The Relationship Between International Equity Market Behaviour and the JSE

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Abstract

This paper investigates empirically the relationship between domestic and international market returns and volatilities, using the London Stock Exchange as the international market proxy. In order to address problems of widely differing bourse composition, the relationships are tested at both the broad bourse index level and the sectoral sub-indices level. The paper finds significant evidence of a positive relationship between foreign returns and domestic returns and, in addition, between foreign volatility and domestic volatility. It is found that, for most sectors, the main association period is during the same concurrent trading day, although there are additional significant lags present in most of the series. Strong evidence is also found that the magnitude of volatility on the JSE and most of its sub-indices reacts far more to negative shocks than it does to positive shocks.

JEL Classifications: G15, F36
KEYWORDS: Volatility, Market Returns, Financial Interdependence

1 Introduction

The Johannesburg Securities Exchange (JSE) is currently the 18th largest stock exchange in the world, with a market capitalisation of over R2.7 trillion (JSE, 2005). It is also highly liquid, with both its level and volatility constantly changing as new information is priced in. Information regarding the behaviour of certain key variables, such as the interest rate, the exchange rate and the gold price, are some of the factors widely viewed as being influential to price determination on the JSE. Another factor that is said to be important to the JSE, and the subject of this paper, is the performance of the international equity market.

This hypothesised link (or association) of foreign equity returns and volatility with the JSE is widely held to be fact. Both the press and analysts often explain certain behaviour of the JSE as being affected by the behaviour of other security exchanges. The local bourse, for example, is often said to be ‘tracking’ a certain foreign bourse. Foreign indices are widely understood to affect not only the level of the JSE but also its volatility; both moments of foreign bourses are thought to cross international borders.

This paper investigates empirically the existence and extent of this association between foreign equity markets and the JSE. Specifically, it estimates to what extent market returns and volatility on the JSE are associated with international market returns and volatility, using the London Stock Exchange (LSE) as a proxy for the international market. As will be explained later, the associations are tested at two specific levels, the broad market index level and the narrow sector level, in order to account for differing exchange compositions.

2 The Transmission Literature

The transmission literature makes quite a clear distinction between interdependence amongst markets and contagion amongst markets. The correlation of asset prices and volatility between stock exchanges is generally

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1Consider the following exemplary quote: “The JSE was higher this afternoon on the back of positive global markets.” Business Day, 25 October, 2005
known as interdependence or integration. Contagion on the other hand is most commonly defined as an increase in the correlations of asset prices and volatility during a period of turmoil (Collins and Biekpe, 2003). This paper will be testing for interdependence as it seeks to estimate the extent that domestic market returns and volatility are associated with London returns and volatility.

The international literature on transmissions is extensive. Amongst others, Lin, Engle and Ito (1994) find correlations between day (night) returns on the New York Stock Exchange (NYSE) and night (day) returns on the Tokyo Stock Exchange (TSE) using a GARCH methodology.2 Barclay, Litzenberger and Warner (1990), also studying the perfectly non-overlapping markets of the TSE and the NYSE, find evidence of correlations amongst dual listed stocks. Hamou, Masulis and Ng (1990), using ARCH processes, find evidence of unidirectional transmissions of returns and volatilities from the NYSE to the TSE, from the LSE to the TSE and from the NYSE to the LSE.

Locally, studies on the interdependence of the JSE have mostly focussed on its relationship with other African equity markets. Collins and Biekpe (2003), for example, investigated whether certain African economies, including South Africa, experienced contagion from the Asian Crisis in 1997. They found that the correlations between African markets and the Hong Kong Hang Seng Index increased during the crisis period of October 20, 1997 to November 28, 1997. Piesse and Hearn (2005), using similar methodology to this paper, found evidence of the transmission of both returns and volatility amongst Sub-Saharan African stock markets. Piesse and Hearn (2002), testing for price volatility transmissions across SACU equity markets, found evidence of integration using cointegration analysis. Lastly, using a vector autoregression (VAR) approach, Collins and Abrahamsen (2004) investigated whether various African stock exchanges, including the JSE, are more integrated regionally than globally. While not explicitly testing for association with international equity markets, they did find that South Africa was the most globally integrated of the seven African countries investigated.3

3 Study Justification

This paper adds to this existing literature in three ways. Firstly, it models the association effect using a GARCH type process to take account of the volatility clustering inherent in financial time series. Secondly, the paper explicitly tests the relationship between foreign volatility and domestic volatility and not just the relationship between foreign and domestic market returns. Lastly, the paper addresses the problem of different stock market composition by estimating the correlation between individual foreign and domestic sectors in addition to broad index level association estimations.

