Premium-Discount Patterns in Exchange-Traded Funds (ETFs): Evidence from the Tracker Fund of Hong Kong (TraHK)

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Abstract

Tracker Fund of Hong Kong (TraHK), the first Exchange-traded fund (ETF) in Asia, is designed to trace the Hang Seng Index (HSI). However, the TraHK does not track the HSI successfully at the market opens. Results also show that the TraHK tracks the HSI more efficiently with a higher number of transactions. Compare positive and negative premiums, the positive premiums, between the HSI and TraHK, have higher mean values than those of negative premiums. For intraweek periodicity, a U-shaped pattern forms.

Key words: Exchange-traded funds; HSI; intraday; intraweek

Premium Patterns in Exchange-Traded Funds (ETFs):

A Case of Tracker Fund of Hong Kong (TraHK)

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Introduction

After the first launched in 1990, exchange-traded funds (ETFs) has developed rapidly around the world. In November 1999, the Tracker Fund of Hong Kong (TraHK), the first ETFs in Asia, was listed in Hong Kong Stock Exchange. The characteristic of the TraHK is its unique benchmark, the HSI. "It is expected that investors will be able to buy or sell their units on the Stock Exchange at a price that is close to the Net Asset Value (NAV) per unit but this cannot be guaranteed."[1] Although the NAV of the TraHK is adjusted based on the updated HSI, the TraHK price may not be equal to the actual NAV of the TraHK. There is a potential arbitrage between the ETF shares and the underlying assets. Consequently, numbers studies find the potential arbitrage via examine a tracking performance of ETFs. [See for example, Gastineau (2002). Jares and Lavin (2004). Lin, Chan, and Hsu (2005). Engle and Sarkar (2006).]

In this paper, the tracking performance is defined as the premium, rather than the tracking error. The tracking error is commonly used by index funds, but the term is inappropriate in this case. The tracking error is the standard deviation of the difference between returns on the index fund and its benchmark. Premium, however, is the difference between the

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[1] Risk Associated with TraHK. See http://www.ssgaasia.com/eng/trahk_what.html .

price of the TraHK and the level of the HSI. As the TraHK is not an index fund and hence standard deviation is not used in the calculation, the premium therefore represents the tracking performance of the TraHK, and thus seems more suitable parameter to use than the tracking error. As the cash market changes rapidly with time, the premium will vary at different time periods as well.

During trading hours, the HSI is updated every 15 seconds. The NAV of the TraHK is updated once the HSI is reported. The time lag should be considered in this situation. In addition, investors show their expectation of the TraHK by buying or selling. In Taiwan market, Lin, Chan and Hsu confirmed that Taiwan Top 50 Tracker Fund is pricing efficient in the Taiwan stock market. Will TraHK be a good indicator to replicate the performance of the HSI? The purpose of this paper seeks to have a deeper understanding in the tracking characteristics of TraHK, that is, the difference between premiums from different time periods. Intraweek and intraday patterns in the premium are also investigated.

Extensive studies have summarized the intraweek and intraday patterns of both cash and futures markets. The existence of the day-of-the-week effect in cash markets has been found (Cross, 1973; French, 1980; Simrlock and Starks, 1984 and Harris, 1986). The day-of-the-week effect was also been proved in futures market (Dyl and Maberly, 1986; Junkus, 1986; Keim and Smirlock, 1987). However, Gibbons and Hess (1981) extended the study of S&P 500 daily returns from the period of 1962 to the period of 1978. They confirmed negative Monday returns, but cannot find any variance seasonality. Also, using the trading and nontrading returns on S&P 500 futures index during 1982-1984 periods, Cornell (19852) could not find any day-of-the-week effect. For intraday patterns, A U-shaped pattern has been found in many markets (Wood, McInish and Ord, 1985; Harris,

1986; Amihud and Mendelson, 1987; Jordan et al., 1988; Ekman, 1990, 1992; Brock and Kleidon, 1992; Ferguson, Mann, and Schneck, 1993; Lee and Linn, 1994).

Besides, Smirlock and Starks (1986) found the weekend effect from hourly returns of the Dow Jones Industrial Average (DJIA). The effect has shifted from characterizing active trading on Monday to characterizing the nontrading weekend. Hence, the relation between transaction and premium was examined in this study.

