokers are able to maximise revenues by increasing the research available on a share in order to stimulate trading activity. Consistent with this they found that the number of analysts following a share increased following a share split.

The problem with external information models is that the increase in awareness, and hence information should be gradual as it is not suddenly announced but instead filters through the market. Furthermore, the increase should begin at the announcement when the first official knowledge of the split entered the market. The fact that the increase is discrete and not gradual, and that it occurs at the ex-date of a split and not at the announcement, weighs against the suggestion that the increase in volatility is due to an increase in external information.

NB.

6. Trading activity



The next possible explanation for the genuine increase in volatility concerns a change in trading activity. Most studies conclude, when measuring activity, that there is a decrease in trading volume following a split which is consistent with the widening bid-ask spread. Other studies however, using absolute trading volume or the number of transactions as the measure, find the opposite and conclude that trading activity has increased. Lamoureux and Poon (1987) suggest that the increase in volatility is linked to those measures of trading activity that increase following the split - specifically absolute trading volume and the number of transactions. This section will examine this suggestion in more detail.

6.1. Models linking activity and volatility

The link between volume and volatility was summarised by Karpov (1987), who concluded that two empirical observations can be made:

- The correlation between trading volume and the absolute value of price changes is positive in both equity and futures markets i.e. large volumes are associated with large price changes.

- The correlation between trading volume and price changes is positive only in equity markets. This can be attributed to the fact that investors in equity markets are restricted by short sales constraints with respect to trading on negative information. Generally, price increases are associated with higher volumes and decreases with lower volumes.

As Karpov (1987) concludes:

"It is likely that observations of simultaneous large volumes and large price changes - either positive or negative - can be traced to common ties to information (as in the sequential arrival of information model), or their common ties to a directing process that can be interpreted as the flow of information (as in the mixture of distributions hypothesis). And the relatively large cost of taking a short position provides an explanation for the observation that, in equity markets, the volume associated with a

price increase generally exceeds that with an equal price decrease, since costly short sales restrict some investors' abilities to trade on new information. This summarises much of what is known about the price-volume relation." (Page 21)

The following sections review the models mentioned by Karpov, namely the *sequential arrival of information model* and the *mixture of distributions hypothesis*, to determine whether either could explain the increase in volatility following a share split.

6.1.1. *Sequential arrival of information model*

This model, developed by Copeland (1976), is based on the assumption that information is given to one trader at a time. The reaction of that trader to the arrival of the information depends on whether the trader is classed as an optimist, a pessimist or as uninformed. If an optimist, the trader's demand curve will shift upwards by a specific amount, as opposed to a pessimist, who's demand curve will shift downwards.

Further assumptions are made that uninformed traders cannot become informed by inferring information from the actions of others and that short sales are prohibited. This last assumption means that pessimists are less likely to react to the information and so trading volumes will be lower if generated by pessimists as opposed to optimists.

As the information moves through the market both trading volume and the change in the share price will depend on the ratio of optimists, pessimists and uninformed traders and on the order in which the information is received. The next price change is a function of the previous price changes and the outlook of the trader receiving it next. Total volume is a random variable with an expected value equal to the weighted average of volumes under each possible path of dispersion. Volume and price aren't causally linked but are the outcome of the same process.

Application to share splits

The difficulty with this model is that it attributes the increased volatility to the flow of information, which as stated earlier, should remain unchanged over the ex-date of a split. It must be remembered however, that price changes in response to information do not only depend on the flow of information but also on existing expectations. These expectations are proxied in this model by the mix of optimists, pessimists and

uninformed traders. Volatility may therefore, still increase, even where the flow of information remains constant, if there was a change in the mix of traders i.e. expectations.

While the ex-date of a split shouldn't change the expectations held by any particular trader it may result in an influx of new traders, with substantially different expectations, resulting in a change to the overall mix. This change could then account for the increased volatility. As the increase in volatility occurs at the ex-date it suggests that the entry of new traders is prompted by the lower share price, which in turn suggests that the new traders may be smaller investors who are liberated by the reduction in odd-lot costs. If this is correct, then management's intention of improving liquidity for these smaller investors leads to an unforeseen increase in volatility.

This explanation deviates somewhat from the sequential arrival of information model, but in doing so offers the insight that the increase in volatility may relate to a systematic change in expectations.

6.1.2. *Change in expectations*

The contention that the increase in volatility relates to a change in expectations rests on two assumptions:

1. that there is an increase in trading activity by smaller investors following the split, and

2. that these investors have systematically different expectations (and hence trading strategies) to the pre-split investors.

The first assumption is logical and is consistent with management's stated motivation for undertaking the split. It is also consistent with the documented increase in the number of individual shareholders following the split (Maloney and Mulerin (1992)). Furthermore, it is consistent with the changes observed in the different measures of trading activity, particularly the increase in the number of transactions while overall volumes remain constant or decrease (chapter 5).

Whilst the second assumption is more difficult to support there are reasons why smaller investors may have different expectations to larger investors. These could include:

- Financial considerations such as taxes. In South Africa, for example, large institutional investors such as pension funds or life assurers are not taxed on trading profits whereas smaller individual investors are taxed if their activities are deemed to constitute speculative trading. These differing tax rules may produce differing trading strategies, and hence different responses to information.

- The size of the portfolios held. It is possible that a smaller investor would not have as diversified a portfolio as a larger investor. This may mean that some non-systematic risk is retained, which could result in different trading strategies.

- Different time horizons. It may be argued that larger investors, consisting of portfolio managers, are evaluated on their performance over a relatively short period, and so have short investment horizons. Smaller investors, unfettered by performance constraints, may have longer investment horizons. The sensitivity of portfolio choice to investment horizon was demonstrated by Marshall and Wynne (1992) who showed that an investor is less risk averse the longer his investment horizon.

- Speculative portfolios. Smaller investors may follow a dual strategy by investing a portion of their portfolio in a mutual fund while the remaining portion is held for speculative purposes. This is consistent with a risk averse investor as the majority of funds are invested in a vehicle which provides with natural diversification (such as a mutual fund), the remaining portion is traded on their private beliefs and information.

Consequently, the smaller investors could have different expectations and follow different strategies to the larger investors. The influx of smaller investors could then lead to increased volatility in two ways. The first, is simply that the increase in the number of investors increases the possibility of a trade in response to the arrival of new information, particularly as the influx of new investors results in a wider spread of expectations and hence reasons to trade. Assuming transactions lead to changes in the share price, more transactions would mean more changes and hence an increase in volatility.

The second, is that larger and smaller investors place different values on the share such that the prevailing price may not necessarily reflect the equilibrium value of the share to the other group of investors. Assuming the share price reflected a larger investor's value and information arriving in the market induced a smaller investor to

trade the resultant price change would reflect both the movement from the original larger investor's price to the original smaller investor's price and then from the original smaller investor's price to the new smaller investor's price. This double movement could result in an increase in volatility.

In other words, the closing price is sampled from two separate distributions. These distributions have different means as a result of the differing expectations of the two groups of investors to which they relate. Consequently, the variance of the combined distributions is higher, resulting in increased volatility.

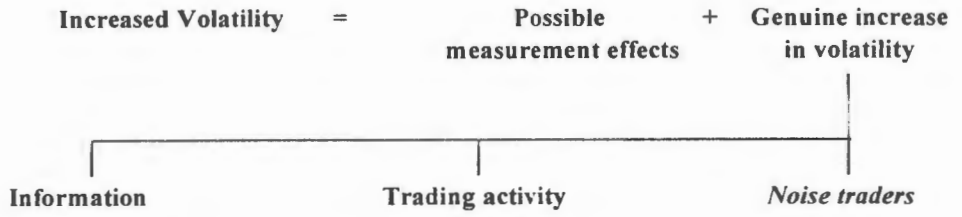
6.1.3. *Mixture of distributions hypothesis ("MDH")*

The MDH holds that volatility is measured by price changes from one period to the next which, in turn, are sampled from distributions of possible price changes. The assumption is usually made that these distributions have a constant variance. In essence, the MDH disputes this and holds that the variances of these distributions are positively related to trading volumes. A consistent increase in trading volume would lead to a consistent increase in the variance of the distribution which would increase volatility.

There are different versions of the MDH. One version holds that the variance of the price change for a single transaction is conditional on the volume of that transaction i.e. the larger the transaction the higher the possibility of a larger price change. Volume and price changes are then related on the level of the individual transaction and this is carried through to the period volatility.

In another version, the period price change is the sum of the individual price changes within that period. The variance of the price change distribution for a period is then related to the number of price changes within that period which may be approximated by the number of transactions. If the number of transactions remained constant then the Central Limit Theorem dictates that the individual period distributions would have a constant variance. If the number of transactions increased however, the variances of the distributions would increase and thereby increase volatility. This explanation is consistent with the increase in the number of transactions following the split (Maloney and Mulerin (1992)).

7. Noise traders



The final possibility, suggested in the literature, is that the genuine increase in volatility is due to the entry of noise traders into the market. This was suggested by Ohlson and Penman (1984) and was attributed to Black from private correspondence with him. In terms of this possibility the market is "...populated by relatively ignorant individuals ('noisy traders') who are interested in trading in low-priced stocks rather than high priced stocks" (Page 265). They would not necessarily be irrational but they would derive utility from the act of trading. This would increase the noise around lower priced shares' returns resulting in the observed increase in volatility following a split.

As a limited test of this they compared split adjusted trading volumes for 100 randomly selected splits. Then using a matched binomial procedure they calculated the proportion of cases where there was a change in trading volume immediately around the ex-date and found that there was no difference between the pre and post-split samples. Because there was little change in trading volumes immediately around the ex-date they suggested that this model had little value in explaining the change in volatility over the same period.

This test however, may be flawed, as from the description of noise traders it would seem that such traders would mainly comprise smaller investors whose effect on overall volumes would be limited. The correct test would instead be to determine whether there was an increase in the number of transactions as the impact of smaller investors would be more evident.

This approach of identifying noise traders with smaller investors allows this possibility to be incorporated in the model formulated earlier in section 6.1.2 *Change in expectations*. This model is more fully developed and is preferable as it accounts for the apparent irrationality of these traders.

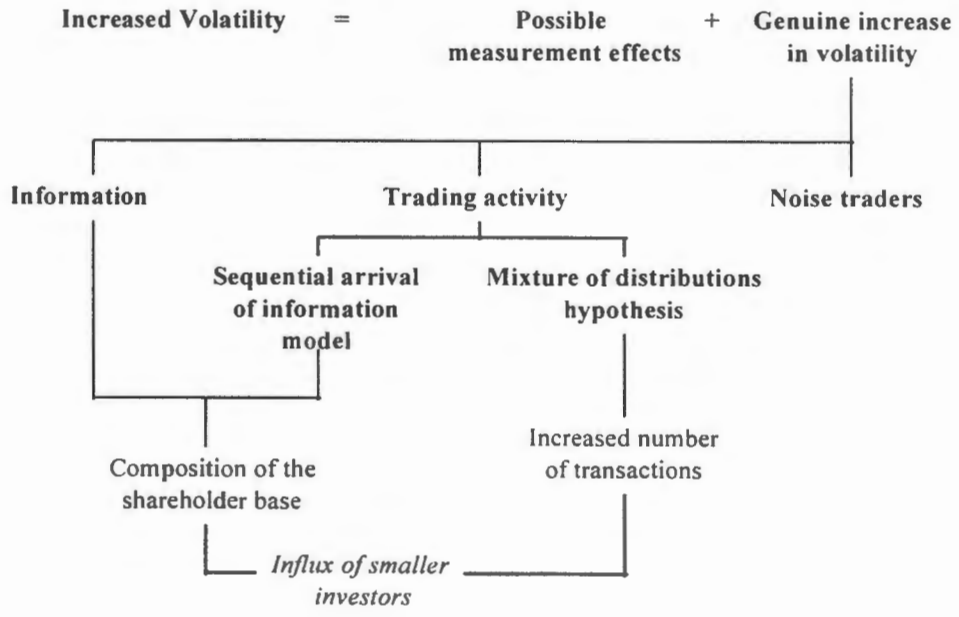
8. Causes of increased volatility- summary

It appears that the change in volatility at the announcement date is due to internal information conveyed by the split and is consistent with other informational events such as earnings announcements (Beaver (1968), Foster (1981) and Firth (1981)).