1. **EGARCH modelling of volatility clustering**

Volatility clustering is an innate property of financial time series. A large shock in a certain direction is often followed by another large shock of a similar magnitude, either in the same direction (herding behaviour) or in the opposite direction (correction or mean reversion behaviour) as market participants attempt to correctly price in the new information. Likewise, small shocks in a certain direction tend to be followed by small shocks of a similar magnitude, again in either direction. Estimations of financial time series are thus likely to be plagued with problems of heteroscedasticity, as the variance tends to be clustered into periods of high and low variance. While the estimated coefficients will still be unbiased, the standard errors of a series with clustered volatility will be biased downwards, leading to possible incorrect inferences regarding the significance of the coefficient estimates. To address this problem of heteroscedasticity Engle (Engle, 1982) proposed allowing the variance of the residuals to be a linear combination of their past values. This Autoregressive Conditional Heteroscedasticity (ARCH) model, and its variant the Generalised ARCH (GARCH) model (Bollerslev, 1986), has provided much insight into financial time series analysis.

This paper employs the Exponential GARCH (EGARCH) variant of the GARCH models (Nelson, 1991). A key shortfall of the GARCH modelling process is that while it addresses the problem of volatility clustering it does so by treating the various shocks symmetrically. GARCH models essentially assume that good news (i.e. positive past errors) and bad news (i.e. negative past errors) of similar magnitudes affect the

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2Day returns are defined in their paper as the open-close change in a respective index, and night returns defined as the close-open changes.

3The countries tested in their study were Egypt, Kenya, Mauritius, Morocco, Namibia, Zimbabwe and South Africa.
level of volatility to the same degree. It is unrealistic to assume this a priori, and if incorrectly assumed
seriously hampers the explanatory power of GARCH modelling of the conditional second moments. EGARCH
processes, in contrast, address this asymmetry by making the conditional variance a function not only of the
magnitude of past disturbances, but also the direction of them. (The exact forms of the EGARCH models
estimated in this study are given in section 5 below.) Using EGARCH processes allows not only for a far
superior modelling of volatility but also for a formal test of whether good and bad news differ in their effects
on the JSE.

2 Formal testing of intra-market volatility association

Most tests of association test some form of correlation between the returns of two or more markets. This paper does this within a framework that also formally tests whether the level of market volatility, and
not just market returns, crosses borders. This is achieved by including a measure of foreign volatility into
the specification of the EGARCH modelled condition variance, allowing the explicit test of intra-market
association of both conditional moments. (See equation (4) below for the exact formulation of the EGARCH
process.)

3 Additional Sector-to-Sector study

A significant problem in estimating the correlations between the various international stock markets and
the JSE is that the two equity markets have very different compositions. The JSE is dominated by the
mining sector, whereas the LSE is dominated by the financial and service sectors. Estimating the degree
of correlation between the broad JSE index and the broad LSE index could therefore provide misleading
results.
To understand why, consider two stock markets (X and Y, respectively), both of which have only two
sectors, A and B. Assume that the two sub-sectors in both markets are in fact perfectly correlated, i.e.
Corr(AX,AY), Corr(BX,BY) = 1. Also assume that stock market X is dominated almost entirely by sector
A, and stock market Y almost entirely by sector B. If specific information becomes available that causes
sector B in both markets to be sold and sector A in both markets to be bought the two stock markets would
move in opposite directions, even though the equity markets are in fact perfectly correlated. In general then,
testing for market correlation is strictly only true when the stock markets have exactly the same composition
of sectors. This paper attempts to address this problem by testing for contagion not only between the broad
markets but between the individual sectors of the indices as well. The sectors used are the ten sectors\(^\text{4}\) as
defined by the FTSE Global Classification System; a system common to both respective indices. In practise,
however, only nine of the ten series could be investigated as the Utilities sub-index of the JSE contains no
companies.