The paper is organized into five sections. Section Chapter 1I describes the data used and the calculation of the premium. Section Chapter 1II introduces statistical analysis, non-parametric, normality and correlation tests. Section Chapter 1III presents empirical evidence and discusses results, and Section Chapter 1IV provides concluding remarks.

I. Data

A. Sources

The HSI compiled by HSI Services Limited, is the benchmark of the Hong Kong stock market. The index composition consists of 33 listed companies. These companies form around 70% of the total value of the market. The index was computed after 31 July 1964, but was not operative until November 1969. Nowadays, the index is recorded at 15-second intervals.

The transaction data of the TraHK is obtained from the Hong Kong Stock Exchange (HKEx). Data consist of date, time, price and number of shares traded in every transaction. In this study, we examine 164,253 transactions of the TraHK. With numerous transactions, a thin trading problem and the corresponding discounts and premiums widen effect would be ignored (Barney, 2000).

B. Period

In this study, we consider two sets of data (1) the HSI and (2) the price of the TraHK. The study period starts from 12 November 1999[2] to 30 November 2000. The entire period covers more than a year, totaling 267 trading days. With four trading hours in a day, we divide it into 16 15-minute intervals. Data are also separated into five weekdays. We can then test whether there are any day-of-the-week and/or intraday effects.

There are two missing pieces of data. One is from 24 December 1999, as the afternoon trading session was cancelled for Christmas Eve. The other piece of missing data arose because the computer system of the Hong Kong Stock Exchange broke down on 12 June 2000, causing the day's trading to be delayed by an hour. Transactions started at 11:00 then.

C. The calculation of premiums

The calculation of the premium is undertaken step by step. The premium is firstly calculated in each of a pair of transactions using the matched recorded index of the 15-second interval. The premium, *PM*, is used to study the mispricing between the HSI and adjusted price, *AP*, that is, the price of the TraHK * 1000 (AP is used because each unit of the TraHK represents 1/1000 of the HSI). The premium of adjusted price j in interval i on day d is defined as below:

$$PM_{i,j}^{d} = \frac{\left(AP_{i,j}^{d} - HSI_{i,j}^{d}\right)}{HSI_{i,j}^{d}} \times 100\% \qquad \text{i = 1, 2, 3… 80.} \qquad (1)$$

[2] The TraHK of Hong Kong was first issued on 12 November 1999. The issue price was HK$ 12.88.

We then carried out an in-depth study, in which the data were divided into three groups: premium, positive premium and negative premium. We not only studied the existence of any trends in these groups, but also examined whether there was any relationship due to the sign of the premium.

II. Methodology

As the HSI operates on a 15-second basis, the transaction price of the TraHK is matched with the index every 15 seconds. Thus, a pair of HSI and TraHK prices is reported every 15 seconds. We then group the available data into 16 15-minute classes for every weekday. In each 15-minute interval within same time period and on the same weekday, we calculate a mean, a standard deviation and a range of premium values, and count the number of transactions of the TraHK. Within a trading day, there is a total of four hours' trading in the morning (10:00 – 12:30) and afternoon (14:30 – 16:00) sessions. Hence, we have approximately 4,272 15-minute intervals (16 time intervals in a day multiplied by 267 trading days). In each interval, we have four measures on premium (mean, standard deviation, range and number of transactions) calculated based on the transaction data matched at 15-seconds.

Finally, we apply the Chi-Square statistic and the normality test to examine our hypotheses. The Chi-Square statistic is used to test if the distribution of a variable has the same location parameter across different groups. In this study, we used the Kruskal-Wallis Test to compare the intraday and/or intraweek populations. Because the Kruskal-Wallis Test only determines whether a difference exists, we further test the normality of

populations using other method. The correlations of the data are also examined. We measure the extent to which premiums are related based on different weekday and 15-minute time intervals. We also examine whether the variances of premiums are associated with the numbers of transactions in each time period.

