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Price Changes and Trading Volume Relationship: Some Preliminary Evidence from the Kuala Lumpur Stock Exchange

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ABSTRACT

This study provides evidence the relationship between price changes and volume of trading of firms listed on the KLSE. Absolute price changes were found to have a strong relationship with trading volume compared to price changes per se. Transaction volume associated with a price upturn was, on average, larger than the transaction volume associated with a price downturn, which probably explained the positive correlation between price changes and trading volume. Causality tests indicated that price changes cause volume changes but not vice versa. The interaction test showed that large transaction volume coupled with an increasing trend in price will further gather momentum and result in a further increase in price. This finding, however, does not suggest that the KLSE is weak-form inefficient. The findings defy the basic tenet of technical analysis that past price volume data can be consistently used to design profitable investment strategies.

ABSTRAK

This study provides evidence regarding the relationship between price changes and volume of trading of firms listed on the KLSE. Absolute price changes were found to have a strong relationship with trading volume compared to price changes. Transaction volume associated with a price upturn was, on the average, larger than the transaction volume associated with a price downturn which probably explained the positive correlation between price changes and trading volume. Causality tests indicated that price changes cause volume changes but not vice versa. The interaction test showed that large transaction volume coupled with an increasing trend in price will further gather momentum and result in a further increase in price. This finding, however, does not suggest that the KLSE is weak-form inefficient which provides an opportunity to investors to devise strategies as there is evidence that the KLSE is weak-form efficient and pockets of inefficiencies observed are not economically viable. The findings defy the basic tenet of technical analysis that past price volume data can be consistently used to design profitable investment strategies.

INTRODUCTION

There is copious evidence (Karpoff 1987) of the relationship between price changes and trading volume from developed markets, which provides an insight into the structure of their financial markets. The price-volume relationship depends on the rate of information flow to the market, how the information is disseminated, the extent to which market prices convey the information, the size of the market and the existence of short sales constraints. Empirical relations between prices and volume can help discriminate between differing hypotheses about market structure.

Volume, together with price changes, reflects two things: a lack of consensus, or agreement, about how a newly disclosed piece of (public) information should be interpreted, and the extent to which that information changes individual investor expectations (Beaver 1968).

The most notable relationship between price changes and trading volume is that absolute price changes and price changes *per se* are positively correlated with trading volume, though it is recognised that this relationship is generally weaker for the latter. This is probably due to the asymmetric volume, and price change is greater when the price moves up than when it moves down. Such an asymmetric relationship may be due to the differences in the costs of holding equity and short-selling stocks. A lagged relationship between trading volume and price change is generally found to be not significant (Rogalski 1978). This is inconsistent with the inveterate belief of most technical analysts that movement of prices in one direction coupled with increasing trading volume repeats itself over time. There is no published evidence regarding the relationships between trading volumes and price changes of firms listed on the Kuala Lumpur Stock Exchange (KLSE). This study provides some evidence on the relationship.

Theoretical treatment of trading volume arises in the literature in at least three settings: its relation to the bid-ask spread, its relation to price changes and its relation to information. Empirical evidence suggests that volume is negatively related to the bid-ask spread (Karpoff 1987). Studies on price-volume relation were fist conducted indirectly by Osborne (1959, 1962), who attempted to model the stock price change as a diffusion process with variance dependent on the number of transactions, implying a positive correlation between absolute price change and trading volume. Assuming transactions are uniformly distributed in time, he expressed the price process in terms of time intervals but did not directly address the volume-price issue. Osborne's work was later developed with various modifications (Tauchen and Pitts 1983).

Stock price series and the series of sales of stock are wholly unrelated (Crouch 1970), and in the same vein, no connection could be found between the price series and the corresponding volume of transaction series. Their failure to detect significant correspondence between price and volume led to questions on the applicability of existing theory (Godfrey *et al.* 1964). The failure to uncover (Ying 1966) a price-volume relation motivated further analysis (Ying 1966) by applying a series of chi-square tests, analyses of variance and cross-spectral methods to six-year, daily series of price and volume. The findings were consistent with the literature (Karpoff 1987), but his empirical methods were criticised.[1] Nevertheless, Ying was the first to document both price-volume correlations in the same data set.

