CHAPTER 3

INTRADAY RETURN AND VOLUME BEHAVIOUR

3.1 Introduction

In this chapter, we discuss the results on intraday return volatility, variation in return, trading volume behaviour, variation in volume, overall increasing trend and the change in the speed of price adjustment.

3.2 Intraday Price Volatility

The CI average return for the three subperiods are presented in a tabular form in Tables 3.1(a), 3.2(a) and 3.3(a) and in a graphical form in Chart 3.1. It is obvious from Chart 3.1 that the returns form a U-shape with a peak in the first 15-minute interval of trading for the day and another peak at the last 15-minute interval before the close.

The return before the extended trading hours is positive at the opening with an average of 0.0129 per cent at time 1015.

Table 3.1(a)
Statistics of Intraday Composite Index Returns (%) for Subperiod 1: 9 March 1992 - 21 July 1992

	Average	Skewness	Kurtosis	Standard Deviation	Variance Ratio
Overnight	0.011185	0.641268	12.124760	0.072242	1.066606
1000-1015	0.012903	-0.035615	5.834961	0.098482	1.982158
1015-1030	0.005782	0.776816	4.830827	0.060347	0.744279
1030-1045	-0.003388	0.094327	5.167806	0.039657	0.321414
1045-1100	-0.012437	-0.435801	3.683573	0.044317	0.401389
1100-1115	-0.001125	0.553949	6.888245	0.038944	0.309960
1115-1130	-0.002999	2.205270	17.262300	0.048482	0.480381
1130-1145	-0.004248	0.037879	7.588437	0.031542	0.203331
1145-1200	-0.004839	1.122608	7.772437	0.032737	0.219029
1200-1215	-0.002340	0.177067	7.725541	0.030042	0.184452
1215-1230	-0.003795	-1.578664	12.176450	0.036423	0.271129
Lunch Break	-0.007086	-0.755590	6.691482	0.034306	0.240527
1430-1445	-0.002621	-1.503143	10.444590	0.046171	0.435675
1445-1500	-0.006016	-0.174651	7.829161	0.051975	0.552095
1500-1515	0.003274	1.969957	10.844860	0.045760	0.427954
1515-1530	-0.004142	1.847440	9.762946	0.058968	0.710653
1530-1545	-0.006773	0.522128	4.435217	0.048764	0.485985
1545-1600	0.040141	-0.256458	2.702694	0.069950	1.000000
MO-MC	-0.037963	-0.381721	4.106835	0.444313	
AO-AC	0.054945	0.323457	6.374394	0.362796	
MO-AC	0.000667	-0.141725	3.561296	0.679616	

Note:
1. MO, MC, AO and AC denote Morning Open, Morning Close, Afternoon Open and Afternoon Close respectively.
2. Overnight return is calculated by using the MO and the previous AC.
3. Variance ratio is calculated by dividing the particular intraday variance with the closing variance.

Source:KLSE

Table 3.2(a)
Statistics of Intraday Composite Index Returns for Subperiod 2: 22 July 1992 - 27 November 1992

	Average	Skewness	Kurtosis	Standard Deviation	Variance Ratio
Overnight	-0.007352	-8.356758	74.758500	0.260222	16.031774
0930-0945	0.033973	3.567673	23.694650	0.109855	2.857151
0945-1000	0.001844	0.221997	4.115853	0.063964	0.968645
1000-1015	-0.006703	0.145455	4.000896	0.050016	0.592259
1015-1030	-0.004838	2.362465	15.397170	0.050667	0.607777
1030-1045	-0.013474	0.550040	7.001231	0.049227	0.573720
1045-1100	-0.007585	0.060852	3.494339	0.036899	0.322346
1100-1115	-0.001973	0.827511	6.094441	0.035842	0.304143
1115-1130	0.001470	1.129370	6.425769	0.039737	0.373838
1130-1145	-0.001411	0.885107	6.567762	0.035803	0.303482
1145-1200	-0.001101	-0.653855	6.664769	0.043003	0.437815
1200-1215	0.002592	0.186302	4.709004	0.038332	0.347870
1215-1230	-0.000117	-0.678987	6.287779	0.039798	0.374987
Lunch Break	-0.000396	-0.634373	6.303395	0.030367	0.218322
1430-1445	0.005631	-0.624134	7.127071	0.044241	0.463387
1445-1500	-0.005760	-0.016242	5.834326	0.056500	0.755771
1500-1515	-0.007745	0.848320	8.697490	0.053048	0.666241
1515-1530	-0.004030	1.095602	6.146300	0.057386	0.779660
1530-1545	0.001163	0.189139	4.229437	0.036924	0.322783
1545-1600	0.001412	1.605406	10.732370	0.046997	0.522918
1600-1615	-0.003381	0.085916	5.739509	0.040660	0.391407
1615-1630	0.007435	1.184632	6.285617	0.037847	0.339122
1630-1645	-0.002290	0.275700	3.820592	0.042364	0.424901
1645-1700	0.042352	0.135193	2.763748	0.064991	1.000000
MO-MC	0.006163	1.167101	7.645639	0.628643	
AO-AC	0.080103	0.318961	3.890581	0.441158	
MO-AC	0.085354	0.600581	7.314615	0.841863	

Note:
1. MO, MC, AO and AC denote Morning Open, Morning Close, Afternoon Open and Afternoon Close respectively.
2. Overnight return is calculated by using the MO and the previous AC.
3. Variance ratio is calculated by dividing the particular intraday variance with the closing variance.