We further classify our data into two datasets: (i) positive premium and (ii) negative premium. As mentioned earlier, we define the premium as the adjusted price of the TraHK minus the HSI. Thus, a positive premium is the surplus and a negative premium is the discount. If the premium is in surplus, investors can buy the HSI to exchange the TraHK units and vice versa. In addition, the classification of the premium can ignore the skewness of the distribution of the premium. In order to examine any difference in the tests results concerning the nature of the premium, we repeat above tests in both datasets.

A. Mean

The average value of the premium in each interval is calculated. We first calculate the mean value of the premium in each interval within the same day. Then, the averaged mean of the premium in each interval is measured.

$$\overline{PM_i^d} = \frac{1}{N_i^d}\sum_{j=1}^{N^d} PM_{i,j}^d \qquad \text{for i =1,2, …, 16.} \qquad (2)\backslash$$

$$\text{d = 1, 2, …, 5.}$$

N^d_i = Number of transactions recorded for interval i on day d.

$$\overline{PM} = \frac{1}{d_i}\sum_{d=1}^{N_i^d}\overline{PM}_i^d \qquad \text{for i = 1,2,…, 16.} \qquad (3)$$

$$\text{d = 1, 2, …, 5.}$$

for d_i = Number of days over which transaction is recorded in interval i.

B. Standard Deviation

Following Schwert (1989),[3] the standard deviation for each interval in each day is calculated as below:

$$STD_i = \left[\frac{\sum_{i=1}^{N_i^d}\left(PM_{i,j}^d - \overline{PM}_i^d\right)^2}{N_i^d - 1}\right]^{\frac{1}{2}} \qquad \text{for i = 1, 2, …, 16.} \qquad (4)$$

$$\text{d = 1, 2, …, 5.}$$

From 267 trading days in the sample period, the variability is measured in each data pool of the same interval. We first obtain one averaged premium from the same 15-minute time interval in a single day. The averaged premium is then compared with others in the same interval and we calculate the standard deviation for that interval. The standard deviation of every interval of every day is available, allowing studies of the intraday and intraweek patterns of premium volatility.

[3] Schwert (1989) uses this method to estimate the monthly variance of the S&P 500 portfolio as the sum of the squared daily return deviations from the average daily return in the month.

C. Range

Within the same 15-minute interval of a day, the range of premiums is defined as the difference between the maximum and minimum premiums. Thus, every day during the study period provides ranges from every 15-minute interval. Based on all transactions in the same 15-minute interval, the average of the range of premium is calculated per 15-minute interval and per weekday. Similarly to the standard deviation, the mean range is a measure of volatility. The mean range gives a measure of variability by considering the overall tracking of premiums during a certain interval.

D. Number of transactions

Similarly, we find the number of transactions in every interval in the same day. The average number of transactions in the same interval is thereby obtained. For the overall period, there are a total of 80 different intervals for number of transaction within a week. All number of transactions shows the level of activity of the TraHK in each interval of a day.

E. Testing Statistics

Three test measures, Chi-square statistic, normality test and correlation analysis, are considered in this study. Thus, a series of hypotheses are firstly set up. Two hypotheses are examined to find the existence of differences across the week and the significance of differences.

Day-of-the-week Effects

Hypothesis $H_{(a)}$: The statistical measure, a, is the same across all five weekdays for interval t.

for a = mean, standard deviation, range and number of transactions

t = 1, 2, 3, …, 16

Intraday Effects

Similarly, another hypothesis is tested to measure differences between the various intervals.

Hypothesis $H_{(b)}$: The statistical measure, a, is the same across all 16 intervals for day

d.

for a = mean, standard deviation, range and number of transactions

d = 1, 2, 3, …, 5

F. Correlation

Correlation tests are applied to premiums and to the number of transaction studies. Both studies are divided into three groups: 1) All premiums 2) positive premiums and 3) negative premiums. The correlation test is a measure of the degree of linear relationship between two variables. The correlation coefficient is in the range of plus one (+1) and minus one (-1). The strength of the relationship is measured after taking the absolute value of the correlation coefficient.

We first apply correlation tests to premiums in both the intraday and the intraweek studies. In this regard, correlation tests study relationships between premiums in various intraday time intervals, and also examine the relationship between premiums in various intraweek time periods.