4 Data used in this study

The data used in this study was drawn from the Datastream database. The two indices focused on were
the JSE/Actuaries All Share 40 Top Companies Index (ALSI40) for the JSE and the Financial Times-Stock
Exchange 100 Share Index (FTSE 100) for the LSE. The nine sectoral indices for each market were sub-
indices of each of these two respective broad indexes. The data consists of the daily levels of both the broad
indices and the nine individual sub-series for both indices, running from 01/01/1996 to 31/12/2004, for a
total of 2351 observations over the full nine years.
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companies.

4 The sector classifications are: Basic industries, Cyclical consumer goods, Cyclical services, Financials, General industrials,
Information technology, Non-cyclical consumer goods, Non-cyclical services, Resources and Utilities.
the daily returns; and dummy variables were constructed for both markets to designate return periods that included the information of more than one period, i.e. Mondays and trading days following holidays. The LSE was used as a proxy for the international market when modelling international transmissions to South Africa for two major reasons. Firstly, there is strong evidence to suggest that the LSE is correlated with other major international exchanges. Hamou, Masulis and Ng (1990), amongst many others, find strong evidence of returns and volatilities associations amongst the three biggest exchanges, namely the LSE, the NYSE and the TSE, validating the use of the LSE as an proxy for the other markets. Secondly, when compared to the other major exchanges, the respective trading hours between the LSE and the JSE are relatively more concurrent.

It must however be noted that the trading hours of the LSE and the JSE are not perfectly concurrent, although there is significant overlapping. The LSE opens trading at 9:00 GMT and closes at 15:30 GMT, while the JSE trading hours run from 9:00 to 17:00, local time (GMT+02:00). Giving the relative time zones differences, this implies that the LSE starts trading two hours after the JSE opens, and suspends trading half an hour after the JSE closes. During Daylight Saving Time\(^5\) (DST), when the UK sets its clocks forward one hour (to GMT+01:00), the LSE opens one hour later and ends half an hour earlier than the JSE. While not ideal, this overlapping is not a significant problem in generating ‘clean’ correlations as the study uses daily data, the index level changes being investigated incorporates the information available for the entire previous day. As such, tests of concurrent association involve LSE returns and volatility on day \(t\) with JSE returns and volatility on the very same day \(t\). Lagged correlations (of lag \(i\)) are tested by investigating the relationship between the JSE returns and volatility for return period \(t\) and the LSE returns and volatility for period \(t-i\).

5 Methodology

This paper uses the methodology of Lin, Engle and Ito (1994) to model the international association effect. In their Aggregate-Shock model, the Foreign Daily Return on the LSE is specified as:

\[
FDR_t = \alpha_1 + \beta_1 FDR_{t-1} + \beta_2 DM + \epsilon_t \tag{1}
\]

where \(FDR\) is the foreign daily daytime return for period \(t\), defined as the percentage change in the respective index from open to close during trading period \(t\); and \(DM\) is a Monday/holiday dummy.

This estimation of the London Day return allows for both a potential autocorrelation of the Day returns with the previous Day returns (Persistence) and a monday/holiday dummy to take account of those return periods that incorporate the information of more than one period. The return not accounted for by these variables is the ‘surprise’ return \(\epsilon_t\). Assuming efficient markets, the ‘surprise’ return can be interpreted as the return on the index for period \(t\) that cannot be predicted based on public information available when the bourse commences trading.

It should be noted at this stage that this paper does not seek to explain how the surprise return \(\epsilon_t\) is generated, it is simply acknowledged that there is some underlying Data Generating Process (DGP) that provides a return of \(\epsilon\) at period \(t\). It is the international correlation of this \(\epsilon_t\) that this paper is concerned with, not its generation. As such, equation (1) does not include variables that could potentially explain FDR\(_t\), such as money market rates or commodity prices.

At the same return period \(t\), the paper models domestic daytime return on the JSE as:

\[
JDR_t = \alpha_2 + \beta_3 JDR_{t-1} + \phi_i L^i \epsilon_t + \beta_4 DM + \mu_t \tag{2}
\]

where \(L^i\) is the Lag Operator of \(\epsilon_t\), up to \(i\) lags.

In addition to the variables included in the formulation of the London Day return in equation (1), this domestic Day return equation incorporates \(\epsilon_t\), the ‘surprise’ return on the foreign bourse for period \(t\), at \(i\) lag(s). The coefficient associated with \(\epsilon_t\) is the relationship between foreign returns and JSE returns, up to \(i\) lags, one of the two associations investigated in this paper.