Source:KLSE

Table 3.3(a)
Statistics of Intraday Composite Index Returns for Subperiod 3: 30 November 1992 - 15 April 1993

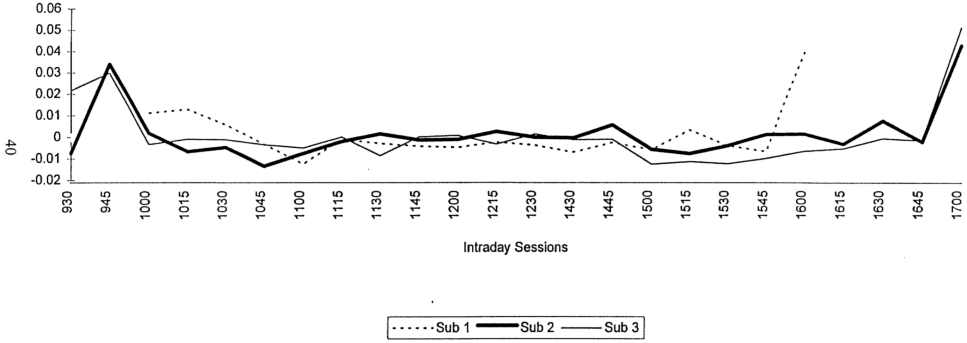
	Average	Skewness	Kurtosis	Standard Deviation	Variance Ratio
Overnight	0.021643	-2.729711	18.075810	0.071976	1.278769
0930-0945	0.029938	0.428418	5.279055	0.077298	1.474869
0945-1000	-0.003358	0.134043	3.588145	0.052832	0.688987
1000-1015	-0.000957	-0.589264	5.499648	0.046946	0.544019
1015-1030	-0.001275	-0.606147	3.766078	0.041944	0.434267
1030-1045	-0.003609	0.662766	5.214198	0.041716	0.429558
1045-1100	-0.005069	-1.155995	4.755193	0.035254	0.306785
1100-1115	0.000041	-0.311912	3.804792	0.035254	0.306785
1115-1130	-0.008658	-0.411774	4.578409	0.027067	0.180841
1130-1145	0.000023	-0.461693	6.061661	0.028557	0.201299
1145-1200	0.000775	-0.479858	4.708596	0.030516	0.229865
1200-1215	-0.003265	-0.231924	2.948953	0.033075	0.270033
1215-1230	0.001394	-0.056656	4.380100	0.026885	0.178417
Lunch Break	-0.001303	-0.306903	3.693667	0.034576	0.295098
1430-1445	-0.001118	0.390522	7.017120	0.035104	0.304180
1445-1500	-0.012634	-0.448651	5.817030	0.047688	0.561352
1500-1515	-0.011438	0.183678	6.481469	0.046647	0.537111
1515-1530	-0.012455	-0.356653	3.819204	0.041218	0.419364
1530-1545	-0.009951	-0.971959	7.113241	0.041669	0.428591
1545-1600	-0.006633	-2.063455	14.216640	0.045834	0.518552
1600-1615	-0.005507	-0.145342	3.868263	0.047952	0.567584
1615-1630	-0.000802	0.258460	4.651257	0.042357	0.442861
1630-1645	-0.001792	-0.546932	3.481943	0.047028	0.545921
1645-1700	0.051008	0.196535	3.682793	0.063649	1.000000
MO-MC	0.013768	-0.433832	3.045903	0.417433	
AO-AC	-0.026073	0.000163	4.771444	0.349779	
MO-AC	-0.015304	-0.108132	3.471856	0.590417	

Note:
1. MO, MC, AO and AC denote Morning Open, Morning Close, Afternoon Open and Afternoon Close respectively.
2. Overnight return is calculated by using the MO and the previous AC.
3. Variance ratio is calculated by dividing the particular intraday variance with the closing variance.

Source:KLSE

Chart 3.1

Average Returns of KLSE Composite Index (%) for Subperiods 1,2 and 3



However, after 15 minutes of trading, it starts to fall and remains in the negative territory almost throughout the day except for the last 15 minutes where the return turns to positive again to record an average of 0.0401 per cent before the closing. This pattern is generally consistent with that obtained by Chang et al (1993a) although the positive return during the first 15 minutes in the afternoon session as observed by Chang et al does not exist in this study.

After the introduction of extended trading hours, the pattern remains the same. However, the overnight return turns out to be negative. As in subperiod 1, the highest return is also observed in the first 15 minutes and the last 15 minutes of trading for the day with an average of 0.0340 per cent and 0.0424 per cent, respectively. The lunch break return is close to zero (-0.0004) in subperiod 2. The return for subperiod 2 is more volatile and generally mixed, with positive and negative values, during the day.

In the period after full automation, the return has the similar pattern as in subperiods 1 and 2. The peak, 0.0299 per cent, achieved during the first 15-minute interval is higher than that of subperiod 1 but lower than that in subperiod 2. The other peak

observed during the last 15-minute interval, registers 0.0510 per cent in return, being the highest score at this interval, among the three subperiods. On the overnight return, subperiod 3 shows a positive value of 0.0216 per cent which is consistent with the one observed in subperiod 1 (0.0112 per cent).