A number of studies have examined the relationship between volatility and volume. For our study, has the relationship between variances and number of transactions been established? From the results of descriptive statistics in former sections, we examine the correlation relationship between variances and number of transactions in every 15-minute interval. Furthermore, correlation results may be due to particular 15-minute time periods. Each time interval may have an influence on the others. Thus, the correlation test is also used to look for intraday and/or intraweek patterns.

III. Empirical Results

A. Positive and Negative Premiums

The mean of the premiums measures the average benchmark performance of the TraHK. Table 1 and Figure 1 clearly show that high premium always exists on Thursdays. Moreover, all premiums are non-normally distributed across a week and also across a day. Compared with the result of the mean, the range of the premiums (see Table 2 and Figure 2) undergoes many changes. Due to the formation of a W-shaped pattern during the course of a week, high values of ranges are recorded on Mondays, Fridays and even on Wednesdays, but not Thursdays. All large differences are recorded in the first 15-minute interval of the morning session (10:15). Being an alternative measure of volatility, the results of standard deviation are similar to those of the range. Large values of standard deviation (see Table 3 and Figure 3) always occur in the first 15-minute interval of the

morning session (10:15). Moreover, large values of standard deviation occur mostly on Mondays, after the weekend break. In addition to Monday, Tuesday is the second weekday on which a large fluctuation of premiums is recorded. There is also one 15-minute interval (16:00) in which large fluctuations are noted. Before the end of the week, there are three 15-minute intervals (10:30, 10:45 and 12:15), which show large fluctuations, on Fridays.

Considering the absolute value of premium, the highest standard deviation of a day exists during the first 15-minute interval of the session. Two patterns are found in the view of number of transactions (see Table 4 and Figure 4). A W-shaped pattern of day-of-the-week is formed. High numbers of transactions are recorded on both Mondays and Fridays. These results would be expected, as more transactions are made either at the beginning of the week or at the end of the week. A W-shaped pattern also exists for a single day, as transactions are active at the morning opening and afternoon opening and closing of the markets.

B. Positive Premiums

Table 5 and Figure 5 show that the mean value of positive premiums; the values are almost at the same level for all weekdays. From Table 6, Table 7, Figure 6 and Figure 7, the range and standard deviation reach a maximum during the first 15-minute interval (10:15) of the day on every weekday, except Fridays. It is interesting that many transactions are completed during the first 15-minute interval (10:15) and at the last 15-minute interval (16:00) of a day (see Table 8 and Figure 8).

C. Negative Premiums

Table 9 and Figure 9 give us a simple intraday picture of the mean of the negative premiums. An L-shaped pattern is shown in Figure 10. Table 10 shows that negative premiums are marked a large range at the beginning of a day (10:15). From the results of calculating standard deviations (see Table 11 and Figure 11), we know that fluctuations are active at the beginning of the day due to the fact that all high mean values fall during the first 15-minute interval (10:15) of a day. At the same time, negative premiums always show high transactions during the first 15-minute intervals of the morning (10:15) and the afternoon (14:45) sessions. In addition, negative premiums always occur either on Mondays or Fridays (Shown in Table 12 and Figure 12).

D. Intraday Pattern

Considering the absolute values of the premiums, the highest standard deviation of a day exists during the first 15-minute interval of the morning session (10:15) (see Table 3 and Figure 3). There is no doubt that the TraHK does not benchmark the HSI closely at the market opens.

From the results of number of transactions with positive and negative premiums (see Table 8 and Table 12), we find that positive premiums are mainly recorded during three 15-minute intervals: 1) the first interval of the morning session (10:15) on Mondays, Tuesdays and Thursdays; 2) the first interval of the afternoon session (14:45) on Fridays; and 3) the last interval of the afternoon session (16:00) on Wednesdays and Fridays. Similarly, negative premiums also exist during the same three 15-minute intervals but on different weekdays: 1) the first interval of the morning session (10:15) on Mondays and

Fridays; 2) the first interval of the afternoon session (14:45) on Wednesdays and Thursdays; and 3) the last interval of the afternoon session (16:00) on Tuesdays.

Overall, the averaged means of the positive premium are higher than those of the negative premiums. Almost all averaged means of the positive premiums (from Table 5) are greater than 0.5, which are even greater than the averaged means of the original premiums (from Table 1) dataset, while the averaged means of the negative premium (see Table 9) are range from -0.2 to -0.3.