Trading volume is also important in the "mixture of distributions" models (Taucten and Pitts 1983) which provide explanations of the leptokurtosis in the empirical distributions of speculative prices. These models predict that volume is positively related to the size of the corresponding price change over fixed intrvals or on a given transaction. The model (Pfleiderer 1984) considers price and volume in a noisy rational expectations equilibrium. The magnitude of the price change is not correlated with trading by speculators with private information but is positively related to trading by liquidity-motivated investors. So the strength of the correlation between absolute price changes and volume is negatively related to the existence of private information.

The lack of consensus (Beaver 1968), could be induced by a new piece of information, e.g. the earnings report. Since investors may differ in the way they interpret the report, some time may elapse before consensus is reached, during which time increased volume would be observed. If consensus were reached on the first transaction, there would be a price reaction but no volume reaction, assuming homogeneous risk preferences among investors. If risk preferences differ, there still could be a volume reaction, even after the equilibrium price had been reached (Verrecchia 1981).

Several theoretical models have been developed to detect the relation of trading volume to price changes. A new model in which a common bit of information arrives sequentially to investors is also tested (Epps 1975). Using simulations, he shows that volume, after all investors receive the information, is positively related to the magnitude of the price change. This model was extended (Jennings *et al.* 1981), to include real-world margin constraints and the possibility of short sales and come up with the additional prediction that volume is relatively heavy on transaction when price moves up. However, a significant feature of each of these models is a dependence on behavioural distinctions between groups of market participants, e.g. "bulls" vs. "bears" or "optimists" vs. "pessimists".

[1] One problem arises because the S&P 500 price and the NYSE percentage volume series used in this study are not necessarily comparable. Secondly, there was a problem in adjustment of data, the price series was adjusted by quarterly dividends data and the volume series was adjusted by monthly data on the number of oustanding shares. Several findings reported in this study are inconsistent with weak-form efficiency.

MATERIALS AND METHODS

The study covers the daily activities in the KLSE from January 1985 to December 1992. Daily data of the Composite Index (CI) and total market volumes were collected from the Daily Diary at the KLSE library. The changes in the logarithms of the daily closing Composite Index values are used as a measure of the market performance or price changes of the market as a whole:

$$\text{lnci}_{it} = \text{lnci}_{it} - \text{lnci}_{it-1}$$

The changes in the logarithms of the KLSE Composite Index lnci it (denoted as CI, hereafter) were regarded to be the price changes of the market as a whole. The daily total market turnover divided by the closing index was used as a proxy of volume transacted in the whole market (denoted as V, hereafter) (Lam *et al.* 1989).

Method

Test 1A: The daily absolute price change of CI was correlated against the daily volume (V) to observe any significant correlation between them. Statistical analyses in this test are performed on a yearly basis to bypass the possible non-stationarity of the time series CI and V.

Test 1B: The measure of the effect of volume on the magnitude of price changes was quantified by dividing the days in a year into three equal groups with small, medium and high volume of transaction (V). Then the analysis of variance test was performed to ascertain any significant differences in the absolute price changes for the three groups (Chan 1989). The results were thought likely to substantiate the findings int Test 1A.

Test 2A & 2B: Test 1A and 1B are repeated using the change in price (ΔCI) and volume. Any statistical difference in results using the change in price and absolute price change, CI, is observed.

Test 3: Here we will test if there is any difference in the ΔCI and V relationship in a "bull" and "bear" market. The asymmetric relationship between ΔCI and V is tested with regressions, where ΔCI is an independent variable and V is the dependent variable, expressed as follows:

$$V = \alpha + \beta\ \Delta\ CI = \gamma\ (D_t)\ (\Delta\ CI) + \epsilon_t$$

where D_t is a dummy variable introduced to indicate a positive price movement ($D_t = 1$) or a negative price movement ($D_t = 0$). The CI and V relationship will have slope $\beta + \gamma$ on positive price movements and slope β - on negative price movements. The hypothesis of symmetry is H_0: $\beta = \gamma = \beta$- and the asymmetric alternative is H_1: $\beta + \gamma > \beta$-. The number of years with or without asymmetric relationship are observed.