The ex-date volatility, however, cannot be attributed to internal information as this information should already be in the market. It is also unlikely that the increase in volatility at the ex-date is the result of external information as an increase in external information should generate a gradual increase in volatility starting at the announcement date, which is not consistent with the observed change in volatility at the ex-date.

The sequential arrival of information model does not provide a direct link between trading activity and volatility but instead attributes the increased volatility to a change in the mix of traders in the market. This may be interpreted as a change in expectations resulting from a change in the investors able to trade. The MDH on the other hand links the increase in volatility directly to the increase in trading activity - or more accurately, to the change in the number of transactions. Alternatively, the increase in volatility could be attributed to an influx of investors into the market who had previously been excluded from trading. These explanations are summarised in Figure 7.

Figure 7: Causes of increases in true volatility



9. Volatility and value

Whilst the models discussed in the previous sections attempted to explain the increased volatility around the split they did not attempt to link the positive ex-date returns to the process which causes the increase in volatility. The following sections will attempt to establish whether such a link exists.

9.1. Measurement effects

As discussed above, it appears that part of the increase in volatility following the ex-date of a split is related to measurement effects caused by the widening of the bid-ask spread. Similarly, a widening of the bid-ask spread was also identified in chapter 2 as a possible cause of the ex-date return. The coincidence of these effects suggests a link between them.

In terms of evidence presented by Maloney and Mulerin (1992) the ex-date return results from orders clustering at the ask quote following the split which widens the spread by skewing it upwards. The wider spread could in turn account for the persistent increase in volatility and would in this way link the return to part of the increased volatility. Consistent with this, evidence presented by Kryanowski and Zhang (1993) shows that the ex-date abnormal return is no longer significant once the effects of the increased spread and trading volumes are accounted for.

Consequently, it appears that the ex-date return and part of the observed increase in volatility may be related.

9.2. Tax-timing option

It is also possible that there is a link between the abnormal return at the announcement of a split and the increased volatility following the ex-date. The only model to propose such a link was presented by Lamoureux and Poon (1987), in which they suggested that the increased volatility had value as it presented investors with a tax timing option.

The concept of a tax timing option was related to the structure of U.S. capital gains tax which taxed short term capital gains more heavily than long term capital gains. A more volatile share presented its owner with an option in that if the share price fell in the short term it could be used to offset a short term capital profit, while a gain could

be deferred for the longer term. As this option has value its recognition at the announcement date could produce the abnormal return.

To test this they ran a number of regressions which related the change in the level of return variance to the abnormal returns across the split event. In other words they attempted to show that a relationship existed between the volatility and the abnormal returns (which, in terms of their model, represented the value derived from that increased volatility). Their findings confirmed the correlation, thus supporting their model.

Subsequent evidence however, does not support this model. The model predicted that the introduction of the revised 1986 U.S. tax bill, which removed the distinction between short and long term capital gains, would lead to a decrease in the announcement return. Maloney and Mulerin (1992), who were able to use data from years after 1986 specifically tested this hypothesis and were unable to support it.

10. Systematic Risk

The discussion in the preceding sections was restricted to volatility. This section examines the split's effect on systematic risk, generally measured by the correlation of changes in a share's returns to those of the market.

Lamoureux and Poon (1987) were the first to measure the effect of a split on systematic risk by comparing the pre- and post-split Beta's (as measured using the market model). The pre-split Beta was measured over the 150 days ending 20 days prior to the announcement and the post-split Beta was measured over the 150 days beginning 20 days after the ex-date.

Using the Chow test 39 of the 201 splits showed a significant increase in their Beta, while eight experienced a decrease. In addition, there was a significant increase in the average Beta across the split. These results were contrary to their expectations and so they conducted further tests by comparing their original Betas to Scholes-William Betas to identify the presence of measurement problems caused by non-synchronous or infrequent trading. They found that the Scholes-William Betas were similar to their original Betas which meant that the increases were not due to measurement problems.

Similar results were obtained by Brennan and Copeland (1988) and Kryanowski and Zhang (1993). The periods used by Brennan and Copeland were more precise than those of Lamoureux and Poon as they calculated a Beta across three distinct periods i.e. the period before announcement, the period between announcement

and the ex-date and the period after the ex-date. When comparing the pre-announcement Beta to the Beta measured between the announcement and ex-date they found that there was no significant change. When comparing Beta's across the ex-date however, they found that there was a significant change

They extended the study by examining the time series behaviour of the average Beta across the split event using a cross sectional measure. They found that there was a tendency for the average Beta to increase temporarily on the day before and on the day of the announcement itself. However, another larger increase was observed at the ex-date which persisted for the next 300 days.

10.1. Systematic risk and volatility

As these results are not consistent with the received theory which holds that systematic risk should not change in response to a firm specific event further analysis is needed, particularly with regard to the role which volatility plays in the Beta measure of systematic risk.

If volatility for a particular share increases following the ex-date of the split, and the volatility of the market remains constant (as it should not be affected by firm specific events) then the Beta measure should increase. This can be seen in the formula to calculate Beta:

$$\frac{\text{The covariance of the share's return with the market return}}{\text{The variance of the market return}}$$

As Kryanowski and Zhang (1993) state: "The post-split increase in Beta can be attributed to change in at least one of the three factors: the variance of the market, the variance of the splitting stock, and the correlation (or covariance) between the returns on the splitting stock and the market" (Page 60).

As the split is a firm specific event there is no reason for the market's standard deviation (and hence variance) to change. Kryanowski and Zhang confirmed this by comparing the Toronto Stock Exchange's 300 Composite index before and after 100 split ex-dates.

The covariance of the share's returns with those of the market was also investigated by Kryanowski and Zhang who compared both the covariance and correlation coefficients (being the relative measure) between the pre and post-split periods. For the covariance measure, they found that the mean increased by 50% but was only significant at a 10% level as was the Wilcoxon test. The sign test however, was not

significant. The difference between the correlation coefficients, on the other hand, was not significant under any of the tests. From this they concluded that: "Thus, for this sample, the post-split increase in the mean covariance and Beta on the split ex-date is attributable to the increase in the mean (residual) variance of the splitting stocks' (Page 73). If systematic risk is defined by the correlation between the movements in the share and the market, then it may be argued that there is no change in systematic risk following a split.

10.2. Summary

The Beta measure of systematic risk has three components, namely the return volatility of the particular share, the volatility of the market return and the covariance of the share's return with that of the market. An increase in the share's volatility while the other components remained constant would lead to an increase in the measured Beta. This then does not represent an increase in systematic risk as the increase is solely driven by the particular share's volatility with no change in the covariance of the share and market returns.

11. Overall Summary

This chapter set out to examine a number of issues relating to the change in volatility and systematic risk around share splits by means of a review of the related literature. These issues are summarised below.

Issue	Answer	Comment
Is there an increase in volatility following a split?	Yes	Surprisingly, the most significant increase occurs at the ex-date of a split and not at its announcement. Furthermore, the increase in volatility at the ex-date persists for a considerable period without abating.

Issue	Answer	Comment
Is the increase due to a distortion in the measurement process or is there a genuine increase in volatility?	Both	It appears that part of the increase in volatility at the ex-date is due to distortions caused by the widening of the bid-ask spread and by the discrete change in the price of the share following the split. Whilst these measurement effects are present, they cannot account for the entire increase in volatility which suggests that there is also a genuine increase in risk.
What drives the genuine increase in volatility.		Three possible causes were identified including: - an increase in the amount of information on the share available following the split; - an increase in trading activity; - an influx of "different" traders following the split with different expectations. It appears that the increase in volatility observed at the announcement of a split may be attributed to information conveyed by the announcement. The increase at the ex-date however, does not appear to be related to information but instead may be related to the increase in trading activity and influx of "different" investors.
Is there any link between the increase in volatility and the positive returns observed around the ex-date of a split	Yes	It appears that the ex-date return and part of the increase in volatility may be attributed to the widening of the bid-ask spread.
Is there an increase in systematic risk following the split	No	There is an increase in the traditional measure of systematic risk, the Beta, following the split. The increase in the Beta though, appears to be solely due to the increase in the splitting share's volatility. Other components of the Beta measure such as the covariance of the share's return with the market return and the volatility of the market return itself remain unchanged. This suggests that the share's systematic risk has remained unchanged.

Chapter 5: Liquidity

1. Introduction

Market folklore holds that improved liquidity, defined in terms of the size of shareholder base or the level of trading activity, is responsible for the positive returns observed around share splits. While this appears to be a reasonable proposition it is not supported by research which demonstrates that liquidity decreases following a split. It is along this divide, resulting primarily from differing bases of analysis, that market opinion and academic evidence have traditionally been at odds. These contrary positions regarding liquidity are the focus of this chapter.

The question of liquidity is important as it serves as the deciding factor between two opposing views as to the cause of the returns observed around the announcement of a share split. If liquidity improves, it supports the common view that the returns are driven by the improvements in liquidity. If liquidity worsens, then the returns cannot be driven by improved liquidity and must instead be driven by other positive information.

In this chapter, the literature relating to changes in liquidity around a share split is reviewed, commencing with an examination of the views held by market participants and the evidence of an increased shareholder base. The concept of liquidity is then analysed and the literature concerning empirical tests of liquidity around the share split is reviewed, looking specifically at trading activity, bid-ask spreads, direct trading costs and odd-lots. Finally, the normal trading range model of share splits is examined.

1.1. Market folklore and surveys of market participants

The common view concerning liquidity was confirmed in two separate studies, undertaken around the same time, which focused on the attitudes of market participants to share splits. One, by Baker and Gallagher (1980), examined management's motivation to undertake a split, while the other, by the research department of the NYSE (1980), extended beyond managers to individual and institutional investors.

The findings of these studies regarding management's attitudes were similar and can be summarised by Baker and Gallagher's comment, "...the statement showing the highest percentage of agreement indicates that stock splits make it easier for small stockholders to purchase round lots. Managers also believe that stock splits keep a firm's stock price at an optimal price range and increase the number of shareholders in the firm. Finally they felt that, by increasing the number of shares outstanding, stock splits make stocks more attractive to investors." (Page 74)

They continue later: "These responses seem to indicate that in making stock split decisions managers are more concerned with small investors than with institutional investors. That is, stock splits provide a means of reducing the stock's market price, thereby making it more appealing to small investors. This notion is linked to the commonly-held belief that high-priced stocks are not as popular with individual investors and that these stocks tend to have a more restricted market. By reducing a stock's price through a split, managers seem to think that a firm can increase marketability and increase the ownership base." (Page 74)

These views were echoed in the results of the NYSE survey of small individual investors whose opinions can be summarised by the following statements which had the highest percentage of agreement amongst the respondents:

- When a stock splits, the price per share gives you a better chance to invest in that stock. (82.1% agree).
- An issue is more active after a stock split. (80.8% agree).
- Stocks that split represent an investment opportunity for me. (77.0% agree).

Furthermore, 90% of the respondents stated that they would retain, or increase, their holding of a share that underwent a share split.

Institutional investors, represented by portfolio managers and traders, did not have as positive a view. To them the split was a non-event which did not affect them beyond any simultaneous dividend announcement. However, despite the fact that they attached no importance to it, both the managers and traders noted that there was increased trading activity after the split.

Based on this evidence there appears to be consensus amongst the market participants that liquidity is positively affected by a split, yet this view is not supported by any empirical studies of liquidity. The reason for this, at least in part, appears to lie in differences in the definition and measurement of liquidity.