The skewness of the return for subperiod 1 is presented in Table 3.1(a). It can be seen that most of the distributions are skewed to the right which is shown by its positive value. The negative skewness is recorded at time intervals 1000-1015, 1045-1100, 1215-1445 and the 15 minute closing interval. In subperiod 2, the negative skewness is also observed around the opening, lunch break and the closing (see Table 3.2(a)). The skewness in subperiod 3 (Table 3.3(a)) tends to be negative in more 15-minute intervals than in subperiods 1 and 2. The return distributions in all three subperiods share the same phenomenon where it tends to be left skewed especially around lunch break. The left skewed phenomenon is consistent with Dayananda and Fagg (1993) on the Thai stock market.

The kurtosis is mostly larger than three in the various 15-minute intervals in the three subperiods. The exceptionally high kurtosis is recorded in the overnight return. The value is at least four times

higher than that of normal distribution. Generally, the return distributions are leptokurtic except for the closing intervals in subperiods 1 and 2, and at 1200-1215 interval in subperiod 3 which record kurtosis of 2.7027, 2.7637 and 2.9490, respectively.

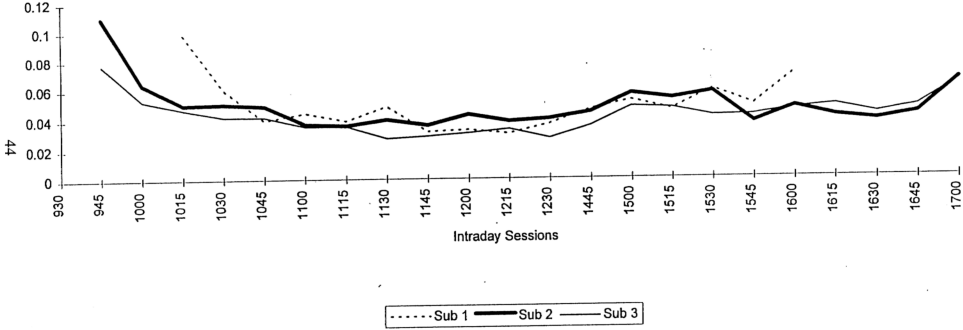
The skewness and kurtosis in the KLSE are greater than those of Taiwan which was reported by Chang et al (1993c). Thus, it confirms Chang et al's (1993a) observation that there is much instability and non normality in the return in the KLSE.

Chart 3.2 demonstrates a rough U-shaped curve for standard deviation during the trading day in subperiods 1, 2 and 3. Except for the overnight interval, the highest standard deviation is recorded in the first 15 minutes of trading which is 1000-1015 in subperiod 1 and 930-945 in subperiods 2 and 3. This pattern persists across the three subperiods. During the rest of the trading interval, the standard deviation fluctuates in narrow range before making a surge again at the last 15 minutes before the close of the day.

For all 3 subperiods, the variance for the morning session is higher as compared to that of afternoon session. Variance per hour is calculated by taking the variance of the day (MO-AC) divided

Chart 3.2

Standard Deviation of KLSE Composite Index Returns for Subperiods 1,2 and 3



by the number of trading hours in that day. After the extended trading hours, the variance per hour increases to 0.1531 from 0.1155. However, after the full automation, variance per hour falls to 0.0631. Variance for overnight non-trading return tends to be larger after the extended trading but smaller after full automation. This may indicate that market information is released more efficiently after full automation.

3.3 Variation in Return

The effects of both day of the week and time of the day are tested using F-statistic. The F-statistic tests the null hypothesis of equal means of a given intraday session across the weekdays and also the hypothesis of equal means of a particular weekday across the intraday sessions. The return variations for subperiods 1,2 and 3 are demonstrated in Tables 3.1(b), 3.2(b) and 3.3(b), respectively. In Table 3.1(b), the F-statistic (F1) is not large enough to reject the null hypothesis, implying that the intraday returns across the weekdays are not significantly different from one another. This suggests that the day-of-week effect may not exist in subperiod 1. However, F2 values reveal that intraday variations are significant at 1 per cent level for Monday and Wednesday and at 10 per cent level for Friday. The results are still similar even when the non

Table 3.1(b)
Intraday Composite Index Average Returns (%) for Weekdays in Subperiod 1: 9 March 1992 - 21 July 1992

	Mon	Tue	Wed	Thur	Fri	F1
Overnight	-0.008746	0.016801	0.006564	0.008703	0.033657	0.818624
1000-1015	0.040023	0.022040	-0.023648	0.019098	0.008629	1.011509
1015-1030	-0.012885	0.016865	-0.007178	0.017317	0.016108	1.089411
1030-1045	0.005053	0.000475	-0.006327	-0.017171	0.000424	0.843860
1045-1100	-0.028688	0.009330	-0.010177	-0.020152	-0.014365	1.934038
1100-1115	-0.012395	-0.006459	0.015035	-0.006275	0.003860	1.439291
1115-1130	-0.008105	-0.004210	-0.000684	0.013539	-0.015367	0.851428
1130-1145	-0.015258	-0.003624	-0.004729	-0.000468	0.003471	0.871959
1145-1200	-0.013058	0.003281	-0.001117	-0.009787	-0.004424	0.710682
1200-1215	-0.004491	0.010561	-0.004564	-0.011416	-0.002920	1.311099
1215-1230	-0.003630	0.001009	-0.008057	0.004656	-0.013029	0.672419
Lunch Break	-0.010504	-0.003983	-0.007211	0.000421	-0.014300	0.487528
1430-1445	-0.014207	-0.011029	0.006451	-0.005168	0.011452	1.037977
1445-1500	-0.014331	-0.000110	-0.007902	0.000343	-0.008065	0.240858
1500-1515	-0.002625	0.009425	0.005124	0.007387	-0.003538	0.285327
1515-1530	0.005232	-0.006074	-0.024888	0.017372	-0.010236	1.332488
1530-1545	-0.010520	-0.020064	0.006218	0.001741	-0.010984	0.844143
1545-1600	0.034371	0.025947	0.055599	0.047428	0.037550	0.476583
F2	2.162857 ***	1.087558	2.412325 ***	1.160775	1.475275 *	
F3	2.307636 ***	1.126399	3.018152 ***	1.232527	1.299675	