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\(^5\)Daylight Savings Time for the UK begins on the last Sunday in March at 01:00 GMT, and ends at 01:00 GMT on the last Sunday in October of that year.
The second association this paper investigates is that of the volatility on the London bourse and volatility on the JSE. As explained above in section 3, this is done using an EGARCH process. The surprise return $e_t$ is assumed to be normally distributed with a mean of zero and a variance that follows the EGARCH process:

$$\ln \sigma^2_t = \omega + \beta_{E} \ln \sigma^2_{t-1} + \gamma_{1} \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \alpha_{1} \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right|$$  \hspace{1cm} (3)

Here, the natural log of conditional variance of period $t$ for $e_t$ is a function of the time invariant mean reversion value, $\omega$, the natural log of past conditional variance, $\sigma^2_{t-1}$, and both the level and absolute value of the standardised residuals, $\varepsilon_{t-1}/\sigma_{t-1}$ and $|\varepsilon_{t-1}|/\sigma_{t-1}$, respectively.

The inclusion of the last two terms allows the modelling of volatility to be asymmetric to past shocks provided that $\gamma_{1} \neq 0$. If $\gamma_{1} > 0$, for example, then positive shocks (good news/positive past errors) will have a larger effect on volatility than negative shocks (bad news/negative past errors) do; the reverse would be true if $\gamma < 0$. If $\gamma = 0$ then the use of the EGARCH model would be inappropriate; a simple GARCH model would have sufficed given the symmetry of the shocks on the level of volatility.

This lag specification of a single ARCH term and a single GARCH term (i.e. an EGARCH(1,1) specification) for modelling the volatility was chosen for two reason. The first is that the (1,1) specification is by far the most standard formulation of the ARCH family models, being the most simple and robust (Engle, 2001). Secondly, the ARCH LM test showed that after the application of the (1,1) specification no ARCH terms remained present in the residuals for every single series in this study.

It is further assumed that the ‘surprise’ return on the JSE, $\mu_t$, is normally distributed with a mean of zero and a variance that follows the EGARCH process:

$$\ln \sigma^2_{j,t} = \omega_{j} + \beta_{j} \ln \sigma^2_{j,t-1} + \gamma_{j} \frac{\varepsilon_{j,t-1}}{\sigma_{j,t-1}} + \alpha_{j} \left| \frac{\varepsilon_{j,t-1}}{\sigma_{j,t-1}} \right| + \kappa_{j} \sigma^2_{j,t-1}$$  \hspace{1cm} (4)

where the subscripts $j$ and 1 denote domestic (JSE) and foreign (LSE) measures, respectively.

As with the formulation of the domestic return in equation (2), this specification of the variance of the JSE includes a foreign measure, $\sigma^2_{j,t}$ in addition to the variables included in the specification of the variance of the foreign return in equation (3). This allows for the explicit testing of the association between local volatility and foreign volatility, up to $i$ lags. The foreign conditional variance term in equation (4), $\kappa_{j} \sigma^2_{j,t-1}$, is the association between foreign volatility and domestic volatility.

The model as outlined above thus formally tests for the association of both returns and volatility on the JSE and the foreign bourse. It was estimated using a two step process. In step 1 equations (1) and (3) were estimated\(^6\), and the fitted values of $\varepsilon_{t}$ and $\sigma^2_{t}$, obtained. Equations (2) and (4) were then estimated using these fitted values, the results of which are presented in section 7 below.

### 6 Causation and Association

Before the results of the estimation are examined it needs to be made clear what the results actually indicate. The hypothesised link that is held by many market watchers is that the behaviour on the international markets cause certain behaviour on the domestic market. Higher returns on the LSE, under this view, cause higher returns on the JSE by themselves. However, as will be seen shortly, the dominant relationships between the domestic and foreign markets are concurrent, occurring during the same trading period. Movements on the LSE on a respective day are correlated with movements on the JSE predominately on that very same day. Given that the paper uses daily data, it is impossible to infer direction, or specifically cause, from this methodology. Rather, the paper’s methodology tests for evidence of association, not causation. What is tested is whether domestic market returns and volatilities are associated with domestic market returns and volatilities, not whether they cause domestic market returns and volatilities.