2. Components and measures of liquidity

Market liquidity represents the ability of an investor to buy or sell a security quickly with little change in price from the price prevailing in the previous transaction. Liquidity may be expressed in terms of cost, as the value which must be foregone or the discount given in order to sell it quickly. Or it may be expressed in terms of time, as the delay required before the security may be sold without a discount.

Market liquidity may be separated into a number of components. These normally include market depth, breadth and resilience. A market has depth where orders exist both above and below the price level at which the security is currently trading. It has breadth where the orders exist in large volumes and it has resilience where price changes caused by order imbalances are immediately compensated for by increases in orders. These components in turn may be proxied by surrogate measures including trading volumes and the bid-ask spread (Reilly 1994).

Trading volumes are typically measured either by the number of shares or by the value of the shares traded. Whichever measure is used the assumption is being made that it is easier to effect a trade where there are higher volumes and thus higher volumes are indicative of higher liquidity. The value traded has the advantage over the number shares traded of not needing to be adjusted for the split-factor following a share split. It also has an advantage in that the bid-ask spread has been shown to be inversely related to the value traded and so provides a link between the two measures of liquidity.

The bid-ask spread is the gap between the quoted prices for buyers and sellers of a security at any point in time. The exact nature of the spread depends on the market. The NYSE for instance, has dealers who quote their selling and buying prices for a security which become the bid and offer quotes respectively. In this type of market the spread is set by the market makers based on factors such as holding costs, perceived risk and demand for the share. Other markets match buy and sell orders automatically in which case the spread represents the difference between the highest seller's and lowest buyer's price at a point in time- in other words the spread is not set by a third party but is a direct outcome of market forces. The assumption is being made that, in both markets, a consistently lower spread results from there being a larger number of ready buyers and sellers, which is indicative of liquidity.

Trading volumes and the bid-ask spread may in turn be proxied by other measures such as the market capitalisation of the firm or its number of shareholders. Both of these measures provide an indication of how readily a buyer or seller for that firm's

securities may be found. Finally, as liquidity represents the cost or discount in realising a security, consideration must be given to the direct costs of transacting such as brokerage commissions and taxes.

Usually all of these measures provide consistent results when evaluating liquidity and so are used interchangeably. In the case of a split however, this consistent behaviour appears to break down. This reflects both the nature of the event and the fact that while the measures may on average behave consistently over a period of time they may not necessarily do so around a specific event. These problems are examined in the following sections.

3. Change in the number of shareholders

An indication of liquidity is provided by the number of shareholders. Market folklore holds that a split improves liquidity by enabling smaller investors to buy and sell the share more easily which is then reflected in an increase in the number of shareholders. For this argument to be valid the following questions need to be answered:

- is there an increase in the number of shareholders;
- is this increase due to the split; and
- does this increase represent an improvement in liquidity?

An increase in the number of shareholders following a share split has been confirmed in a number of studies as can be seen in Figure 8.

Figure 8: Findings regarding the change in the number of shareholders following a split

	Increase in average number of shareholders	
Study	Splitting group	Control group
Barker (1956)	30%	6%
Lamoureux and Poon (1987)	34.65%	-1.92%
Maloney and Mulerin (1992)	23.4%	N/A

Maloney and Mulerin extended this analysis and determined that the average number of individual shareholders increased from 6 817 before the split to 8 288 afterwards. They also found that there was an increase in the average number of

institutional shareholders from 32 to 55, and an increase in their average percentage holdings from 23.8% to 31.2%.

That this increase in the number of shareholders may be attributed to the split is uncertain as the change in the number of shareholders is not measured continuously over the split period as are changes in trading volumes or returns. It is therefore, possible that another factor, such as pre-split equity appreciation, could be the cause of the increased number of shareholders. This possibility is consistent with the documented increase in the numbers and holdings of institutional investors who, by definition, should be unaffected by changes in odd-lot costs following a split. If these increases in their holdings are not being driven by odd-lot costs then these increases must then be driven by another factor. It logically follows that this other factor could then also be responsible for the increase in the number of smaller investors.

The answer to the third question, as to whether this increase in the number of shareholders represents an improvement in liquidity, is also uncertain. Firstly, the question is circuitous: is improved liquidity evidenced by an increased number of shareholders or is the increased number of shareholders the source of the improved liquidity?

Secondly, assuming that shareholders primarily trade in round lots, the number of shareholders may increase as each shareholder has more round lots to sell following a split. This increases the possibility that the original holding will be spread among more shareholders following the split. If this is the case, then the expansion of the shareholder base is a mechanistic outcome of the trading process and is not necessarily indicative of improved liquidity, i.e. the same amount of trade occurs but through more people. Finally, while there may be an increase in the number of smaller shareholders this may not necessarily improve the liquidity of larger shareholders as the volumes traded may be too small.

So while there is an increase in the number of shareholders following a split the arguments presented above suggest that it is neither certain that the increase is caused by the split nor that the increase is indicative of improved liquidity, particularly for larger investors.

4. Changes in trading volume around the share split

Trading volume is often measured by the number of shares traded, which is also known as absolute trading volume. Absolute trading volume is sensitive to a split as a split increases the number of shares in issue which automatically increases the

measured volumes. To compensate for this, the pre or post-split volumes may be adjusted by the split factor to provide what is known as adjusted trading volume.

Alternatively, trading volume may be measured against the number of shares in issue, known as relative trading volume. As the number of shares in issue is automatically adjusted by the split this measure provides a comparable measure across the pre and post-split periods. Lastly, trading volume may also be measured by the value of the shares traded which is known as the value traded or value based trading volume. As with relative trading volume, this measure does not need to be adjusted for the effects of a split.

The following sections will briefly summarise the methodologies and findings of studies on trading volumes around share splits before attempting to compare and draw conclusions from their results.

4.1. Studies on trading volume

4.1.1. Copeland (1979)

Copeland used a finite time series model to determine whether there was any change in the relative trading volumes for a sample of 25 shares following a split. The results did not provide strong evidence but did suggest there was a change.

To investigate this further Copeland formulated a measure of abnormal trading volume by comparing the actual volume for a share against the predicted volume in terms of a finite time series model after adjusting for the split factor and for the number of trading days per week. The results were then measured as cumulative residuals (being the cumulative difference between the actual and predicted volume) across the split ex-date. This revealed persistent negative residuals starting before the ex-date indicating a decrease in the split adjusted trading volume.

4.1.2. Lamoureux and Poon (1987)

Following Copeland's (1979) work, Lamoureux and Poon measured daily split adjusted and absolute trading volumes over a period 60 days before and 100 days after the split ex-date for a sample of 215 shares. Both the absolute and split adjusted volumes were normalised by the market volume to counter the general increase in trading volumes over the long period from which their sample was drawn (1962 to 1985).

Consistent with Copeland's findings they noted that the mean split adjusted volume declined after the ex-date with 87 of the 215 shares showing a significant decrease while only 27 exhibited a significant increase. As expected, the absolute trading volume increased after the share split.

4.1.3. *Lakonishok and Lev (1987)*

Lakonishok and Lev compared relative monthly trading volumes measured around a group of share splits to similar measures for a control group. This revealed an increase in the average trading volumes for the splitting group, above that for the control group, starting from about a year before the month of the split announcement. Up until that point the average volumes of the two groups had been similar.

The difference increased closer to the split and peaked in the announcement month when the average monthly turnover was 5.4% for the splitting group as compared to 4.1% for the control group. The difference then disappeared by the second month following the announcement.

4.1.4. *Conroy, Harris and Benet (1990)*

Conroy, Harris and Benet compared trading volumes, for a sample of 147 share splits from 1981 to 1983, to a random sample of shares. The comparison was made of trading volumes during the two months preceding the month of split announcement against the two months following the month of the ex-date. This comparison was repeated for each share and each measure of trading volume (absolute, relative, split-adjusted, and value based).

They found that prior to the split the splitting sample had significantly lower absolute trading volumes than the random sample of shares. After the split the absolute volumes of the splitting sample increased but were still lower, on average, than the random sample.

The splitting shares were also lower in terms of relative volumes prior to the split (though this difference was not significant). Unlike absolute volumes, there was no increase in relative volumes following the split. Similarly, they found that there was no significant change in the value of shares traded.

While these measures showed that there was no change, they did find a significant decrease in split adjusted volumes following the split. This finding however, seems strange, as the relative measure is equivalent to the split adjusted measure except that its denominator is multiplied by the number of shares in issue prior to the split. The only difference between the denominator of the relative measure in the pre and post-split period is the split factor, and hence it is equivalent to the split adjusted measure and should provide the same result.

4.1.5. *Maloney and Mulerin (1992)*

Maloney and Mulerin used a sample which included all share splits on NASDAQ between 1985 and 1989 excluding multiple splits. Their period of study was long and covered the period from 500 days before the split ex-date to 500 days afterwards. The change in trading volume was measured by the change in the total value traded over this period.

They found that there was an increase in value traded starting around 200 days before the split ex-date. This increase was due to an increase in the number of shares traded and to an increase in the average share price over the same period. After the split, the value traded stabilised. This stabilised volume represented a decrease from the volume prevailing less than 100 days prior to the split, but was higher than the average volume over the 400 days prior to this.

4.2. Summary of the studies

The results of these studies are summarised in Figure 9.

Figure 9: Summary of the changes in trading volume

Measure	Study	Period of study (prior to the split)	Change in volume (after the split)
Absolute	Lamoureux and Poon	60 days	Increase
	Conroy, Harris and Benet	2 months prior to the 1 month prior to the split announcement	Increase
Relative	Lakonishok and Lev	5 years (change observed from 8 months)	Decrease
	Conroy, Harris and Benet	2 months prior to the 1 month prior to the split announcement	No significant change
Split adjusted	Lamoureux and Poon	60 days	Decrease
	Conroy, Harris and Benet	2 months prior to the 1 month prior to the split announcement	Decrease
	Copeland	336 days	Decrease
Value	Conroy, Harris and Benet	2 months prior to the 1 month prior to the split announcement	No significant change
	Maloney and Mulerin	500 days	Long term- increase Short term- decrease

This table shows that most studies find that trading volume either decreases or experiences no significant change. The measures which do show an increase either concern absolute volumes, which are expected to increase given the increase in the number of shares in issue, or they concern the value of the shares traded, which is influenced by a documented increase in the share price immediately prior to the split (Maloney and Mulerin (1992)).

A further observation is that the change in volume is sensitive to the period over which the change is measured. This is particularly apparent in the finding by Maloney and Mulerin that value based volume decreases when measured over the short term but increases when measured over the longer term. This effect may also be seen in the findings of Lakonishok and Lev (1987) who observed that the largest

increase in volumes in their test group occurred from eight to twelve months prior to the announcement. The volumes then returned to the level of the control group two months after the announcement which was approximately when the ex-date occurred. As they conclude: "Clearly, compared to the peak volume during the eight to twelve months preceding the split announcement, the post-announcement volume is lower. However, this peak volume is obviously abnormal for the splitting firms, reflecting their unusual operational performance....". (Page 930)

The possibility that the pre-split volume is abnormally high was acknowledged by Copeland (1979) in the conclusion to his paper: "That brokerage fees and bid-ask spreads are higher after splits is consistent with abnormally favorable pre-split liquidity followed by normal post-split liquidity..." (Page 138)

If the pre-split volumes are abnormally high then any study which compares these volumes to the volumes following the split is likely to find that there is a decrease. If the period of study immediately prior to the split is extended, then a conclusion that there has been no change in volume becomes more likely. This does not alter the fact that there has been a decrease in trading volume but it raises the question as to whether this decrease was caused by the split. If the high pre-split trading volumes would have declined naturally, then the decline observed in the above studies cannot necessarily be attributed to the intervention of the split.