Test 4A & 4B: Instead of looking at an individual lagged or leading relationship, we are proposing here to study the causality relationship between price changes (ΔCI) and trading volume (V). To ascertain the causality between trading volume and price changes, that is whether trading volume causes price changes or vice versa, a causality test is carried out by using Granger and Newbold's approach (1986) with the following linear models tested on 4 lags:

$$CI = c + \Sigma\alpha_i\ \Delta\ CI_{t-i} + \Sigma\beta_i\ V_{t-i} + \epsilon_i$$

In the first direction, the CI is taken as the dependent variable and lagged V (up to 4 lags as k is 4) is the independent variable. For the second direction, the roles are reversed as V is the dependent variable and lagged CI (4 lags) is treated as the independent variable.

To test for causality, one can test for the null hypothesis

$$H_0 : \beta_1 = \longrightarrow = \beta_k = 0.$$

In testing the causality between V and ΔCI, a one-way Granger causality test as suggested (Geweke 1984) was applied. This test uses the ordinary least squares regression and the following specification is used to test causality between X (V) and Y (ΔCI) and vice versa:

$$Y_t = \alpha_0 + \Sigma\alpha_i\ Y_{t-i} + \epsilon_t \quad (1)$$

$$Y_t = \beta_0 + \Sigma\beta_i\ Y_{t-i} + \Sigma\beta_k\ X_{t-k} + \mu_t \quad (2)$$

where ϵ_t and μ_t are disturbance terms, α_i and β_i are parameters relating Y_t, and its lagged values, and β_k are parameters relating X_k and its lagged variables. As a rule of thumb applied in most causality studies, four lags of X_t were used in this study. A null hypothesis test that X does not cause Y based on equation (1) and (2) is carried out with the F-statistic estimated as follows:

$$F = \frac{[(SSE_1 - SSE_2/N)]}{[(SSE_2/T\text{-}M\text{-}N\text{-}I)]}$$

where SSE_1 and SSE_2 are the sum of squared errors from the OLS regression on equation (1) and (2) respectively. T is the number of time series observations on Y_t and under the null hypothesis, F is distributed with (N, T-M-N-1) degrees of freedom. M and N are the number of lags in the Y and X variables respectively.

The first direction of causality is whether trading volume causes price changes and the second direction is whether price changes affect trading volume.

FINDINGS

Test 1A:- Relationship between Absolute Price Change and Trading Volume

Much research has been done to verify an old Wall Street adage which purports that "It takes volume to move prices". The findings suggest that absolute price changes and trading volume are positively correlated (Ying 1966; Tauchen and Pitts 1983).

Table 1 shows the correlation coefficient (CORR.COEFF) of absolute change in price and trading volume of stocks traded on the KLSE. It shows that absolute price change and trading volume are significantly positively correlated at the 0.05 level for 6 years and significant at the 0.01 level for 5 years. The correlation coefficient ranges from 0.064 to 0.256. The average correlation coefficient is 0.178. These findings suggest a significant positive relationship between absolute price change and trading volume.

Test 1B:- Percentage Price Change and Trading Volume

Table 2 presents the level of volume of trading and the respective changes in prices. For days with high transaction volume, CI, the average magnitude of percentage changes in price is 41.02%. The corresponding percentage changes for medium and low volume of transactions are 33.67% and 17.76% respectively. These results are consistent with the findings in Table 1.

TABLE 1
Correlation coefficient of absolute price change in CI and Volume

Year	Correlation Coefficient	Calculated F	0.05* @ 3.84	0.01* @ 6.63
1985	0.256	15.06	S	S
1986	0.240	15.05	S	S
1987	0.092	2.11	NS	NS
1988	0.193	9.40	S	S
1989	0.163	6.57	S	NS
1990	0.174	7.52	S	S
1991	0.243	15.53	S	S
1992	0.064	1.005	NS	NS
Average:	0.178			
Range:	0.064	-0.256		

*S-significant; NS-not significant

TABLE 2
Returns of absolute change in CI

Year	High Vol.	Medium Vol.	Low Vol.
1985	0.3420397	0.2248928	-0.0259892
1986	0.3772001	0.2266355	0.0038502
1987	0.4818671	0.4702048	0.4105656
1988	0.3408360	0.2442127	0.1017804
1989	0.2596216	0.2359643	0.1602895
1990	0.6417344	0.4748443	0.2975938
1991	0.4591374	0.4420092	0.1864945
1992	0.3788542	0.3746953	0.2859335
Average	0.4101638	0.3366824	0.1775648

Magnitude of the percentage price changes represents risk on the part of investors. Findings in Table 2 are consistent with the belief that risk is higher on days with higher volume transactions. The percentage price change for the high volume category is on average 23.26% higher than the low volume category. However, the analysis is not totally satisfactory as the classification into low, medium or high volume is arbitrary. The relationship between risk involved and volume transacted is investigated further and reported in a later section.