Given the relative size difference, there is the obvious tendency to interpret the associations as the LSE’s behaviour (at least partially) driving the JSE’s during a certain period. However, it may well be that any significant international concurrent relationships that are found represent not a causal transmission from the LSE to the JSE but reactions to some common globally relevant signal interpreted by both domestic

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\(^6\)As the residuals (‘surprise returns’) of some of the series were suspected of being leptokurtic, Bollerslev and Wooldridge (1992) quasi-maximum likelihood (QML) covariances and standard errors were always computed.
and foreign market participants as independently influencing their respective indices. A change in the world gold price, for example, would affect gold producing companies in all countries directly. Even evidence of a significant relationship between the lagged behaviour of foreign markets and current domestic markets cannot be interpreted as providing evidence of causality, even of the specific Granger type. Lags would be present regardless of the existence of directional causality if markets in both countries take longer than one trading period to correctly price in the new information provided by some global signal. Significant lagged effects would also be present if a certain market incorporated new globally relevant information faster than another market, but even under these conditions it cannot be said that the one market’s behaviour is causing the other market’s behaviour, it is simply leading it in time.

This problem of separating globally relevant market signals from the effects caused entirely by international market movements (pure contagion) is a classic signal extraction problem. Together, these two effects combine to form the global factor, with the result being that this paper can only discuss domestic returns and volatilities as being associated with foreign returns and volatilities, not caused by them. However, while this paper cannot state that domestic market movements are caused to a certain extent by international markets, it can estimate the degree that local markets are affected by the global factor, using the LSE returns and volatilities as a proxy for it. In other words, the paper estimates the existence, magnitude and direction the global factor exerts on the JSE, where the global factor consists of both foreign bourse behaviour and globally relevant market signals.

7 Results

The results of the relationship tests are given in tables 1, 2 and 3 below. Table 1 shows the effects for each individual years, from 1996 to 2004, for the broad indexes as a whole. For each year both the significant association periods and the magnitude of the global factor effects are estimated.

Addressing the problem of differing bourse compositions, Table 2 extends the same analysis to each of the nine sub-sectors of the JSE. Two things should be kept in mind when examining this table. Firstly, the estimated effects are for the period as a whole and, secondly, the relationships tested are those between a respective LSE sector and the same respective JSE sector. The results given for the Basic Industries index, for example, is the association between the returns and volatilities of the LSE’s Basic Industries index and the returns and volatilities of the JSE’s Basic Industries index.

In order to gain further insight, Table 3 concludes the analysis into the global factor by providing some insight into its magnitude and direction, through the main association period, on the JSE by providing the coefficient estimates of the main foreign variables for each sector. In addition, Table 3 also provides evidence supporting the use of the EGARCH methodology to model the foreign effect.

The results provided in Table 1 provide strong evidence to suggest that the returns on the JSE are most associated with international returns during the very same trading period for every year of the study. During the latter half of the period, from 2000 to 2004, there is also evidence of a one period lag effect of international returns on local returns. The relationship between domestic and foreign volatility, in contrast, is more mixed. For four of the nine years there is no evidence of any significant relationship, concurrent or lagged, between domestic volatility and foreign volatility, while for other three years there is only evidence of a concurrent relationship. In the years 2000 and 2004, in contrast there is evidence of a lag effect in addition to a dominant concurrent effect.

The average explanatory power of the foreign effects is 19.1%, although it differs greatly between the years. The global factor is most important in 1998 (36.6%) and the least important in 1996 (10.3%). For the full period as a whole, from the 1st of January until the 31st of December 2004, 21.0% of the movement of the ALSI40 was associated with the movements on the FTSE100, imply that in general around one fifth of the local equity market’s daily behaviour is determined outside of South Africa.

Table 2 extends the analysis by estimating the main association periods for both returns and volatilities. As can be seen, in every sector the dominant return period is during the same concurrent trading period, although there is also strong evidence of additional lagged associations being present as well. The Information Technology sector, for example, experiences the effects of return movements on the LSE up to 6 periods later, and Cyclical Consumer Goods up to 4 periods later.

As was found with the yearly analysis, the association of international volatility is again markedly dif-
different from the association of returns. In some sectors, namely the Cyclical Consumer Goods and General Industries, there are no significant effects of international volatility at all. In contrast, global volatility affects local volatility on the Basic Industries sector not concurrently but at lags of one and two periods later. In the other six sectors though international volatility was found to significantly affect domestic volatility during the same concurrent trading period; and with most of those sectors having additional lagged relationships.