It is interesting to note that all of the statistical intraday results are significantly non-normality at the 1% level. The results show a non-normal distribution. Without considering tables of mean, all of the results are significantly different to those in the datasets of both the positive and the original premiums.

E. Day-of-the-week Pattern

Thursday can be considered as the peak day of the week in terms of the averaged mean of the premiums from Table 1 and Figure 1. Eleven out of 16 15-minute intervals contain the highest averaged means. However, patterns of averaged means of positive and negative premiums are different from those of the overall premiums. For positive premiums (see Table 5), although there are 8 out of 16 15-minute intervals in which the highest averaged means can be found on Thursdays, there are also five 15-minute intervals which contain the highest averaged means on Tuesdays. However, 10 out of 16 15-minute intervals record the highest mean values for the negative premiums on Wednesdays.

Comparing datasets of three kinds of premium, there are no same day-of-the-week patterns in regard to the range and standard deviation. From the results of the premiums in Table 2, large values for range are recorded on Mondays and Fridays. Similarly, high values of standard deviation occur on Mondays and Fridays, while more fluctuation also exists on Tuesdays (see Table 3 and Figure 3). For positive premiums, large ranges exist on Mondays, Wednesdays and Fridays (see Table 6 and Figure 6). From the results of standard deviations, shown in Table 7, high values for standard deviation are evenly distributed over weekdays. As there are larger values for ranges on Wednesdays, more 15-minute intervals are recorded with high values in standard deviation.

For number of transactions, three datasets are recorded, showing almost the same day-of-the-week patterns as each other. From Table 4 and Figure 4, we know that more transactions are completed on both Mondays and Fridays than at other times during the week. Furthermore, more transactions are made on Fridays than on Mondays. Thus, the results of number of transactions, with regard to both positive (see Table 8) and negative premium (see Table 12) premiums are considered here. Most of the number of transactions takes place on Mondays and Fridays. The results seen on Wednesdays are interesting, in terms of both positive and negative premiums. Trading with positive premiums is active on Wednesdays, while there are fewer transactions with negative premiums. Table 4 does not show that fewer transactions are made on Wednesdays. Hence, the prices of the TraHK will always be higher than the HSI on Wednesdays. From the number of transactions, in terms of both positive and negative premiums, we know that both datasets show W-shaped patterns. In fact, more transactions gave rise to negative premiums.

Although the statistical results show no significant differences, all non-normality tests results are significant difference. Nearly 90% of the results are non-normally distributed. However, regardless of positive or negative premiums, only about 10% of the number of transactions falls within a normal distribution.

F. Intraday and Day-of-the-week Correlation of Premiums

In Table 13 , Table 14 and Table 15, it can be seen that in all of the intraday tests, all of the data are positively correlated within a single day. This statement is strongly supported as all related results are significant. Moreover, the positive premiums, similarly to the original premiums, produce high correlation coefficients (0.8 – 0.9) whereas the negative premiums have correlation coefficients between 0.3 and 0.8. For the overall premiums (Table 13), the value of the correlation depends on the time interval. Closer time intervals are recorded as having higher correlation coefficients. However, this effect is not seen with either positive or negative premiums.

However, negative correlations exist in our intraweek study. It can be seen from the original premiums (see Table 16), that there are negative correlations between Thursdays and other weekdays. Moreover, the positive premiums show negative correlations for two pairs of workdays: Mondays and Fridays, and Tuesdays and Fridays (see Table 17). From Table 18, we discover that negative premiums give us a different picture. All data show highly positive correlations. Furthermore, 70% of the data have a p-value of less than 0.0001.