This is difficult to prove as there is no direct evidence available. On an indirect basis, it may be argued that the pre-split volumes are related to the pre-split equity appreciation which, as with volumes, accelerates closer to the split date (Lakonishok and Lev (1987), Karpof (1987)). The question of whether the high pre-split volumes may have persisted may then be rephrased by asking whether the simultaneous equity appreciation could have persisted. On this basis the answer appears to be no, as the equity appreciation appears to be driven by earnings growth across the splitting firm's industry (Asquith, Healy and Palepu (1989)), which means that the firm's growth in earnings would continue only as long as its industry's growth continued, and would decline as earnings growth in its industry declined.

From this, it seems that the split is therefore not responsible for the decline in trading volumes. Yet, even if this indirect evidence is applicable, and the pre-split volumes were abnormal and would have returned to lower levels over time, the fact remains that volumes are generally lower following a split. At minimum the split seems to precipitate the decline in trading volumes.

Finally, care needs to be taken as the split may itself be the result of the increases in trading volumes and equity prices. If the share split tends to coincide with the point

at which these increases end, then the finding of decreased volumes would not so much comment on the result of the split as much as its cause.

4.3. Summary

On the whole volumes appear to be lower or, at best, unchanged following the split. Apart from absolute trading volume (which is affected by the increase in the number of shares in issue), and value based volume over the longer term (which is affected by the general increase in the share price), no measure shows an increase. The conclusion that volumes decrease must however take into account that volumes appear to be abnormally high immediately prior to the split and that the measured decrease may then represent a natural adjustment to normal levels.

4.4. Number of transactions and the average number of shares per transaction

Trading volume is a product of the number of transactions and the average number of shares or value per transaction. Normally no consideration is given to these components of trading volume as they are incorporated into the overall measure. However, where an event intervenes resulting in a change in trading volume it is instructive to understand how this change comes about.

The only empirical evidence on U.S. markets regarding the change in the number of transactions appears in a study by Maloney and Mulerin (1992) who found that there was a marked increase in the number of transactions following the ex-date of a split. This was confirmed on the JSE by Manan and Uliana (1994). Lamoureux and Poon (1987) also reached the same conclusion on the NYSE but this was based on the assumption that an increase in the number of transactions is an automatic outcome of the significant increase in the number of shareholders.

There is no empirical evidence regarding the change in the average number of shares per transaction following a split. Maloney and Mulerin (1992) suggest that, as the overall volumes remained constant or decreased slightly and the number of transactions increased, there must be a decrease in the average number of shares per transaction. While this is a simple mathematical relationship the conclusion regarding liquidity needs more careful consideration.

If the decrease in the average number of shares per transaction is caused by investors trading in smaller blocks of shares then the conclusion that the split has had a negative effect on liquidity (as overall volumes are lower) ignores the fact that

the decline is the outcome of investors choosing to trade in smaller blocks of shares. The fact that a choice is involved suggests that there must be value attached to the choice which outweighs any additional costs imposed by the decrease in overall volume.

Similarly, if the decrease in the average number of shares per transaction is the result of an increase in the number of transactions by smaller investors then the conclusion that there is a decrease in liquidity needs to be revisited. Assuming the effect of smaller investors on overall volumes is limited, an increase in the number of smaller investors would increase the number of transactions without a corresponding increase in overall volumes. This would then be observed as a decrease in the average number of shares per transaction. While a decrease in overall volumes would suggest an adverse affect on the liquidity of larger investors it equally suggests a positive effect on smaller investors.

Both scenarios outlined above, explain the decrease in overall trading volumes but suggest some corresponding gain, the first relating to the market in general and the second relating specifically to smaller investors. Any conclusion regarding liquidity, when based on the decline in trading volumes, needs to take these corresponding gains into account.

4.5. Summary

The use of different measures of trading volume and different measurement periods has resulted in some confusion regarding the change in trading volume around a share split. These problems aside, the available evidence is generally indicative of decreased volumes. What is debatable however, is whether this decrease is attributable to the split as the level of trading volume immediately prior to the split, against which the decrease is measured, appears to be abnormally high.

The decrease in volumes is accompanied by an increase in the number of transactions. This somewhat contradictory result may be interpreted either as a general improvement in liquidity or, more specifically as an improvement in the liquidity of smaller investors. Of these two interpretations the latter appears to be more likely.

5. The bid-ask spread

The bid-ask spread represents the difference between the prices at which a security may be bought or sold at a particular point in time. In principle the spread is set by the elasticity of the supply and demand curves for the security. This principle also applies in dealer markets, but the spread is then adjusted for factors specific to the dealer making a market in that security. This section will focus on changes in the spread around a share split.

5.1. Changes in the bid-ask spread around the split

As was the case with volumes, studies of changes in the bid-ask spreads subsequent to a share split have produced conflicting results. Copeland (1979), for instance, compared the relative spreads, being the absolute spread divided by the share price, at 1, 20 and 40 days before and after selected splits and found that there was a significant increase. Conversely, a later study by Murray (1985), measured the change in the relative spread around the split for 100 over-the-counter (OTC) shares and found that there was no increase in the relative spread when compared to a control group.

A later study by Conroy, Harris and Benet (1990) was specifically aimed at reconciling these conflicting results. In order to increase the accuracy of their findings they did not use the quoted bid-ask spread, as in the two earlier studies, but instead used the actual inside quotes (the highest bid and lowest ask available to an investor on that day) as these represented the actual spread available and not merely the one that was published. Using these quotes they compared the change in the absolute and relative spreads to a randomly selected control group. They found that the absolute spread decreased while the relative spread increased significantly after the share split.

Maloney and Mulerin (1992) also examined the effect of a split on bid-ask spreads, but indirectly as part of a broader model of share price behaviour. Like Conroy, Harris and Benet they found an increase and decrease in the relative and absolute spreads respectively.

The effect of the split on the bid-ask spread is summarised in Figure 10.

Figure 10: Summary of findings regarding changes in the bid-ask spread

Measure	Period	Change in spread after the split	Studies
Relative	Short term	Increase	Copeland (1979), Conroy, Harris and Benet (1990), Maloney and Mulerin (1992)
	Long term	Slight increase	Murray (1985), Maloney and Mulerin (1992)
Absolute	Short term	Decrease	Conroy, Harris and Benet (1990), Maloney and Mulerin (1992)
	Long term	No change	Maloney and Mulerin (1992)

5.2. Relative and absolute spreads

It is apparent from Figure 10 that the conclusion drawn with regard to the effect of a split depends to a large extent on whether an absolute or relative measure is used. Because the relative measure takes the price of the share into account it allows the spreads on different shares to be compared. If this were not done then a conclusion could be made that two shares with a R1 spread were equivalent which would clearly be incorrect where the shares had prices of R10 and R100 respectively.

Maloney and Mulerin (1992) argue differently. They assert that use of the relative spread is inherently problematic: "A more general critique of the analysis of bid-ask spreads and stock splits is the emphasis on relative spreads in the reported results. While the relative spread is one method of comparing liquidity cross-sectionally, the same measure can create estimation problems in time series analysis when the event being studied causes significant changes in stock prices. In such cases, results can be driven by changes in the denominator of the relative spread rather than being due to any change in the bid-ask differential." (Page 47)

Despite this argument, it seems that if the issue is the liquidity cost of the spread then it is the relative bid-ask spread which is important. Their assertion that the change in the relative spread is driven by the change in the share price appears to

be accurate. But their further assertion, that the change in share price causes estimation problems is obscure as, after all, the change in price is the purpose of a split.

5.3. Period sensitivity

As with trading volumes, conclusions relating to the change in the bid-ask spread following the split may also be sensitive to the period over which that change is measured. While no direct work has been done on this question it is interesting to note that Murray (who found no increase in the relative spread) used a longer period than Copeland (1979) and Conroy, Harris and Benet (1990) (who both found that the relative spread increased).

Period sensitivity, hinted at by the above studies, is more evident in the work of Maloney and Mulerin (1992), particularly in the finding that the relative spread persistently declined from around 350 days prior to the split. The decline in relative spread occurred despite an increase in the absolute spread over the same period suggesting that the lower relative spread was a product of an increasing share price. Consistent with the suggestion of an increasing share price the period of study, being the 350 days prior to the split, coincides exactly with the period of share price appreciation observed by Lakonishok and Lev (1987) and Maloney and Mulerin (1992). After the split, the absolute spread decreased to a level equivalent to that prevailing before the equity appreciation began (+/- 350 days prior to the split). Thus the split may return the spread to "normal" levels.

5.4. Changes in the spread and changes in trading volume

The increase in the relative spread is consistent with the decrease observed in the relative, split adjusted and (short term) value based measures of trading volume. But before a conclusion can be drawn that the increase in the spread was caused by the decrease in trading volume it is necessary to determine whether there were other causes. It has been demonstrated that the size of spread is also related to a share's risk and the absolute level of its share price and it is conceivable that changes in either may influence the spread.

Conroy, Harris and Benet (1990) investigated the relationship between the change in spread and factors including the change in share price, trading volume and risk by regressing the change in spread against these factors. On this basis they found that the change in the spread was, as they expected, linked to the change in trading

volume and to the change in the share price. It was however, independent of the increase in volatility.

A link between the change in trading volumes and the bid-ask spread is also suggested by the similar timing of these changes. Maloney and Mulerin (1992) for example, found that the relative spread was unusually low in the period immediately prior to the split during which unusually high trading volumes were also noted. The increase in the spread following the split is therefore consistent with the decrease in trading volumes identified in 4 above.

5.5. Microstructure effects

As discussed in chapter 2 on returns, the abnormal returns observed at the ex-date of a split may be due to microstructure effects, specifically an asymmetrical increase of the ask quote relative to the bid. As this increase accompanies the positive ex-date returns it may be argued that the decrease in liquidity (suggested by the widening spread) is compensated for by positive ex-date returns. The split would then benefit existing shareholders through the positive return.

5.6. Summary

The relative bid-ask spread, at least over the short-term, appears to widen following a split while the absolute spread narrows. These conflicting movements in the different measures of the spread are caused by the decrease in the share price following the split which is not fully compensated for by the decrease in absolute spread. Accordingly, the increase in the relative spread is directly attributable to the change in price caused by the split.

The change in spread is also sensitive to the period over which it is measured with shorter measurement periods tending to show evidence of an increase in the relative spread while longer periods tend to exhibit no change. This period sensitivity matches that displayed by measures of trading volumes. In part this reflects the documented link between trading volumes and the bid-ask spread which was confirmed in relation to share splits by Conroy, Harris and Benet (1990).

Considering the evidence regarding the change in the relative spread following a split, it seems that, as with trading volumes, a split causes liquidity to worsen or, at best, to remain unchanged.

6. Direct transaction costs

The focus of this section is on the change in brokerage commissions and taxes ("direct costs") around a share split. The only study to examine direct costs was Copeland (1979) who demonstrated, using a simulation model, that direct costs increased by 7.1% following a split. Apart from this there is only indirect evidence that the split would lead to higher direct costs. Coler and Schaefer (1988) for example, show that brokerage commissions, measured as a percentage of the value of a transaction, are inversely related to both the share price and the size of the transaction.

If this relationship holds around a share split then Copeland's findings of higher transaction costs can be attributed to two effects. The first, is the decline in the share price resulting in a higher cost per transaction of similar value. The second effect, is the decline in the size of the average transaction which was confirmed by Maloney and Mulerin (1992). The first effect is an unavoidable outcome of the split. The second effect however, is avoidable because investors do not have to trade in smaller blocks of shares following the split. That they choose to, and incur higher costs as a consequence, indicates that there must be some benefit attached to trading in the smaller blocks of shares. So while there are increased costs, there is a corresponding benefit.

As discussed in 4.4 above, the decrease in the average transaction size may also be related to an influx of smaller investors. If this is the case, then the additional costs suggested by the decline in the average transaction size would only apply to smaller investors.

7. Odd-lot costs

Odd-lot costs are additional charges levied on transactions of less than 100 shares. Recently, following the implementation of the JET system on the JSE, odd-lot costs have fallen away. All odd-lots are now dealt with through a specially designated odd-lot broker where any odd-lot shareholder is given the price prevailing in the previous full lot transaction with no additional charges. Prior to this however, odd-lots still involved additional costs as is the case presently on U.S. exchanges such as the NYSE.