Table 2A + 2B:- Relationship Between Price Change and Trading Volume

There is evidence of a positive relationship between price changes and trading volume, though there is no consensus on the theoretical explanation of this phenomenon. The findings in the study reported in Table 3 show the correlation coefficients of price changes and volume for KLSE are significant and positively related with an average yearly correlation coefficient (Richardson *et al.* 1986) of 0.151.

These findings suggest a positive relationship between price changes and trading volume. However, there is no clear relationship between price changes during different levels of trading volume (Table 4).

TABLE 3
Correlation coefficient of price change *per se* in CI and Volume

Year	Correlation Coefficient	Calculated F	0.05* @ 3.84	0.01* @ 6.63
1985	0.183	7.40	S	S
1986	0.230	13.70	S	S
1987	0.077	1.48	NS	NS
1988	0.100	2.47	NS	NS
1989	0.047	0.53	NS	NS
1990	0.187	8.78	S	S
1991	0.304	25.07	S	S
1992	0.081	1.62	NS	NS
Average:	0.151			

Range: 0.047 to 0.304
*S- significant; NS- not significant

TABLE 4
Returns of price change in CI

Year	High Vol.	Medium Vol.	Low Vol.
1985	0.0004357	-0.0011440	-0.0007786
1986	0.0027643	-0.0008770	-0.0015030
1987	0.0008233	-0.0003083	-0.0003374
1888	0.0007868	0.0008865	-0.0000136
1989	0.0012246	0.0009588	0.0002321
1990	0.0009452	-0.0008133	-0.0007094
1991	0.0018570	-0.0003661	-0.0009933
1992	0.0010465	0.0001060	-0.0003904
Average	0.0012354	-0.0001947	-0.0005617

The average value of price changes for days with high volume is 0.124%. The equivalent figure for medium and low volume is negative 0.195% and 0.0562% respectively. The average daily changes were negative when transaction volume was medium or low.

The literature suggests that although there is a positive correlation between ΔCI and V, it is generally weaker than that between CI and V. The findings in this study (Table 5) are consistent with the literature.

TABLE 5
Absolute price change and price correlation coefficient

Year	Corr. Coeff Absolute	Corr. Coeff. ΔCI	Accept ABD or ΔCI
1985	0.256	0.183	ABS
1986	0.240	0.230	ABS
1987	0.092	0.077	ABS
1988	0.193	0.100	ABS
1989	0.163	0.047	ABS
1990	0.174	0.187	ΔCI
1991	0.243	0.304	ΔCI
1992	0.064	0.081	ΔCI
Average:	0.178	0.151	ABS

A theoretical explanation of the positive relationship between ΔCI and V is that there is an asymmetry in the relationship when ΔCI is positive and negative. Note that if the relationship were symmetrical, there would be no correlation between ΔCI and V. This is further investigated in the next section.

Test 3:- Asymmetry in the price and Trading Volume Relationship

A model was developed (Beaver 1968) to show that the trading volume and price changes relationship is steeper for positive returns than for non-positive returns. The findings suggest that days with general price increase were found to have a larger transaction volume than days with equivalent price decrease. Their model relies on a behavioural distinction between two types of investors, "bulls" and "bears". However, there is evidence (Karpoff 1987) that the asymmetry is not to behavioural distinction, but to the institutional rules which raise the cost of selling short, and observed that in some futures markets, the relationship between price changes and volume is not significant as no asymmentry can be found. In such markets, the costs of going long and short are the same and hence no asymmetry can be observed.

Short selling is illegal in Malaysia. The cost of selling short can be regarded as much higher than of buying, therefore asymmetric relationships between price changes and volume are expected on the KLSE.

Test 4:- Causality Relationship between Price Changes and Trading Volume

Karpoff (1987) suggested that the relationship between price changes and trading volume was almost entirely contemporaneous, as most leading and lagged relations were statistically insignificant. In this study, causality tests were carried out to determine (1) whether trading volume causes price changes and/or (2) whether price changes affect trading volume.