As also shown in Table 2, the sectors differ not only in respect to when the global factors affect them but also to the degree that they are affected. The most globally affected sectors on the JSE are the Financial, Cyclical Services and Information Technology sectors, with foreign factors explaining 18.4%, 16.3% and 14.2% of the movement in their returns, respectively. The sectors found to be least globally affected using this methodology were the Cyclical Consumer Goods sector (3.9%) and the non-Cyclical Consumer Goods sector (5.4%). A possible explanation for this low is that these consumer based sectors are determined more by local conditions than by global factors.

The last two columns of Table 3, provide estimates of the coefficient of $\gamma$, the EGARCH term. As can be seen, with the exception of the Basic Industries sub-indices the null hypotheses of symmetry ($\gamma = 0$) can be rejected for all sub-indices and for the index as a whole, validating the use of EGARCH modelling. For eight of the nine sectors, and for the broad index as a whole, the null hypothesis of symmetric responses to both goods news and bad news can be rejected at the 5% level, with the additional ninth sector, Non Cyclical Consumer Goods, being rejected at the 10% level. Basic Industries appears to be the only sub-index where symmetric responses to past shocks cannot be rejected. In general though, the estimated coefficients suggest that the volatility on the markets reacts far more to negative shocks (bad news) than to positive shocks (good news); negative market returns appear to have a far greater effect on the magnitude of current volatility than do positive past errors.

This result of a negative relationship between returns and volatility is well documented in the financial literature, with Turner, Startz and Nelson (1989), Glosten, Jagannathan and Runkle (1993), and Nelson (1991), amongst others, finding evidence of such a relationship amongst US equities. The reason for this negative association is not widely agreed upon, with the literature providing two dominant explanations. The first view is based on a firm level financial leveraging effect. A negative return, i.e. a drop in the value of a stock, implies greater financial leverage of that firm, which makes the stock riskier and hence more volatile (Bekaert and Wu, 2000). The second view has the causality running in the other direction. Under this view, originally associated with Pindyck (1984), markets price in volatility as a type of risk. Anticipated higher volatility on a stock raises its required return, and hence leads to an immediate negative price return.

As can also been seen in Table 3, the effect of both international returns and volatility on the JSE is positive for all nine sub-indices and for the ALSI40 as a whole. Positive returns on the LSE are associated with positive returns on the JSE, and negative LSE returns with negative returns on the JSE. For the Basic Industries sub-indices for example, an increase in the sub-index on the LSE by 1 percent is associated with a 0.464 percent increase in respective index on the JSE. For the Financial sub-index, the respective relationship is a 0.334 percent increase in the JSE sub-index for a one percent return on the LSE Financial sub-index. For the JSE ALSI40 index as a whole over the full period, a one percent increase in the LSE FTSE 100 index is associated with a 0.425 percent increase in the ALSI40 index.

The estimated relationships between foreign and domestic volatility during the same trading day are also found to be positive. Higher volatility on the LSE is associated with higher volatility on the JSE, and lower LSE volatility with lower JSE volatility. This is true for the ALSI40 index as a whole and for all sub-indices except for the General Industries sector, where no significant international association was found. However, while the relationships were all found to be positive, there was a large difference in the magnitude of the effects. The volatility of the Non Cyclical Consumer Goods sector, for example, increases by 0.941 units for every one unit increase in the volatility on the same sector on the LSE, an almost unitary relationship. In contrast, the relevant figures for the Information Technology is only a 0.160 unit increase for every unit increase in volatility on that respective sector on the LSE. For the JSE as a whole, this paper found that a one unit increase in volatility on the FTSE100 is associated with a 0.560 unit increase in volatility on the ALSI40 during the same trading day.

7
8 Conclusion

This paper tested empirically the widely held view that the JSE’s behaviour is associated with international market behaviour. Using the LSE as a proxy for the international market, this paper found four significant results regarding this international/local relationship.

The first is that there exists a positive relationship between domestic market returns and international market returns. Bullish (bearish) international returns were found to be associated with bullish (bearish) domestic returns.

The second important result is that there also exists a positive relationship between domestic and international volatility. Periods of higher (lower) international volatility were found to be, on the whole, associated with periods of higher (lower) domestic volatility.