Traditionally, the primary benefit of a split was seen as the reduction of odd-lot costs and the improvement in tradability enjoyed by smaller investors (Barker (1956)).

Perhaps because the reduction of odd-lot costs is self evident or perhaps because the benefit is limited to smaller investors, there has not been a direct study of the change in odd-lots following a split. Contrary to the traditional view, the evidence available as to the effect of a split on odd-lots suggests that odd-lot costs increase following a split.

The evidence referred to was provided in a study by Choi and Strong (1983) which showed that when-issued shares (contracts entitling the holder to receive the post-split shares once they are issued) trade at a premium of about 1% over the un-split shares. Their study also showed that the premium was higher where the share split was more likely to result in the creation of odd-lots such as in the case of a five for three split. From this they, together with other authors including Grinblatt, Masulis and Titman (1984) and Brennan and Copeland (1988), concluded that investors were willing to pay a premium for when-issued shares in order to avoid potential odd-lot costs.

The problem with this conclusion is that it ignored the possibility that odd-lot costs may simultaneously be reduced by a split. Particularly for smaller investors for whom the purchase of any shares prior to the split would have resulted in odd-lot costs. These smaller investors would then be paying the when-issued premium for the convenience of acquiring the shares prior to the split date.

This suggests that the when-issued premium consists of two parts: a first part paid for the benefit of acquiring shares that will not become odd-lots after the split (a potential odd-lot premium) and a second part, paid for the benefit of acquiring shares prior to the split without having to incur odd-lot costs (a present odd-lot premium). This two-part explanation is consistent with Choi and Strong's finding of higher when-issued premiums where the split factor is likely to result in odd-lots.

This two-part model is also consistent with the traditional view that a split benefits smaller investors. Smaller investors are primarily affected by present odd-lot costs which are reduced by a split. Conversely, larger investors are primarily affected by future odd-lots costs and so would be adversely affected as these cost are increased by a split.

7.1. Odd-lots and returns

Grinblatt, Masulis and Titman (1984) and Brennan and Copeland (1988) also suggested that the ex-date return may be due to potential odd-lot considerations. Investors who did not buy the share in the period between the announcement and

ex-date (because of potential odd-lots) enter the market at the ex-date resulting in the ex-date return.

This suggestion implies that the pre-split share price includes discounted odd-lot costs and so is below its "true" value. What this fails to recognise is that some shareholders are unaffected by odd-lots prior to the split and so the pre-split share price should not include a discount for odd-lot costs. If this were not the case then the share would be undervalued prompting purchases by those investors who are unaffected by odd-lots forcing the share to return to its "true" value.

As discussed in Chapter 2 on returns however, the ex-date return appears to relate to microstructure effects related to a clustering of orders at the ask quote at the ex-date of a split. Consequently, if the influx of investors causes this clustering the removal of odd-lot costs may ultimately be responsible for the ex-date return.

7.2. The economic significance of odd-lot costs

The question of economic significance is important as it justifies whether odd-lot costs may be ignored when determining the effect of a split on liquidity. It is difficult to show that odd-lot costs are significant. Maloney and Mulerin (1992) attempted to do this and were only able to provide some weak anecdotal evidence: "...we do not have information on small investors, but across the 826 institutions filing 13fs in 1989, 124 held stocks in lots of 100 shares or less. The small-lot stocks held by these 124 funds were predominately standard industrial companies. This says that even institutional investors have small-lot holdings and we expect the frequency to be substantially higher for small investors." (Page 56)

This shows that odd-lots do exist in institutional portfolios, but does not show that they are in any way significant. In any event, the significance of odd-lots may not lie in the odd-lots which exist but in those which would come into existence were a shareholder to adjust his holding. These latent odd-lot costs are likely to be more significant, both in terms of value and decision making than odd-lots already in existence.

The strongest evidence that odd-lot costs are significant lies in the existence of when-issued premiums. Assuming the when-issued premium is paid to avoid odd-lot costs, the fact that a market for when-issued shares exists and, moreover, that investors are willing to pay a premium for them suggests that odd-lot costs must have some significance.

Furthermore, if the ex-date results in the influx of smaller investors it suggests that odd-lot costs are important, but that their importance is limited to this group of shareholders.

7.3. Summary

It appears that the reduction of odd-lot costs by a split is not as simple as some literature suggests. Odd-lot costs may be divided into present and potential costs which are affected differently by a split. Evidence suggests that present odd-lot costs are reduced by the split while potential odd-lot costs are increased. As present odd-lot costs relate to smaller investors (who are unable to trade prior to a split) and potential odd-lots relate to larger investors (who are able to trade prior to a split) it may be argued that smaller investors benefit from a split while larger investors are adversely affected by it.

8. Normal trading range

The normal or optimal trading range model is based on the differing effects which a split has on bid-ask spread and odd-lot costs. In essence the model holds that the split moves the share price into a range where the cost considerations of various groups of investors are balanced. This section will examine the normal trading range model, first in terms of its basic formulation, then in terms of empirical support.

8.1. Formulation

The key features of the model were aptly summarised by Copeland (1979):

"For example, one often hears on Wall Street that there is an 'optimal' price range for securities. Stocks which trade in this range are presumed to have lower brokerage fees as a percentage of the value traded and therefore appear to be more liquid. This 'optimal' range is considered to be a compromise between the desires of wealthy investors and institutions who will minimise brokerage costs if securities are high-priced, and the desires of small investors to minimise odd-lot costs if the securities are low-priced." (Page 115)

While plausible, there is no direct evidence that the split event is the outcome of such a process, or that such a process determines the split factor. Research that does exist seems to indicate that there may well be a normal trading range for

shares, but that this range is a function of the size of the firm and average prices in the market.

8.2. Evidence

The evidence which is available concerning the existence of a normal trading range is based primarily on work done by Lakonishok and Lev (1987). They compared the average share prices for a sample of splitting firms to a control group for an extended period around the share split. This comparison revealed that there was no difference between the average price for the splitting and control groups in the fifth year prior to the split. However, closer to the split announcement the differential between the two groups widened as the average prices for the splitting firms increased by 96% with the result that they were more than 70% higher than those for the control group by the announcement month. After the split, this situation reversed and by the second month after announcement the differential had disappeared (which represented the average period between announcement and the ex-date). From this point onwards the average prices were similar. The conclusion they drew from this was that the split followed a period of phenomenal growth in the share price which the split effectively adjusted back to "normal" levels.

To determine whether management deliberately chose the split factor to adjust the share price to the "market average" they used a cross sectional regression, with the split factor as the dependent variable. This indicated that the deviation in the share price from the average market price explained about 25% of the variability in the split factor. To increase the explanatory power of their model the regression was repeated but including the deviation of the firm's share price from the industry average as a second independent variable. The combination of the price deviations from the market and industry average prices explained 32% of the split factor. They concluded that the average market and industry prices are targets for the splits but that other firm specific factors such as past prices may also affect the size of the split. Support for their conclusions was provided by Conroy, Harris and Benet (1990) and by McNichols and Dravid (1990).

A different conclusion however, was drawn by Brennan and Copeland (1988). Their study compared the share prices of a sample of share splits to a control group comprising 13 shares selected randomly from each month across the sample period. On this basis they found that the prices of the splitting group were above the prices for the random sample at both the announcement and ex-date. They interpreted this as indicating that the split factor was generally too small to return the shares to the normal trading range as represented by the market average. Brennan and Copeland

suggested that their different finding was due to the fact that Lakonishok and Lev selected larger firms in their control sample which created an upward bias resulting in the conclusion that the split had returned the share price to the market average.

While this does appear to be the source of the difference, the interpretation that Lakonishok and Lev's results were biased is not necessarily correct. Lakonishok and Lev selected their control group by matching each firm in the splitting sample with a firm in the same industry which had a similar total asset value. This is then not a upward bias but reflects the fact that firms who undertake share splits tend to be larger, in terms of the size of their total assets, than average firms in the market.

8.3. Summary

There does appear to be a normal range for shares. The hypothesis that this range is the outcome of competing cost considerations is feasible but has not been proved. Instead, evidence suggests that the range is a function of the size of the firm and average prices in the market. While the cost based normal trading model cannot be supported, there is still validity in the assertion that larger and smaller investors are affected differently by the split. As a broad statement on liquidity, allowing for different measures and periods of study, it may be said that larger investors are adversely affected and that smaller investors positively affected by a split.

Chapter 6: Empirical work

1. Introduction

The previous chapter reviewed the literature available on the change in liquidity following a share sp

lit. Following from that review, this chapter will focus on the deceptively simple question of how trading activity, which is one element of liquidity, changes following a share split.

Despite its apparent simplicity the change in trading activity constitutes a theme which may be observed throughout all aspects of a share split. For example, the announcement return may be in anticipation of improved liquidity following the ex-date of a split. This hypothesis however, is not consistent with the empirical evidence available from U.S. markets, which shows that volumes decline or at best remain unchanged following a split, but is consistent with the beliefs of U.S. market participants.

Alternatively, trading activity may be linked to the return observed at the ex-date of a split. As discussed in Chapter 2, evidence suggests that the ex-date return is an outcome of the widening of the bid-ask spread. Other evidence discussed in chapter 5 shows that the size of the bid-ask spread is related to the level of trading volume such that a decrease in volume is associated with a wider bid-ask spread. This suggests that the documented decline in volumes, following a split, is responsible for the wider spread which, in turn, is responsible for the ex-date return.

The widening of the bid-ask spread could also be related to the increase in return volatility observed at the ex-date of a split. Chapter 3 suggested that, despite the presence of distortions caused by measurement effects, there is a genuine increase in volatility. Chapter 3 then showed that both the measurement effects and the genuine increase in volatility may be linked to the change in trading activity following a split.

Understanding the change in trading activity is therefore essential to understanding the effect of a share split. The aim of this chapter is to understand this change with regard to shares on the JSE.

2. Statement of hypotheses

An event, such as a share split, may have two possible effects on trading activity:

1. a short-term effect, typified by a temporary change in the level of activity; and/or

2. a long-term effect, typified by a sustained change in activity.

A short-term change is usually attributed to the event itself, or more particularly, to the information which it conveys as this information changes investors expectations and induces them to readjust their portfolios (refer chapter 3). Thus the short term effect is an accepted outcome of any informational event and may be accommodated within accepted information theory.

Conversely, a long-term change in trading activity is not as easily accommodated within accepted information theory as investors should not keep adjusting their portfolios for the same information. This could mean that the change in activity is not due to information but to changes in other underlying structural factors such as the share's trading cost structure or its shareholder base.

Thus to understand the effect of an event on trading activity it is necessary to separate any long and short-term changes. The aims of this study may be summarised as follows:

1. Is there a change in trading activity following a split?

2. Is this a long-term or short term change in activity?

Based on these questions two related null hypotheses may be established:

H01:	Trading volume (pre-split)	=	Trading volume (post-split)
H02:	Change in trading volume (short-term)	=	Change in trading volume (long-term)

3. Limitations and assumptions

The following limitations apply to the study:

1. **Sample size**- in order to find share splits with the necessary information on volumes and which met the selection criteria a large proportion of the original

share splits were excluded. This resulted in a small sample which limited the interpretations which could be made from the data.

2. **Methodology-** the illiquid nature of trading activity on the JSE made application of U.S. tests inappropriate. Revised tests were therefore developed to accommodate the JSE trading characteristics. The use of these revised tests meant that the results were not directly comparable to the results from studies on U.S. markets.

Other limitations and assumptions relating to the individual hypotheses and tests used are discussed in the relevant sections below.