Note:
1. F1 is the F-statistic which tests the equality of means of a given intraday across the weekdays
2. F2 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions (includes non trading hours).
2. F3 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions (excludes non trading hours).

*** 1% Significant level
** 5% Significant level
* 10% Significant level

Source: KLSE

Table 3.2(b)
Intraday Composite Index Average Returns (%) for Weekdays in Subperiod 2: 22 July 1992 - 27 November 1992

	Mon	Tue	Wed	Thur	Fri	F4
Overnight	0.017555	0.026804	-0.108408	0.011310	0.022027	0.861290
0930-0945	0.014260	0.041989	0.064127	0.028248	0.018400	0.575807
0945-1000	-0.005998	-0.015038	0.008692	0.012024	0.007294	0.529842
1000-1015	-0.000779	-0.031377	-0.005817	0.010890	-0.006814	1.601758
1015-1030	-0.004970	-0.013846	-0.003462	0.000612	-0.003048	0.189035
1030-1045	-0.026475	-0.021607	-0.009859	-0.006574	-0.005476	0.624804
1045-1100	-0.017142	-0.019035	-0.003679	-0.004548	0.004251	1.228452
1100-1115	0.011252	-0.013218	-0.007034	0.003454	-0.002742	1.191839
1115-1130	-0.005525	0.001774	0.000492	0.002052	0.007410	0.214432
1130-1145	0.003859	-0.014881	-0.002376	0.007254	-0.000781	0.815881
1145-1200	0.002422	-0.011857	-0.002965	0.013548	-0.006663	0.867126
1200-1215	0.000333	0.016453	0.001524	-0.003909	-0.001050	0.730325
1215-1230	0.002839	-0.000153	0.006041	-0.002337	-0.006482	0.244640
Lunch Break	0.000515	-0.010251	0.002641	0.012161	-0.007440	1.454501
1430-1445	0.008772	-0.009935	0.001802	0.011137	0.016037	0.897442
1445-1500	-0.006232	-0.019027	-0.005553	-0.000241	0.001437	0.327974
1500-1515	-0.026329	-0.007935	0.004742	-0.002194	-0.010116	0.800969
1515-1530	-0.020895	-0.001894	0.014418	-0.005953	-0.008516	0.852145
1530-1545	0.001789	0.013453	-0.001949	-0.006956	0.000265	0.715445
1545-1600	-0.000951	-0.008002	0.017185	-0.015465	0.013378	1.553178
1600-1615	-0.002270	-0.010638	0.002877	-0.010121	0.003030	0.445382
1615-1630	0.017692	0.007455	0.009295	0.008271	-0.003827	0.670405
1630-1645	-0.006410	-0.004527	0.001694	-0.004517	0.001500	0.127962
1645-1700	0.044198	0.043979	0.040770	0.044792	0.038419	0.029060
F5	1.493339 *	2.890257 ***	0.861790	1.322553	0.980728	
F6	1.525078 *	2.964937 ***	1.252382	1.360483	0.881921	

Note:
1. F4 is the F-statistic which tests the equality of means of a given intraday across the weekdays.
2. F5 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions (includes non trading hours).
3. F6 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions (excludes non trading hours).

*** 1% Significant level
** 5% Significant level
* 10% Significant level

Table 3.3(b)
Intraday Composite Index Average Returns (%) for Weekdays in Subperiod 3: 30 November 1992 - 15 April 1993