The first direction of causality is whether trading volume causes price changes, which interest investors and/or speculators because if there is a significant causality relationship, then past volume data can be used to devise investment strategies. If their strategies are economically viable, this would imply weak-form inefficiency. Contrary to the belief of technical analysts, in a weak-form efficient market, past information (including data on trading volume) is already fully reflected in the current price and would not be useful for predicting future prices.

Findings in Table 6 show that there is no causality between trading volume and price changes. This implies that linear relationship between V and ΔCI cannot be used to predict future price changes. However, it does not preclude the possibility of a non-linear relationship between V and ΔCI which can give better prediction of price changes. There is some evidence (Table 7) which suggests that the lagged relationship between trading volume and price changes is interactive. This arises from the observation of large transaction volume with an increasing trend in prices, which implies that the market is gathering momentum and the price will increase further. However, the economic viability of such a relationship in designing profitable investment strategies is not ascertained. The earlier findings of no causality between volume and price changes suggest that at best this interaction is weak.

TABLE 7
Causality between price changes and trading volume

Year	β	γ	Accept HO or H1
1985	0.0087679	-0.5941733	H1
1986	0.0040950	0.4551683	H1
1987	0.0019589	0.9551814	H1
1988	-0.0004767	-0.1726059	H1
1989	0.0059158	-1.3397898	H1
1990	0.0027263	0.39551411	H1
1991	0.0022803	-0.8732490	H1
1992	0.0014456	-0.6732561	H1

TABLE 6
Causality between price changes and trading volume. Direction: trading volume causes price changes

Dependent Variable	Lag	Calculated F	0.05* @ 2.37	0.01* @ 3.32
ΔCI	1	0.0600	NS	NS
ΔCI	2	0.0059	NS	NS
ΔCI	3	0.0298	NS	NS
ΔCI	4	0.0238	NS	NS

* Key: S - significant; NS - not significant

TABLE 8
Causality between price changes and trading volume. Direction: Price changes trading volume

Dependent Variable	Lag	Calculated F	0.05* @ 2.37	0.01* @ 3.32
V	1	13.30	S	S
V	2	7.690	S	S
V	3	2.807	S	NS
V	4	1.904	NS	NS

* Key : S - significant; NS - not significant

The second direction of causality is whether price changes affect trading volume. Findings in Table 8 suggest that at the 0.05 level 3 lags are significant, while at the 0.01 level, only 2 lags are significant. Therefore, the alternative hypothesis that price change drives trading volume cannot be rejected.

CONCLUSION

This study provides evidence regarding the relationship between price changes and volume of trading. Absolute price changes are found to have a strong relationship with trading volume compared to price changes *per se*. Days with high volume are found to be associated with greater price changes than days with low volume. Asymmetric flow of information is a possible reason for these simultaneous large volumes and large price changes (either positive or negative). Investors should be wary that risks are higher on days with high volumes.

For the KLSE, transaction volume associated with a price upturn is, on average, larger than the transaction volume associated with a price downturn. This asymmetry is suspected to be the reason behind the positive correlation between price changes and trading volume. If changes in prices are a reflection of risk, the findings show that risk on days with high volume is higher than on days with a lower volume of trading. This could be attributed to the highly speculative mode of trading in the KLSE.

Causality tests indicate that there is a two-way (direction of causality) relationship between price changes and trading volume. The test indicates that price changes affect volume but volume does not cause price changes. The interaction test implies that large transaction volume coupled with an increasing trend in price will further gather momentum and result in a further increase in price. This finding, however, does not suggest that the KLSE is weak-form inefficient and therefore provides an opportunity for investors to devise strategies as there is evidence (Annuar *et al.* 1991) that the KLSE is weak-form efficient and pockets of inefficiencies observed are not economically viable.

The above preliminary findings on the price-volume relationship in the KLSE are consistent with the findings in developed markets. This implies that investors and the regulating agencies should not be unduly alarmed at occasional temporary price-volume irregularities. The market is fairly efficient, and is capable of weeding out irregularities over time.

These findings are inconsistent with the basic tenet of technical analysis that past price volume data can be consistently used to design profitable investment strategies. KLSE is a weak-form economically efficient market. Any profitable investment strategy based on past price volume data will not be able to generate profits consistently.

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