4. Methodology and data

For the purposes of this study a share split was defined as a transaction which was announced between December 1990 and 30 June 1995[1] :

- which increased the number of shares in issue by a factor;
- which was identified as a "sub-division" or "sub-div" in the JSE Monthly Bulletin; and
- which was not accompanied by a simultaneous event, initiated by or with regard to the splitting firm, which may have affected the share capital of the firm.

This sample of splits was then screened to include only those shares where the split announcement occurred within 3 months of the split ex-date. This screen was used as the effect of the split was more likely to be obscured by other contaminating events where there was a long period between the announcement and the ex-date. This resulted in a sample of 23 share splits.

It may be argued that, as the splits chosen represent the entire population of share splits, tests should be structured accordingly. Alternatively, it may be argued that the

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[1] The last date was limited to June 1995 as the JSE moved onto the JET computerised trading system from 8 March 1996. The move on to the JET system resulted in large increases in trading volumes. Consequently, splits with announcement dates falling after June 1995 would have had study periods extending beyond the move onto the JET system and thus their volumes would have been distorted.

splits are a sample from a broader population of splits extending beyond the sample period. Under this second interpretation all tests would need to be structured such that inferences could be drawn regarding the population from which the sample was taken. For the purposes of this study the latter position was adopted.

4.1. Study period

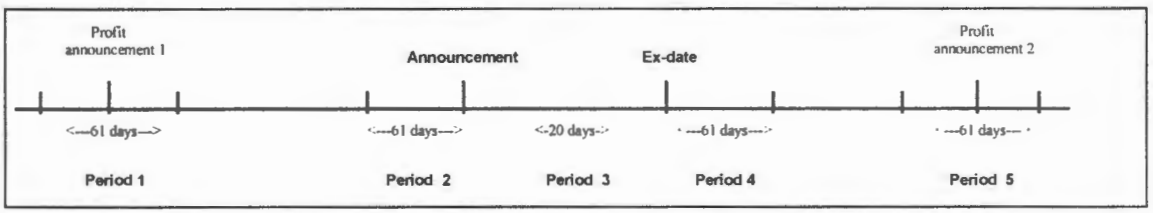
Evidence from U.S. markets showed that where the change in trading volume was measured over a longer period the study was more likely to find no change in trading volume. Shorter periods, on the other hand, tended to show that volumes decreased following a split primarily due to the presence of abnormally high volumes prior to the split announcement date.

Consequently, any study period should be long enough to reveal this effect but should not be so long as to allow the effect of the split to be obscured by other intervening events. The study period should also be divisible into smaller sub-periods to allow further analysis to enable the test to determine whether there was a long or short-term change in volume. These periods in turn needed to be long enough to include meaningful levels of activity as shares in the sample were characterised by thin trading volumes.

The following study periods were chosen:

Period	Description
Period 1	A period of 61 trading days[2] set around the first profit announcement[3] occurring at least three months prior to the split announcement date.
Period 2	A period of 61 trading days immediately prior to the day on which the split was announced.
Period 3	A period of 20 days falling a similar number of days after the announcement date as before the ex-date[4].
Period 4	A period of 61 trading days immediately following the day on which the ex-date of the split occurred.
Period 5	A period of 61 trading days set around the first profit announcement occurring at least 3 months after the split ex-date

These study periods are illustrated below.



[2] A trading day was defined as a day on which trading activity could occur i.e. all days excluding week-ends and public holidays.

[3] To ensure consistency the type of announcements were matched in the pre and post-split periods. Therefore, an interim profit announcement in period 1 was always matched to an interim announcement in period 5. Likewise a year-end profit announcement in period 1 was always matched to a year-end profit announcement in period 5.

[4] The number of days between the announcement date and the ex-date varied for each share. 20 days was chosen as it represented the minimum period between the announcement and ex-date.

4.2. Data

For each of the shares selected the following information was gathered for months around the split event from the I-net Information Service (I-Net), the JSE monthly bulletin, MacGregors Information Service and the Stock Press service.

Item	Source
Ex-date	JSE Monthly Bulletin
Split announcement date	Stock Press, MacGregors Information Service
Profit announcement dates	Stock Press, MacGregors Information Service
The adjusted number of shares traded	I-Net

5. H01 and H02: Change in trading activity following a split

5.1. Calculation

To determine whether there was a change in trading volume[5] across the split event a comparison was made of volumes across each of the periods identified in 4.1 above. In doing so each trading day in the one period was paired with a trading day in the period which followed it. The differences between the volumes in the paired trading days were then combined to form a sample of differences and a matched sign test was used to determine whether this sample of differences indicated a change in activity across the comparison periods.

A matched sign test was chosen as the data was characterised by a large number of trading days where no activity had occurred and also by individual trading days with very large trading volumes. These characteristics meant that the population from which the differences were sampled was probably not normal and therefore, necessitated the use of a non-parametric procedure such as the sign test.

As the sign test is solely based on whether the difference is positive or negative it also has the advantage of allowing the sample of differences to be pooled across all of the shares. This would not have been possible in a test where the magnitude of

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[5] Trading volume was defined as adjusted trading volume which was calculated by increasing the volumes prior to the ex-date of the split by the split factor.

the difference was retained as data relating to different shares would not have been comparable due to differences in the size of the underlying firm and the number of shares that firm had in issue.

Stated more formally:

Di = the number of days where the daily trading volume for share Xi over period Yi exceeded the daily trading volume for share Xi over period Zi.

Where Xi included all of the shares in the sample and where Yi and Zi included periods 1 to 5.

In other words Di was calculated for each of the comparison periods as follows:

	Yi	Zi
Comparison 1	Announcement period (period 2)	Pre-split profit period (period 1)
Comparison 2[6]	Event period (period 3)	Announcement period (period 2)
Comparison 3	Ex-date period (period 4)	Event period (period 3).
Comparison 4	Post-split profit period (period 5)	Ex-date period (period 4)
Comparison 5	Post-split profit period (period 5)	Pre-split profit period (period 1)

These periods were chosen as comparisons 1 through 4 showed the change in activity from study period to the next. Comparison 5 then showed the change across all of the study periods and summarised the long-term effect of the split.

The test statistic was defined as follows:

$$z^* = \frac{\text{Positive\% - 50\%}}{\sqrt{0.5 * (1 - 0.5)/n}}$$

where Positive% = Di/n*100

Where the comparisons resulted in zero differences the zero differences were excluded from the sample and the sample size was reduced accordingly.

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[6] As the event period had only 20 days it was compared to its two comparison periods 3 times. In other words days 1 to 20 in the event period were compared to days -30 to -11, and then to days -10 to +9, and then again to days +10 to +29 in the comparison periods (the match was not exact as the other event periods contained 61 days and consequently, day 1 in the event period was also compared to day +30 in the comparison periods). The results of these three comparisons were then combined to provide the sample of differences.

For example, the matched sign test for comparison 1 worked as follows: the trading volume in day -30 in period 2 was compared to the volume in day -30 in period 1. Then the volume in day -29 in period 2 was compared to the volume in day -29 in period 1 and so on for all of the remaining days (-28 to +28) in each period. Thus each share provided a sample of 61 differences which were recorded as positive (where the volume in period 2 exceeded the volume in period 1), as negative (where the volume in period 2 was less than the volume in period 1), or as zero (where the volume in period 2 equaled the volume in period 1).

Next, all zero differences were excluded and the sample size reduced accordingly. This was done as a zero difference resulted from equal volumes and therefore did not indicate whether the volume in period 2 exceeded those in period 1, i.e. the difference did not provide a sign.

The proportion of positive differences, out of the remaining sample of differences, across all shares was then determined. It was expected that this proportion would be equal to 50% as a random sample of daily volumes in one period would be expected exceed the daily volumes in another period half of the time. If volumes in one period exceeded volumes in the other more often it would indicate that the volumes in the two periods were different and that this difference was possibly significant.

5.2. Assumptions

In using the matched sign test the following assumptions were made:

1. the population of differences (Di) was continuous;

2. the n differences were a random sample from the population of differences.

As discussed above zero differences were excluded from the sample and the sample size was accordingly reduced. Typically, in a sign test, zero differences should be relatively rare as they would require the two comparison days to have exactly the same volumes. The current sample however, was characterised by a large number of days in which no trading activity occurred.

This meant that it was relatively common for a zero difference to result as a day with no volume in one period would often be matched to a day with no volume in the comparison period. The adjustment was therefore necessary to obtain meaningful results otherwise the zero differences would have obscured the effects brought about by the split.

5.3. Results

The results of the test outlined above is summarised in Figure 11 which shows the z* score and associated probabilities or P-values for the periods Yi as compared to periods Zi.

Figure 11: Results for matched sign test (full sample)

	Di	n	Zero values	Adj n	Positive%	z*	P-value
Announcement compared to Pre-split	512	1404	574	830	61.69%	6.73	99.99
Event compared to announcement	488	1403	488	915	53.33%	2.02	97.83
Ex-date compared to the event	607	1403	369	1034	58.70%	5.60	99.99
Post-split compared to Ex-date	575	1403	291	1112	51.71%	1.14	87.29
Post-split compared to Pre-split[7]	662	1403	396	1007	65.74%	9.99	99.99

As can be seen in Figure 11 above, trading volumes increased across the entire split event. Each period showed a significant proportion of higher volumes than the preceding period. The only exception was the comparison of the ex-date period (period 4) to the post-split profit period (period 5) which provided a positive, though not significant, proportion. Thus it may be said that volumes increased up to the split event, across the split event and that this increase did not abate. This result was unexpected as U.S. studies suggested that trading volumes declined following a split.

5.4. Event effects

As discussed in the design of this study (refer 2 above) the arrival of information in the market may result in temporary increases in volume as investors respond to the information. An additional test was therefore run which attempted to remove the possible effects of the known informational events occurring during the study period

[7] The comparison of the post-split period to the pre-split period summarises the changes across each of the consecutive study periods. However, the nature of the test is such that the proportions of differences are not cumulative and therefore this final proportion is not the sum of the preceding proportions.

i.e. the pre-split profit announcement, the split announcement, the ex-date and the post-split profit announcement.

This additional test was similar to that described in 5.1 above but was based on revised study periods. These revised periods excluded the days immediately around the profit announcements and the days closest to the announcement and the ex-date. As such the revised comparisons should not have been affected by any event effects and thus provided a clearer indication of the underlying change in volumes. The revised periods are set out below.

Revised period	Description
Period 1	A period of 40 trading days around the 21 days around first profit announcement prior to the split announcement date i.e. days -30 to -11 and days +11 to +30.
Period 2	A period of 40 trading days prior to the 21 days prior to the day on which the split was announced i.e. days -11 to -61.
Period 3	A period of 20 days falling a similar number of days after the announcement date as before the ex-date.
Period 4	A period of 40 trading days following the 21 days following to the day on which the ex-date of the split occurred i.e. days +11 to +61.
Period 5	A period of 40 trading days around the 21 days around the first profit announcement following the split ex-date i.e. days -30 to -11 and days +11 to +30.