	Mon	Tue	Wed	Thur	Fri	F7
Overnight	0.020198	0.009277	0.011509	0.040578	0.030116	0.584755
0930-0945	0.028067	0.009160	0.023717	0.048211	0.046084	0.715194
0945-1000	0.000087	-0.021962	0.006199	0.011403	-0.012262	1.113947
1000-1015	-0.008138	0.005177	0.013993	-0.006893	-0.013085	0.901214
1015-1030	-0.007852	-0.017069	0.012673	0.007135	-0.000470	1.360958
1030-1045	-0.008585	-0.010801	-0.013149	0.013719	0.003065	1.288671
1045-1100	-0.011134	-0.001848	0.007356	-0.014476	-0.007063	0.973762
1100-1115	0.015229	-0.001950	0.004026	-0.005596	-0.012896	1.531052
1115-1130	0.005941	-0.013305 a	-0.012518 a	-0.004946	-0.018583 b	2.237449 ***
1130-1145	-0.006737	0.001737	0.000778	-0.002524	0.007547	0.570486
1145-1200	0.003526	-0.003251	0.005856	-0.003661	0.001950	0.310043
1200-1215	-0.016623	0.005634	0.003089	-0.005938	-0.004974	1.205761
1215-1230	-0.011266	0.009355	-0.007432	0.008612 a	0.007642	2.491058 ***
Lunch Break	0.003501	-0.016168	-0.001433	0.005183	0.005674	1.224515
1430-1445	-0.003582	0.005016	0.001496	-0.004800	-0.005513	0.275358
1445-1500	-0.031173	-0.018659	0.000838	-0.010263	-0.003472	1.179710
1500-1515	-0.015027	-0.022789	0.004984	-0.016301	-0.007141	0.889701
1515-1530	-0.022860	-0.015081	-0.011000	-0.018952	0.009017	1.513440
1530-1545	-0.009060	-0.010680	-0.004650	-0.017901	-0.007144	0.231369
1545-1600	-0.012865	-0.010583	0.002604	-0.012272	0.000820	0.455808
1600-1615	-0.002161	-0.002958	-0.019634	0.006804	-0.009577	0.709383
1615-1630	0.007964	0.008642	-0.006331	-0.007117	-0.008862	0.692181
1630-1645	-0.008088	-0.006004	0.017934	-0.003503	-0.012165	1.061326
1645-1700	0.057176	0.043345	0.047202	0.054225	0.055344	0.137601
F8	2.280286 ***	1.965532 ***	1.764719 **	3.797034 ***	1.940291 ***	
F9	2.296441 ***	2.664007 ***	1.927085 ***	3.473850 ***	1.835873 **	

Note:
1. F7 is the F-statistic which tests the equality of means of a given intraday across the weekdays.
2. F8 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions (includes non trading hours).
3. F9 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions (excludes non trading hours).

*** 1% Significant level
** 5% Significant level
* 10% Significant level

a denotes the average returns are significant different from zero at 10% level
b denotes the average returns are significant different from zero at 5% level

trading hours (overnight and lunch break returns) are excluded.

As in subperiod 1, all the day-of-the-week effects in subperiod 2 are not statistically significant across the trading sessions (see Table 3.2(b)). However, the intraday variations are obvious for Tuesday but moderate for Monday.

In subperiod 3, the day-of-the-week effects are most pronounced at intervals 1115-1130 and 1215-1230 as indicated in F-statistic (F7). The results are displayed in Table 3.3(b). At 1115-1130, the return is significant at 5 per cent level for Friday and 10 per cent for Tuesday and Wednesday. All the returns observed during these three days are negative in value. On the other hand, at 1215-1230 interval, the return is only significant for Thursday, which records positive return.

In the test on the equality of all means across the intraday sessions in a particular day, the F-statistic (F8) suggests that all the means are significantly different from one another at 1 per cent level for Monday, Tuesday, Thursday and Friday and 5 per cent level for Wednesday. Again, the results are similar even when the non trading hours are not taken into account.

3.4 Trading Volume Behaviour

Based on the actual transactions in the KLSE, the daily CI volume was, on average, 11.47 million shares in subperiod 1 valued at RM43.93 million . After the extended trading hours, the volume increased to 25.11 million shares worth RM89.54 million and improved further to 40.54 million shares valued at RM132.53 after the full automation.

Taking into consideration the increase of new shares issued arising from rights, bonus, conversion of debts, exercise of warrants/TSRs, etc., the trading volume is transformed into a volume ratio by dividing the absolute volume (Volume) with the number of shares outstanding (NOS). The formula is shown as below:

$$\text{Volume ratio (\%)} = \frac{\text{Volume}}{\text{NOS}} * 100$$

Table 3.4 presents the average volume ratios for the different days of the week in the three subperiods. It is observed that Monday has the lowest mean (0.0023 per cent) in subperiod 1. The volume ratio generally increases over the week from Monday to Friday.

Table 3.4
Volume Ratio (%) for weekdays in Subperiods 1, 2 and 3

Day of Week	Subperiod 1			Subperiod 2			Subperiod 3		
	Mean	Standard Deviation	n	Mean	Standard Deviation	n	Mean	Standard Deviation	n
Monday	0.0023	0.0019	288	0.0038	0.0037	330	0.0059	0.0056	352
Tuesday	0.0026	0.0022	304	0.0037	0.0032	374	0.0052	0.0051	418
Wednesday	0.0024	0.0021	304	0.0037	0.0033	396	0.0055	0.0056	396
Thursday	0.0028	0.0021	272	0.0035	0.0032	396	0.0061	0.0059	374
Friday	0.0028	0.0023	272	0.0036	0.0033	396	0.0053	0.0043	308

Note: n is the number of intraday observations of a weekday in the respective subperiods.

Source: KLSE

On the other hand, the volume ratio in subperiod 2 is highest on Monday and declines over the week. In subperiod 3, however, the volume ratio fluctuates over the week.

Tables 3.5 to 3.7 present the means of the volume ratio for every 15-minute interval for the three subperiods. An interesting pattern is observed for all the weekdays. The volume ratio is generally higher for the first half an hour after opening in the morning session and peaks at the closing 15-minute interval for all the subperiods. To a certain extent, the intraday volume behaviour is quite similar to that of index return in the previous section.

Comparison of the results for the periods before and after extended trading hours as well as the period after full automation shows that the volume ratio has generally increased for all the weekdays. For instance, in Table 3.4, the mean for Monday increases from 0.0023 in subperiod 1 to 0.0038 and 0.0059 in subperiods 2 and 3, respectively. This implies that the two events of extended trading hours and full automation in the KLSE have led to a successful increase in the trading activities in the stock market.