G. Correlation between Variances and Number of Transactions of Premiums

Table 19, Table 20 and Table 21 show the correlations between variances and number of transactions of original premiums, positive premiums and negative premiums within a single day and across a week. From the results of

Table 19, there are 51 out of 80 15-minute intervals showing negative correlations, demonstrating that variances and number of transactions are inversely related. Almost all correlations are non-significant. There are only five 15-minute intervals with significant correlation coefficients: 12:30 on Tuesdays, 15:30 on Thursdays, 10:15, 10:30 and 15:15 on Fridays. Ignoring their positive or negative nature, these correlation coefficients all have high values, from 0.291 to 0.453. This characteristic can also be found in the positive and negative premiums. For the positive premiums, there are only four 15-minute intervals with positive significant correlations (11:30 on Mondays, 11:15 and 15:30 on Thursdays, and 15:15 on Fridays). These intervals also have high correlation coefficients, from 0.317 to 0.522. Positive significant correlations are also found in the negative premiums. These correlation coefficients have high values, from 0.415 to 0.775. There are also nine 15-minute intervals with significant correlations. These results are consistent with those of Jones et al. (1994). They find that volatility is positively related to the number of transactions.

IV. Conclusion

Using more than one year's worth of data, this paper studies the intraday and the day-of-the-week patterns of the benchmark of the TraHK. The Fund tracks the HSI. Thus, the price of the Fund should theoretically show the same trends as the HSI. After performing a number of tests, we may ascertain the efficiency of the TraHK.

The intraday study shows that the trading of the TraHK is active during several time intervals, such as the first 15-minute interval (10:00 – 10:15) in the morning, the first 15-minute interval (14:30 – 14:45) in the afternoon and the last 15-minute interval (15:45 – 16:00) in the afternoon. It is important that the TraHK unsuccessfully tracks the HSI at the beginning of the day. We believed that potential profit occurs when wider deviations happen when the market opens. Jares and Lavin (2004) had proved that deviation creates ETF returns. Based on the operation, the TraHK will only benchmark the HSI once the HSI has opened and the updated historical data for the HSI are available. The TraHK will not track the HSI successfully unless the HSI opens.

It is also worth mentioning that positive premiums have higher mean values than those of negative premiums. Investors show their expectation of the market by investing in the TraHK. Referring to the results of the intraday correlation, the general trend for a single day can be easily estimated as positive correlations are formed.

During the course of a week, a U-shaped pattern forms. As with other stocks, the TraHK is popular on Mondays and Fridays. It is interesting that the Fund tracks the HSI more efficiently with a higher number of transactions. However, tracking becomes more difficult as the week progresses. Hence, high averaged means exist on Thursdays. The phenomenon is significant with negative premiums. Thursdays and other weekdays have negative correlations. Similarly, we find that negative correlations occur on two other pairs of weekdays: (i) Mondays and Fridays, and (ii) Tuesdays and Fridays. Furthermore, none of the statistics show significant differences using the Chi-Square tests even for the

non-normally distributed data. We also found that there is little correlation between the variances and the number of transactions.

Table 1 Intraday and Intraweek Patterns of the 15-minute Interval Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	0.2530	0.2430	0.2720	0.3251	0.2942	0.2774	0.2338	0.9937	0.9743	<.0001
10:30	0.2981	0.2401	0.3226	0.3279	0.3189	0.3048	0.8868	0.9264	0.9671	<.0001
10:45	0.3013	0.2638	0.3208	0.3805	0.2969	0.3140	0.6387	0.9587	0.9649	<.0001
11:00	0.3041	0.2575	0.3199	0.3597	0.3168	0.3119	0.6405	0.9585	0.9647	<.0001
11:15	0.3265	0.2901	0.3033	0.3256	0.2961	0.3093	0.2144	0.9946	0.9681	<.0001
11:30	0.3273	0.2747	0.2951	0.3391	0.3097	0.3101	0.2383	0.9934	0.9670	<.0001
11:45	0.3043	0.2640	0.2973	0.3466	0.3154	0.3068	0.5100	0.9725	0.9638	<.0001
12:00	0.2988	0.2488	0.3080	0.3206	0.3152	0.3014	0.4721	0.9762	0.9615	<.0001
12:15	0.2772	0.2695	0.2845	0.2716	0.3022	0.2830	0.1308	0.9980	0.9491	<.0001
12:30	0.2888	0.2867	0.2912	0.2914	0.2929	0.2906	0.0318	0.9999	0.9642	<.0001
14:45	0.2794	0.2848	0.2335	0.2760	0.3285	0.2824	0.6365	0.9589	0.9572	<.0001
15:00	0.3005	0.2989	0.2899	0.3453	0.3204	0.3113	0.1719	0.9965	0.9700	<.0001
15:15	0.3060	0.2659	0.2947	0.3323	0.3273	0.3091	0.4941	0.9741	0.9677	<.0001
15:30	0.3195	0.3266	0.3091	0.3443	0.2827	0.3132	0.2066	0.9950	0.9741	<.0001
15:45	0.2837	0.3166	0.3137	0.3453	0.3223	0.3161	0.0931	0.9990	0.9654	<.0001
16:00	0.3076	0.2688	0.2919	0.3057	0.3439	0.3062	0.6193	0.9609	0.9726	<.0001
Total	0.2968	0.2739	0.2953	0.3276	0.3129	0.3027	0.3558	0.9859	0.9587	<.0001
CHISQ	2.2802	1.8620	3.1580	2.3413	5.8683	7.9785				
P>CHISO	1.0000	1.0000	0.9999	1.0000	0.9940	0.9670				
W:Normal	0.9709	0.9725	0.9656	0.9615	0.9641	0.0806				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each. For the model