Figure 12: Results for the matched sign test (revised periods)

	Di	n	Zero values	Adj n	Positive%	z*	P-value
Announcement compared to Pre-split	284	920	361	559	50.81%	0.38	64.80
Event compared to Announcement	315	920	328	592	53.21%	1.56	94.06
Ex-date compared to the Event	401	920	242	678	59.14%	4.76	99.99
Post-split compared to Ex-date	380	920	190	730	52.05%	1.11	86.65
Post-split compared to Pre-split	445	920	266	654	68.04%	9.23	99.99

As can be seen in Figure 12 the overall pattern of differences is similar to that from the original sample except that the proportion of differences between the announcement and pre-split profit periods was no longer significant (50,81%, z* 0,38). Such a decrease could either be attributable to there having been:

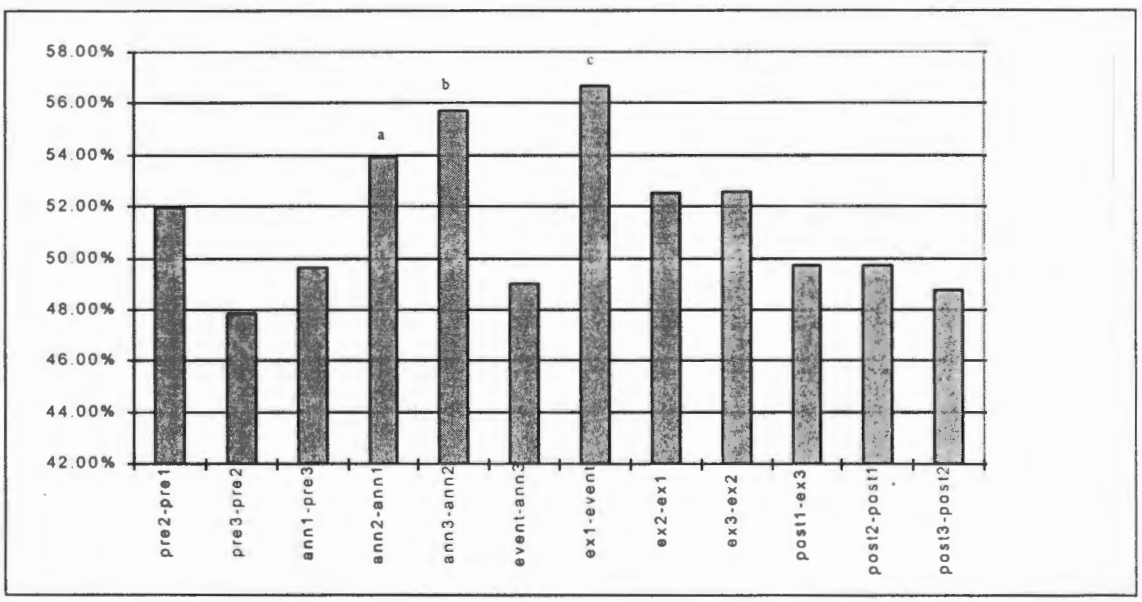
- higher volumes immediately prior to the split announcement date; or
- lower volumes immediately around the pre-split profit announcement.

It may also be observed that use of the revised periods reduced the significance of the proportion relating to the comparison of the event and announcement periods. This decrease however, appeared to be due more to the reduction in sample size as the proportion of 53,21% is very similar to the original proportion of 53,33%.

5.4.1. *Revised event calculation*

To provide a more precise view of how trading volumes changed around the split event the calculation described in 5.1 above was again repeated using narrower study periods. These were derived by dividing each of the original periods (except the event period (period3)) into sequential periods of 20 days. For example, the pre-split profit period was divided into 3 sub-periods pre1, pre2, and pre3. Pre1 covered days -30 to -11, pre2 days -9[8] to +10 and pre3 days +11 to +30. The proportion of positive differences was then calculated across each of these periods as in 5.1 e.g. pre3 was compared to pre2 and ann1 was compared to pre3. These comparisons of the narrower periods across the split event provided a more detailed view of the changes in trading volume. The results of this comparison are set out in Figure 13.

Figure 13: Proportion of positive differences across the split event



[8] Day -10 was excluded to provide uniform periods of 20 days.

Of all the comparisons only three were significant:

"a"- the comparison of the second announcement sub-period (ann2) to the first announcement sub-period (ann1) (z* 1,31, p-value 90,3%);

"b"- the comparison of the third announcement sub-period (ann3) to the second announcement sub-period (ann2) (z* 1,94, p-value 97,4%); and

"c" the comparison of the first ex-date sub-period (ex1) to the event period (event) (z* 2,46, p-value 99,3%).

This showed that the reduction of the proportion in Figure 12, for the comparison of the announcement period and pre-split profit period, was due to higher volumes in the period immediately prior to the announcement (marked "a" and "b"). From the graph it appeared as if there was a sustained increase in volumes immediately prior to the announcement. This increase appeared to be in anticipation of the announcement of the split.

The increase in volumes following the ex-date (marked "c") was exaggerated as it was measured against the slightly lower volumes in the event period. The ex-date increase was however, genuine and volumes in this period were higher than in the periods prior to the announcement date.

5.5. Potential anomalies

It was possible that these results were affected by anomalies relating to the choice of methodology or in the data. Specifically, two possibilities were considered:

1. the order in which trading days in the comparison periods were paired may have introduced bias due to some anomaly in the order of the data;

2. the adjustment, described in 5.1 above, made for zero differences may have introduced bias.

5.5.1. Data Order

It was possible that the data was arranged in such a way that the pairs tended to provide a higher proportion of positive differences. To ensure that this was not the case the tests were repeated with the data in each of the comparison periods ordered randomly e.g. day +30 in period 2 was no longer automatically compared to

day +30 in period 1, but was compared randomly to any day -30 through +30 in period 1.

Figure 14: Results for the matched sign test (full random sample)

	Di	n	Zero values	Adj n	Positive%	z*	P-value
Announcement compared to Pre-split	516	1404	571	833	61.94%	6.89	99.99
Event compared to announcement	472	1403	486	917	51.47%	0.89	81.33
Ex-date compared to the event	626	1403	359	1044	59.96%	6.44	99.99
Post-split compared to Ex-date	566	1403	311	1092	51.83%	1.21	88.49
Post-split compared to Pre-split	670	1403	385	1018	65.82%	10.09	99.99

The results, in Figure 14 above, were similar to the original results (refer Figure 11). The only comparison which changed significantly was the comparison of the event period to the announcement period. This comparison originally provided a significant positive proportion of 53.33%. Based on the randomised data this proportion reduced to 51,47% (which was not significant). This meant that volumes in the event period may not be significantly different from those in the announcement period but that the other conclusions reached based on the original data remained valid.

Figure 15: Results for the matched sign test (revised random sample)

	Di	n	Zero values	Adj n	Positive%	z*	P-value
Announcement compared to Pre-split	291	920	356	564	51.60%	0.76	77.64
Event compared to announcement	318	920	320	600	53.00%	1.47	92.92
Ex-date compared to the event	427	920	233	687	62.15%	6.37	99.99
Post-split compared to Ex-date	370	920	185	735	50.34%	0.18	57.14
Post-split compared to Pre-split	447	920	251	669	66.82%	8.70	99.99

The test on the revised non-event sample was also repeated using randomised data. Use of the randomised data again resulted in changes in all of the comparison proportions, however, no change in the significance of any of the proportions resulted. Accordingly, the conclusions reached based on the original revised data remained valid.

5.5.2. *Adjustment for zero values*

The adjustment whereby all zero values were excluded from the sample may have introduced bias into the results. As can be seen in Figure 11 and Figure 12 the

number of zero values represented a large proportion of the original sample and revised samples. For example, the comparison of announcement period (period 2) to the pre-split profit period (period 1) for the full sample in Figure 11 showed a higher number of zero values (574) than positive differences (512) (i.e. where the announcement day's volume exceeded the pre-split profit day's volume).

Yet this did not represent a deficiency in the methodology so much as a characteristic of trading activity on the JSE. The evidence was still consistent with the conclusion that trading activity had increased. However, to understand the nature of this change further analysis was done to determine to what extent the result was attributable to:

1. a change in the frequency with which trade occurs (in this case the number of days on which trade occurred), and/ or

2. a change in the total number of shares traded.

5.5.3. *Frequency of trade*

A comparison of the proportion of trading days, in which trade occurred, across each of the study periods demonstrated that there was a change in the frequency of trading activity around the split.

Figure 16: Proportion of days with trade across periods 1 to 5

	Total trading days	Days with trade	% Days with trade
Pre-split (period 1)	1403	590	42.1%
Announcement (period 2)	1403	596	42.5%
Event (period 3)	460	222	48.3%
Ex-date (period 4)	1403	845	60.2%
Post-split (period 5)	1403	860	61.3%

In period 1 and 2, only 42,1% and 42,5% of the days had any trading volume. The proportion increased slightly in period 3 to 48,3%. The main increase however, occurred after the ex-date where the proportion improved to 60,2% where it remained to the post-split profit period. This change in frequency meant that if a comparison were made for example, based on the original full sample, of period 5 and period 1 it would be expected that period 5 would automatically show positive differences (Di) for at least 270 days (860 - 590) as the comparison days in period 1 had no volumes.

To observe the change in frequency more precisely the frequencies were calculated across the narrower 20 day sub-periods used in 5.4.1. The results of this calculation are set out in the graph below.

Figure 17: frequency of trade across the split event

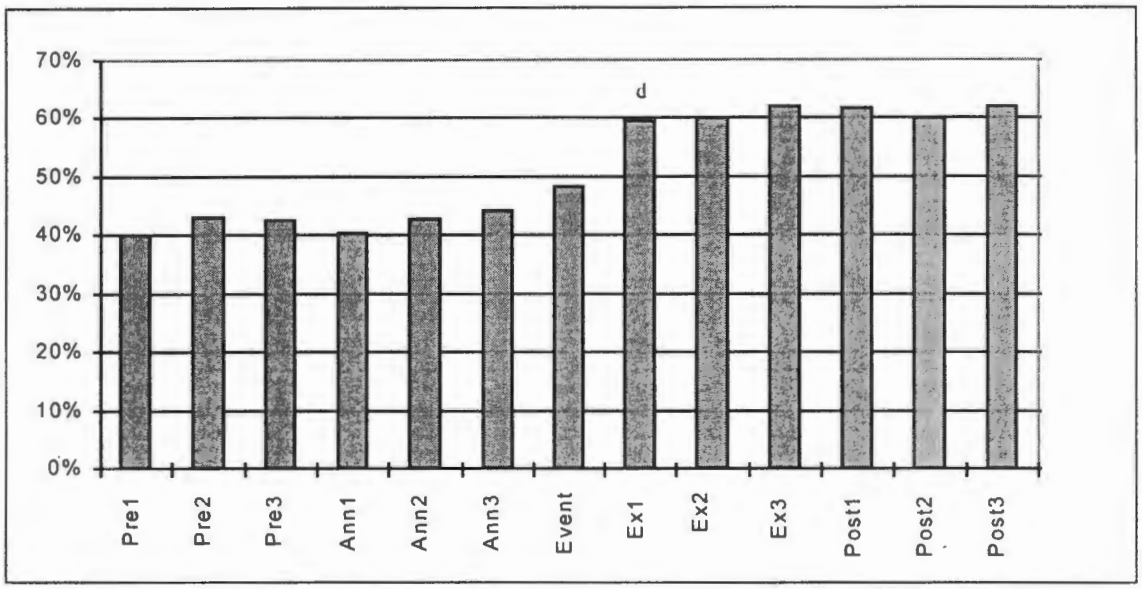


Figure 17 clearly shows the sustained increase in trading frequency following the ex-date of the split (marked "d").

This increase in trading frequency following the split was not limited to a few of the sample shares but could be observed across the whole sample. To test this a comparison was made using a matched sign test (as described in 5.6.1 above) wherein the difference between the number of days in which trade occurred in one period was compared to the number of days in which trade occurred in the comparison period. The proportion of positive differences was then determined and this proportion was tested for significance using the following test statistic:

$$z^* = \frac{\text{Positive\% - 50\%}}{\sqrt{0.5 * (1 - 0.5)/n}}$$

where Positive% = Di/n*100,

and where Di = the number of shares where the number of days in which trading activity occurred over period Yi exceeded the number of days in which trading activity occurred over period Zi,

and where Yi and Zi were the same as for 5.1 above.

5.5.4. *Assumptions*

In using the matched sign test the following assumptions were made:

1. the population of differences (Di) was continuous.

2. the n differences are a random sample from the population of differences.

5.5.5. *Results*

The following table shows the proportion of shares where the frequency of trade in one period exceeded the frequency of trade in the comparison period.