Consistent with the results of Ho et al (1993), the findings also

Table 3.5
Intraday Composite Index Volume Ratio (%) for Weekdays in Subperiod 1

	Mon	Tue	Wed	Thur	Fri	Alldays	F10
1000-1015	0.001653	0.002055	0.002555	0.003082	0.003029	0.002548	1.556282
1015-1030	0.002517	0.002741	0.002216	0.002548	0.002771	0.002555	0.272762
1030-1045	0.002401	0.002443	0.002375	0.002226	0.002694	0.002427	0.245386
1045-1100	0.002205	0.002935	0.002072	0.002150	0.002548	0.002385	1.132221
1100-1115	0.002096	0.002336	0.002499	0.002347	0.002465	0.002349	0.267443
1115-1130	0.001952	0.002027	0.002189	0.002615	0.002454	0.002238	1.404016
1130-1145	0.001714	0.002027	0.002092	0.002391	0.002440	0.002125	1.688001
1145-1200	0.002022	0.001797	0.001901	0.001980	0.002348	0.002003	0.904842
1200-1215	0.001849	0.001783	0.001786	0.002155	0.002354	0.001975	1.207549
1215-1230	0.001817	0.002265	0.001917	0.001870	0.002453	0.002063	1.325166
1430-1445	0.002688	0.003141	0.002394	0.003651	0.002471	0.002863	1.732140
1445-1500	0.002397	0.003360	0.002797	0.003651	0.002940	0.002997	1.417954
1500-1515	0.002854	0.003119	0.002741	0.003650	0.002701	0.003008	1.422703
1515-1530	0.002980	0.003357	0.002893	0.003305	0.003562	0.003213	0.498767
1530-1545	0.003686	0.003250	0.002712	0.004224	0.004281	0.003602	3.301489 **
1545-1600	0.006381	0.007432	0.007874	0.008516	0.008328	0.007689	1.633206
F11	9.680003 ***	12.209420 ***	17.478859 ***	27.803459 ***	12.361168 ***	68.914405 ***	

Note:
1. F10 is the F-statistic which tests the equality of means of a given intraday across the weekdays.
2. F11 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions

*** 1% Siginificant level
** 5% Significant level

Source:KLSE

Table 3.6
Intraday Composite Index Volume Ratio (%) for Weekdays in Subperiod 2

	Mon	Tue	Wed	Thur	Fri	Alldays	F12
0930-0945	0.005738	0.005241	0.004819	0.002964	0.003289	0.004354	1.147570
0945-1000	0.005421	0.005448	0.004231	0.003904	0.003468	0.004451	0.693060
1000-1015	0.005230	0.004466	0.003018	0.004053	0.003889	0.004089	0.691127
1015-1030	0.002973	0.004174	0.004099	0.003160	0.003591	0.003615	0.562121
1030-1045	0.003783	0.004019	0.003250	0.003704	0.003218	0.003583	0.249311
1045-1100	0.003785	0.003714	0.004608	0.002788	0.003133	0.003598	0.928155
1100-1115	0.004171	0.003952	0.002880	0.003580	0.003026	0.003494	0.696115
1115-1130	0.003047	0.003708	0.003142	0.002515	0.003090	0.003095	0.576356
1130-1145	0.002449	0.003350	0.003527	0.003007	0.002677	0.003017	0.608924
1145-1200	0.003638	0.002647	0.002717	0.003380	0.002554	0.002968	0.586885
1200-1215	0.003594	0.002990	0.002718	0.003214	0.003245	0.003139	0.277401
1215-1230	0.003102	0.002749	0.003491	0.003742	0.003304	0.003290	0.344043
1430-1445	0.004615	0.004868	0.004605	0.004583	0.004863	0.004708	0.024857
1445-1500	0.003504	0.003950	0.004641	0.005078	0.003258	0.004108	0.870481
1500-1515	0.003491	0.003489	0.004737	0.004719	0.004128	0.004142	0.579764
1515-1530	0.004294	0.003596	0.004020	0.003732	0.004608	0.004047	0.376276
1530-1545	0.003093	0.003036	0.003818	0.003817	0.004402	0.003659	1.108793
1545-1600	0.003812	0.003906	0.003557	0.003692	0.004231	0.003840	0.220622
1600-1615	0.003832	0.004052	0.003657	0.003212	0.003835	0.003710	0.257601
1615-1630	0.004354	0.004130	0.004302	0.002850	0.003260	0.003755	1.218060
1630-1645	0.003948	0.003948	0.005281	0.003742	0.005023	0.004409	1.017369
1645-1700	0.009018	0.007488	0.008716	0.007657	0.011099	0.008803	1.923051
F13	2.1423158 ***	1.9932076 ***	3.0557105 ***	2.1598146 ***	6.5465966 ***	12.279051 ***	

Note:
1. F12 is the F-statistic which tests the equality of means of a given intraday across the weekdays
2. F13 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions.