Another important outcome of this study was that these two positive associations were found to exist principally during the same concurrent trading period. The behaviour of the JSE on a certain day was found to be primarily associated with international market behaviour during that concurrent trading period, implying that foreign markets cannot be used as a signal of future JSE behaviour. However, this result needs to be qualified in noting that this study used daily return periods to investigate the relationship, whereas equity price changes happen at far smaller intervals. Using finer grained data it could well be established that international market movements anticipate local market movements, providing possible excess return generating information.

The fourth and final significant result generated using this analysis is that the global relationships that were found were far from universal. A large degree of heterogeneity was found to exist across different years and different sectors with respect to the existence, magnitude and importance of global factors.

In conclusion then, while caution must be exercised in inferring causation, this study found that the widely held view that domestic market behaviour is associated with international market behaviour has some empirical legitimacy.

References


Table 1: Returns and Volatility Association between the LSE and the JSE, 1994 to 2004

<table>
<thead>
<tr>
<th>Returns Association</th>
<th>Volatility Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concurrent Association</td>
<td>Main Association Period*</td>
</tr>
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<td>1996</td>
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</tr>
<tr>
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<tr>
<td>2004</td>
<td>Yes</td>
</tr>
<tr>
<td>Full sample</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Defined as the most significant period.
- No Significant Associations
† Significant at the 5% level
‡ Defined as the change in the Adjusted R² of the estimation of the relevant equation with and without the significant variables.

Table 2: Returns and Volatility Association between the LSE and the JSE, by Sector

<table>
<thead>
<tr>
<th>Returns Association</th>
<th>Volatility Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concurrent Association</td>
<td>Main Association Period*</td>
</tr>
<tr>
<td>Basic Industries</td>
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</tr>
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<td>Cyc. Cns. Gds</td>
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</tr>
<tr>
<td>Cyc. Services</td>
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<tr>
<td>Financials</td>
<td>Yes</td>
</tr>
<tr>
<td>Gen. Industries</td>
<td>Yes</td>
</tr>
<tr>
<td>Inform. Tech.</td>
<td>Yes</td>
</tr>
<tr>
<td>N. C. Cns. Gds</td>
<td>Yes</td>
</tr>
<tr>
<td>N. C. Services</td>
<td>Yes</td>
</tr>
<tr>
<td>Resources</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Defined as the most significant period.
- No Significant Associations
† At the 5% level
‡ Defined as the change in the Adjusted R² of the estimation with and without the significant variables.
Table 3: Effects of Main Returns and Volatility Association between the LSE and the JSE, by Sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>Main Variable of Returns</th>
<th>Coefficient</th>
<th>P-Value</th>
<th>Period</th>
<th>Coefficient</th>
<th>P-Value</th>
<th>γ</th>
<th>γ=0⁺</th>
</tr>
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<tbody>
<tr>
<td>Basic Industries</td>
<td>t</td>
<td>0.464</td>
<td>0.000</td>
<td>t-1</td>
<td>0.596</td>
<td>0.000</td>
<td>-0.003</td>
<td>0.659</td>
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<tr>
<td>Cyc. Cons. Gds</td>
<td>t</td>
<td>0.210</td>
<td>0.000</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-0.072</td>
<td>0.000</td>
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<tr>
<td>Cyc. Services</td>
<td>t</td>
<td>0.336</td>
<td>0.000</td>
<td>t</td>
<td>0.450</td>
<td>0.000</td>
<td>-0.023</td>
<td>0.000</td>
</tr>
<tr>
<td>Financials</td>
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<td>0.334</td>
<td>0.000</td>
<td>t</td>
<td>0.376</td>
<td>0.000</td>
<td>-0.044</td>
<td>0.000</td>
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<tr>
<td>Gen. Industries</td>
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<td></td>
<td>-</td>
<td>-</td>
<td>-0.061</td>
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<td>t</td>
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<td>-0.026</td>
<td>0.002</td>
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<td>0.000</td>
<td>t</td>
<td>0.601</td>
<td>0.000</td>
<td>-0.014</td>
<td>0.031</td>
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<tr>
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<td>t</td>
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<td>-0.036</td>
<td>0.000</td>
</tr>
</tbody>
</table>

* Defined as the most significant period.
⁺ Wald Test F-Stats' P-Value: Null: γ=0
- No Significant Associations