Figure 18: Proportion of shares where days with trade exceeds the comparison period

	Di	n	Positive%	z*	P-value
Announcement compared to Pre-split	23	11	47.83%	(0.21)	58.32
Event compared to announcement	23	15	65.22%	1.46	92.79
Ex-date compared to the event	23	18	78.26%	2.71	99.65
Post-split compared to Ex-date	23	12	52.17%	0.21	58.32
Post-split compared to Pre-split	23	21	91.30%	3.96	99.99

The comparison of the post-split profit period (period 5) to the pre-split profit period (period 1) summarised the effect across the entire split event and showed that 21 of the 23 shares in the sample had a higher proportion of days traded following the split. Analysis of the change across the split event revealed that the change occurred at the ex-date (period 3) as the comparison of the ex-date period to the event period resulted in a significant proportion (78,26%, p-value 99,65%). This is consistent with the results in Figure 16 and Figure 17.

5.6. Total number of shares traded

An increase in trading frequency did not necessarily mean that there was an increase in the total numbers of share traded following the split. Another comparison was therefore made of the total number of shares traded, for each of the shares in the sample, across each of the study periods.

A matched sign test was employed to determine whether the proportion of differences between the total shares traded was significant.

Di = the number of shares in the sample where the total volume over period Yi exceeded the total volume over period Zi.

Where Yi and Zi included periods 1 to 4. In other words Di was calculated for each of the periods as follows:

	Yi	Zi
Comparison 1	Announcement period (period 2)	Pre-split profit period (period 1)
Comparison 2	Ex-date period (period 4)	Announcement period (period 2)
Comparison 3	Post-split profit period (period 5)	Ex-date period (period 4)
Comparison 4	Post-split profit period (period 5)	Pre-split profit period (period 1)

The test statistic was defined as follows:

$$z^* = \frac{\text{Positive\% - 50\%}}{\sqrt{0.5 * (1 - 0.5)/n}}$$

where Positive% = Di/n*100.

5.6.1. Data

The data used in the previous tests was adjusted for this test as the data contained periods of thin trading and single days with extraordinarily large volumes. This meant that, for some shares, one day's trade could conceivably equal the sum of all of the other 61 days trade combined.

In the previous tests the effect of such days was limited as they would only have counted for one difference (Di) out of the entire sample of differences across all of the shares. The potential effect on a comparison of shares however, would have been significant.

To adjust for days with very large trading volumes the following two adjustments were made:

1. The adjusted total number of shares traded was calculated by subtracting the largest 3 days' trade in each period from each share's total volume for that period (adjusted 1);

2. The sum of the 3 days with the largest trade and the 3 days with the smallest trade were subtracted from the total number of shares traded. These volumes were then replaced by the average volumes (calculated excluding

the 3 largest and 3 smallest days). The total volume for each share was then calculated (adjusted 2).

These adjustments were designed to remove any outliers from the sample. Two adjustments were used as, depending on the adjustment, it is conceivable that different results would be obtained. The test would then not be reflecting the effect of a split as much as the effect of the adjustment. The use of two adjustments would allow the magnitude of the adjustment effect to be determined.

The event period (period 3) created a problem in that it contained only 20 trading days compared to 61 days in the other periods. To compensate for this the adjusted total volumes over the event date were multiplied by 3,05 to equate to 61 days. Adjusted 1's volumes were calculated by subtracting only the largest day's trade instead of the 3 largest day's trade. Adjusted 2's volumes were calculated by deduction the sum of the largest and smallest day's volumes and not the sum of the 3 largest and 3 smallest days.

5.6.2. *Assumptions*

In using the matched sign test the following assumptions were made:

1. the population of differences (Di) was continuous;

2. the n differences are a random sample from the population of differences.

5.6.3. *Results*

The results are set out in two tables below for adjusted 1 and adjusted 2.

Figure 19: Differences in total volumes (adjusted 1)

	n	Positive	Positive%	z*	P-value
Announcement compared to Pre-split	23	16	69.57%	1.88	96.99
Event compared to announcement	23	10	43.48%	(0.63)	N/A
Ex-date compared to event	23	15	65.22%	1.46	92.79
Post-split compared to Ex-date	23	14	60.87%	1.04	85.08
Post-split compared to Pre-split	23	18	78.26%	2.71	99.66

Figure 20: Differences in total volumes (adjusted 2)

	n	Positive	Positive%	z*	P-value
Announcement compared to Pre-split	23	16	69.57%	1.88	96.99
Event compared to announcement	23	10	43.48%	(0.63)	N/A
Ex-date compared to event	23	15	65.22%	1.46	92.79
Post-split compared to Ex-date	23	14	60.87%	1.04	85.08
Post-split compared to Pre-split	23	18	78.26%	2.71	99.66

The results based on adjustment 1 and adjustment 2 were identical (primarily as a result of the small sample size). This did provide some comfort that the results were not being distorted by the nature of the adjustments made.

The results showed once again that there was an increase in total volumes across the split event and that this increase persisted to the post-split profit period. This result was not as positive as those in 5.3 above but did confirm the long-term increase in trading volumes. What was of particular interest was to determine where within the study period this increase occurred. The results in Figure 19 and

Figure 20 suggested that the increase happened in both the announcement period and the ex-date period. The increase to the ex-date period may have been distorted by the lesser number of days in the event period (even after the adjustments were made). Consequently, an additional direct comparison of the ex-date and announcement periods was made (not included in the above figures). This showed that adjusted total volumes were higher in the ex-date period for 15 out of the 23 shares (65,22%, p-value 92,79%). Whilst this proportion was not highly significant it did follow a decline in total volumes in the event period. This suggested that the ex-date did result in an increase in total volumes.

5.7. Summary

Based on these results both H01 and H02:

H01: Trading volume (pre-split) = Trading volume (post-split)

H02: Change in trading volume (short-term) = Change in trading volume (long-term)

would be rejected as trading volumes were persistently higher following a split. The changes in trading volumes however, appear to be more subtle than initially anticipated for the following reasons:

- a split appeared to have both a long term and a short-term effect on trading volumes;
- these effects occurred at different times.

The results in the previous sections may be summarised as the answers to two questions. These are set out below.

Figure 21: Results summary

	Was there an increase in trading frequency from the previous period?	Was there an increase in total volumes from the previous period?
Pre-split profit period	N/A	N/A
Announcement period	No	**Yes**
Event period	**Yes***	No
Ex-date period	**Yes**	Yes*
Post-split profit period	No	No

* Significant but marginally so.

The split appeared to increase trading volumes at the announcement of the split and following the ex-date. The increase at the announcement of the split appeared immediately prior to the split announcement which suggested that it was in anticipation of the announcement and so was an event effect. This increase was represented by an increase in total volumes but not by an increase in trading frequency. Total volumes then appeared to decline in the following (event) period suggesting that the announcement increase in trading volumes was temporary.

The increase following the ex-date and was characterised by an increase in total shares traded and by an increase in trading frequency. These increases did not reverse in the post-split profit period and thus were of a long-term nature.

Chapter 7: Conclusion

The increase in trading volumes prior to the announcement of the split is consistent with the findings of U.S. studies discussed in chapter 5. The increase in trading activity at the ex-date however, is not inconsistent with U.S. findings. If this increase is analysed it is apparent that this increase is characterised by marginally significant increase in total volumes and by very significant increase in trading frequency.

No U.S. study examines the "frequency of trade" as such (probably as U.S. markets do not suffer from the problem of thin trading which characterises the JSE). Maloney and Mulerin (1992) however, showed that the number of transactions increased following the ex-date a split. A similar increase was noted by Manan and Uliana (1994) who found an increase in the number of transactions following the ex-date of a split on the JSE. If the increase in trading frequency and the increase in the number of transactions are related it may be argued that the increase in frequency identified in the current study is consistent with U.S. studies.

The question is then why an increase is total volumes is observed on the JSE whereas it is not observed in U.S. studies. The answer appears to lie in the fact that the JSE is so thinly traded.

As Bradfield states in his assessment of estimation problems caused by thin trading on the JSE: "One of the initial conclusions in this analysis is that the thinly traded phenomenon on the JSE is fairly severe. For example, it was found that approximately one third of stocks are not traded on average, for at least one week in every four week period." (page 25).

This problem was also noted in the above study. Figure 16 showed that the frequency of trade was around 40% prior to the split and that this improved to around 60% after the split. It was also noted that the data contained shares where a single day's trading volume could exceed the cumulative volume over the remaining 60 days of the study periods.

From this it may be hypothesised that both the U.S. exchanges and the JSE experience an increase in trading frequency following the ex-date. On the JSE however, liquidity is so low prior to the split that the change in frequency has a material effect on overall volumes. While this hypothesis is consistent with the current results the results do not provide conclusive evidence of its validity and further investigation is needed.

As discussed in Chapter 5, an increase in the number of transactions and a decline in total volumes means investors must either be trading in smaller blocks of shares or that there is a decline in the activity of larger investors and an increase in the activity of smaller investors. These smaller investors would have had a marginal effect on overall trading volumes but significant effect the number of transactions. No definitive answer could be determined based on the U.S. literature.

If the current findings are applied to this issue they support the second possibility, namely that smaller investors enter the market following the split ex-date. The first possibility was only considered as it was assumed that the change in total volumes and the number of transactions occurred at the same time.

The findings from the current study show that the change in total volumes and the change in the number of transactions occurred at different times. Assuming that U.S. markets show a consistent pattern, this indicates that the decrease in average number of shares per transaction cannot be due to investors trading in smaller blocks of shares.

If the pattern of changes in trading activity on the JSE does in fact indicate the entrance of smaller investors into the market it provides evidence consistent with the models presented in chapter 4 which explain the increase in true volatility following the ex-date of a split. Section 6.1.3 (Mixture of distributions hypothesis ("MDH")) suggested that the sustained increase in volatility following the ex-date was related to the increase in the number of transactions. The current study provides evidence consistent with a sustained increase in the number of transactions occurring immediately after the ex-date.

Section 7 (Noise traders) suggested that the entrance of smaller investors could lead to the increase in volatility. This could occur either through an increase in the number of transactions (as discussed above) or through a change in the market's expectations as these smaller investors may have systematically different expectations to the investors who traded in the share prior to the split.

Finally, chapter 4 also suggested that a persistent increase in volatility could only be caused by information if:

1. the structure of the markets' expectations were permanently changed (such as would occur with the entrance of smaller investors with systematically different expectations); or

2. if there was an increase in the amount of internal information reaching the market e.g. by an increase in the amount of attention paid to the share.

The current study does not provide any insight as to whether such an increase in the amount of information occurs following a split. This possibility is however, circular as if the split enables more investors to trade the attention directed at the share increases resulting in an increase in information. There is no other evidence to confirm this and it is thus a question for further study.

In conclusion, it appears that a share split does result in a sustained increase in liquidity on the JSE. This finding contradicts findings based on U.S. exchanges which tend to show that liquidity decreases or remains unchanged following a split. The difference in these findings may be attributed to the illiquid nature of the JSE. Both the current findings and those from U.S. exchanges show that there is an increase in the number of transactions or frequency of trade following the split. In the U.S. however, this increase in frequency does not cause a material increase in total volumes. On the JSE volumes are so low prior to the split that the change in frequency does have a material effect on total volumes. This increase in frequency is sustained following a split which in turn results in the finding of a sustained increase in total volumes.

The results of the study also suggest a number of avenues for possible research. The hypothesis was proposed that the increase in trading frequency following the ex-date is the cause of the increase in total volumes following the ex-date on the JSE.

This could be tested by controlling the level of trading frequency of the individual shares prior to the split. For example the shares could be stratified into high and low trading frequency sub-samples and the results compared for each sub-sample. If this hypothesis is correct then only the low frequency sub- sample should show a significant increase in total volumes following the ex-date. The current sample however, is too small for such a stratification to be effective.

Another possibility is to repeat the study with a sample of splits occurring after the introduction of the JET trading system on the JSE. Because the introduction of the JET system caused a dramatic improvement in liquidity it is possible that increase in total volumes may not occur after the ex-date as the increase in frequency would no longer be material.

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