*** 1% Significant level

Source:KLSE

Table 3.7
Intraday Composite Index Volume Ratio (%) for Weekdays in Subperiod 3

	Mon	Tue	Wed	Thur	Fri	Alldays	F14
0930-0945	0.008427	0.006674	0.006705	0.010602	0.006452	0.007773	0.868013
0945-1000	0.007896	0.005486	0.005997	0.006105	0.006112	0.006284	0.462064
1000-1015	0.006478	0.004890	0.005778	0.007355	0.005775	0.006029	0.462307
1015-1030	0.006421	0.004572	0.005427	0.007246	0.003820	0.005523	1.188024
1030-1045	0.004510	0.005459	0.006144	0.006633	0.005052	0.005595	0.408680
1045-1100	0.008016	0.005738	0.004233	0.006254	0.004851	0.005806	1.098843
1100-1115	0.007085	0.004805	0.004362	0.005826	0.005047	0.005391	0.632182
1115-1130	0.006871	0.005264	0.003819	0.004530	0.004193	0.004934	1.152680
1130-1145	0.006092	0.004509	0.005341	0.006489	0.004300	0.005355	0.618300
1145-1200	0.005163	0.004668	0.006459	0.005836	0.004172	0.005300	0.476801
1200-1215	0.006016	0.005883	0.004981	0.004985	0.004605	0.005320	0.279547
1215-1230	0.004906	0.004823	0.005284	0.005266	0.004044	0.004897	0.218701
1430-1445	0.007379	0.007252	0.008510	0.008003	0.007065	0.007666	0.117832
1445-1500	0.006850	0.006147	0.006714	0.006264	0.006372	0.006463	0.049246
1500-1515	0.004598	0.005609	0.006227	0.006615	0.005958	0.005811	0.447588
1515-1530	0.005651	0.004054	0.005086	0.005347	0.005936	0.005154	0.613598
1530-1545	0.004862	0.004454	0.005065	0.005624	0.005706	0.005108	0.352417
1545-1600	0.004639	0.005791	0.004834	0.006459	0.005547	0.005461	0.785227
1600-1615	0.005078	0.005812	0.005908	0.005673	0.005753	0.005655	0.138972
1615-1630	0.004107	0.004119	0.005483	0.006356	0.006541	0.005265	1.742073
1630-1645	0.007058	0.006652	0.007999	0.006307	0.006863	0.006983	0.297341
1645-1700	0.014235	0.012402	0.011196	0.011547	0.012379	0.012316	0.433921
F15	2.499672 ***	2.195752 ***	1.428755 *	1.201917	2.587527	7.573789 ***	

Note:
1. F16 is the F-statistic which tests the equality of means of a given intraday across the weekdays
2. F17 is the F-statistic which tests the equality of means of a given weekday across the intraday sessions.

*** 1% Significant level
** 5% Significant level
* 10% Significant level

Source:KLSE

show evidence of higher day-end volume (see Table 3.5) at the closing where the figure is about three to four times higher than that of other sessions on the same day.

Similar to that observed in subperiod 1, the day-end volume (Tables 3.6 and 3.7) in subperiods 2 and 3 is also seen to be two to three times higher than that of other sessions. The higher day-end volume on the KLSE, however, contradicts that found by Jain and Joh (1988). They found higher volume in the first hour of trading where the figure was about one and a half times higher than the other sessions in the same day. The higher day-end volume on the KLSE could be due to the foreign participation from different geographical time zones.

3.5 Variation in Volume

Tables 3.5-3.7 also present the results of the F test on the volume ratios for subperiods 1,2 and 3, respectively. In Table 3.5 for subperiod 1, the F-statistic (F10) indicates that all the day-of-the-week effects for each intraday session are not significant except for the 1530-1545 interval. At 1530-1545 interval, the volume ratio is found significantly different from zero for each of the weekdays with Friday recording the highest mean. On the other

end, the intraday volume ratios are significantly different at 1 per cent level for each of the weekdays.

In Tables 3.6 and 3.7 for subperiods 2 and 3, there is insufficient evidence for significant day-of-the-week effects for each of the intraday session. Nevertheless, there are some indications of intraday variations for each of the weekdays.

3.6 Overall Increasing Trend

To take into consideration the overall increasing trend of trading, the CI is chosen to capture the extent of the trend. The following simple regressions are run to estimate the residual volume and value:

$$\text{Volume}_t = a + bI_t + \mu_t$$

$$\text{Value}_t = c + dI_t + E_t$$

where Volume_t and Value_t refer to the transaction volume and value for the KLSE CI at day t, respectively. I_t denotes CI on day t. Upon estimation of the residuals, regressions are utilised to test the equality in the trading for both volume and value. The regression models are as follows:

$$Volume^{*}_{t} = g_0 + g_1 Dm + \epsilon_t$$

$$Value^{*}_{t} = h_0 + h_1 Dm + v_t$$

where $Volume^{*}_{t}$ and $Value^{*}_{t}$ represent residual volume and value, respectively. Dm is a dummy variable with Dm=1 for period before extended trading hours and 0 otherwise. The same procedures apply for the case of full automation with Dm=1 for period before full automation and 0 otherwise.

The analysis shows that all the parameters are statistically significant at 1 per cent level. Table 3.8(a) demonstrates the adjusted volume increases from -4.23 million units in subperiod 1 to 4.22 million units in subperiod 2. One should not be perturbed by a negative value for the adjusted volume and value as the main objective here is to test the equality of the trading activities. Similar outcomes are also obtained for the adjusted value; the value is -13.86 million Ringgit Malaysia before the extended trading hours as compared to 14.51 million Ringgit Malaysia after the extended hours.

From the test of equality for the periods before and after extended trading hours, the F values of 48.72 and 41.35 for volume and value regression models, respectively, reject the null hypothesis

Table 3.8 (a)
Change in Trading Volume (in million units) and Value (in million Ringgit Malaysia) Before and After Extended Trading Hours

	Before	After	R^2	F
Average Volume Adjusted Volume	11.47 -4.23	25.11 4.22	22.07	48.72 *
Average Value Adjusted Value	43.93 -13.86	87.1 14.51	19.38	41.35 *

Note:
* Significant at 1% level

Source: KLSE

Table 3.8 (b)
Change in Trading Volume (in million units) and Value (in million Ringgit Malaysia) Before and After Full Automation

	Before	After	R^2	F
Average Volume Adjusted Volume	25.11 0.66	40.54 -0.66	1.2	0.21 ns
Average Value Adjusted Value	89.54 1.89	132.53 -1.90	1.3	0.23 ns

Note:
ns: Not significant at 1% level

Source: KLSE

of equal means across the two subperiods. The results are consistent with Chang et al (1993b) where they found trading volume and value increased substantially after the extended trading hours and the commencement of afternoon trading in the Stock Exchange of Thailand (SET).

On the other hand, the adjusted volume and value after full automation decrease substantially. The results are presented in Table 3.8(b) where the adjusted volume and value reduce to -0.66 and -1.90, respectively, as compared to the period before full automation.

Test of equality of means for the periods before and after full automation shows that the parameters for the adjusted volume and value are not statistically different. The low F value suggests that there is insufficient evidence to reject the null hypothesis of equal means for these two subperiods.

3.7 Change in the Speed of the Price Adjustment

The speed of adjustment is estimated using the regression model as given below:

$$\Delta Var_t = \alpha + \beta Var_{t-1} + E_t$$

where $\Delta Var_t = Var_t - Var_{t-1}$ and Var_t denotes Parkinson's variance. If $|\beta| = 1$, it implies that all private information released on day t-1 is fully incorporated into stock price on day t.

To test the equality of the β coefficients in the respective subperiods, a regression is utilised for the whole period for the events of extended trading hours and full automation. The model is as below:

$$\Delta var_t = \alpha + \beta Var_{t-1} + \gamma(Dm) + \delta(DmVar_{t-1}) + E_t$$

where Dm is the dummy variable with Dm=1 for subperiod prior to the event, and 0 otherwise.

The results of the speed of the price adjustment are presented in Table 3.9. In subperiod 1, informed traders have incorporated approximately 81.74 per cent of private information which they received on day t-1 into the stock prices by the close of day t. However, after the extended hours, the speed of adjustment seems to decline to about 73.44 per cent while the speed of adjustment for the whole period is 73.22 per cent.

These estimates are, nevertheless, in the same range as that

Table 3.9
Speed of the Price Adjustment
Before and After Extended Trading Hours

Coefficient	Before	After	Whole Period	Whole Period #
α	0.0019 (4.8612)	0.0028 (3.2321)	0.0022 (4.7965)	0.0028 (4.2917)
β	-0.8174 (-7.7691)	-0.7344 (-7.1015)	-0.7322 (-10.1113)	-0.7345 (-9.3428)
γ	-	-	-	-0.0009 (-0.9311) ns
δ	-	-	-	-0.0789 (-0.3703) ns
R^2	0.4068	0.3670	0.3661	0.3731
F	60.36	50.43	102.24	34.72

Figures in the parenthesis are t-statistics
ns: Not significant at 1% level
Model with dummy variables

Source: KLSE

observed by Chang et al (1993b) and Lin and Rozeff (1992). Chang et al (1993b) observed 65, 72 and 69 per cent for the periods before and after the extended trading hours, and the whole period, respectively, in the Stock Exchange of Thailand. Lin and Rozeff (1992) obtained 78 and 73 per cent for the Standard & Poor 500 Index and Dow Jones Industrial Averages, respectively.

The results on the equality test is shown in the last column of Table 3.9. It is noticed that γ and δ are not significant, thereby implying that the coefficients are not different from zero. Thus, the null hypothesis of equal means across the two subperiods cannot be rejected. Therefore, the speed of the price adjustment is the same for the periods before and after the extended trading hours. The finding is, however, consistent with Chang et al's (1993b) observation on the Thai market.

On the other hand, comparing periods before and after the full automation, the β coefficient increases substantially to approximately 91.28 per cent after full automation as compared to 73.76 per cent prior to this. The speed for the whole period is 73.39 per cent (See Table 3.10).

However, similar result is obtained in the equality test which

Table 3.10
Speed of the Price Adjustment
Before and After Full Automation

Coefficient	Before	After	Whole Period	Whole Period #
α	0.0028 (3.2774)	0.0019 (5.9638)	0.0022 (4.8131)	0.0019 (2.5036)
β	-0.7376 (-7.0874)	-0.9128 (-8.5686)	-0.7339 (-10.0758)	-0.9128 (-3.5971)
γ	-	-	-	-0.0009 (0.8821) ns
δ	-	-	-	-0.1752 (0.6607) ns
R^2	0.3687	0.4577	0.3671	0.3778
F	50.23	73.42	101.52	35.01

Figures in the parenthesis are t-statistics
ns: Not significant at 1% level
Model with dummy variables

Source: KLSE

concludes that there is no difference in the speed of price adjustment for the periods before and after full automation.