$$\overline{PM_i^d} = \frac{1}{N_i^d}\sum_{j=1}^{N_i^d} PM_{i,j}^d \qquad \text{for i =1,2, …, 80.}$$

N^d_i = Number of transactions recorded for interval i on day d.

$$\overline{PM} = \frac{1}{d_i}\sum_{d=1}^{N_i^d} \overline{PM}_i^{\,d} \qquad \text{for i = 1,2,…, 80.}$$

for d_i = Number of days that transaction is recorded in interval i.

Table 2 Intraday and Intraweek Patterns of the 15-minute Interval Range Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	1.4669	1.0154	1.3688	1.0842	1.1557	1.2341	5.0932	0.2779	0.5992	<.0001
10:30	0.5950	0.5263	0.7722	0.5416	0.6957	0.6316	2.8721	0.5795	0.2301	<.0001
10:45	0.6147	0.5071	0.5704	0.4954	0.9127	0.6446	6.8797	0.1424	0.2431	<.0001
11:00	0.5087	0.4533	0.4921	0.4853	0.4931	0.4906	1.7061	0.7896	0.5578	<.0001
11:15	0.4971	0.4268	0.4214	0.4336	0.3985	0.4387	3.2231	0.5212	0.5371	<.0001
11:30	0.5128	0.4570	0.4029	0.3690	0.3444	0.4153	6.4204	0.1699	0.5797	<.0001
11:45	0.5284	0.3537	0.4108	0.3738	0.4223	0.4305	9.3053	0.0539	0.5877	<.0001
12:00	0.4402	0.4016	0.4097	0.4316	0.3880	0.4148	1.9016	0.7539	0.5049	<.0001
12:15	0.3738	0.3303	0.3715	0.3634	0.4647	0.3908	7.6591	0.1049	0.5539	<.0001
12:30	0.3558	0.3082	0.3527	0.3196	0.3198	0.3334	2.1625	0.7059	0.5547	<.0001
14:45	0.6085	0.6210	0.7191	0.5682	0.6353	0.6335	2.2970	0.6813	0.3782	<.0001
15:00	0.5359	0.4757	0.5007	0.4257	0.5370	0.5033	3.4934	0.4789	0.603	<.0001
15:15	0.5367	0.4282	0.4863	0.4565	0.5038	0.4900	6.1648	0.1872	0.6051	<.0001
15:30	0.5258	0.8531	0.3999	0.4078	0.5437	0.5371	7.2617	0.1227	0.1544	<.0001
15:45	0.5038	0.4692	0.5297	0.4840	0.5483	0.5123	5.0619	0.281	0.6117	<.0001
16:00	0.7005	0.5620	0.6436	0.6237	0.7241	0.6577	4.607	0.33	0.5482	<.0001
Total	0.6315	0.5540	0.5849	0.5269	0.6082	0.5871	3.3107	0.5072	0.4063	<.0001
CHISQ	190.3885	196.2494	192.4667	179.3352	156.4377	918.7026				
P>CHISO	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001				
W:Normal	0.5746	0.2534	0.3471	0.5983	0.3591	0.2843				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each.

Table 3 Intraday and Intraweek Patterns of the 15-minute Interval Standard Deviation Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	0.3026	0.2546	0.2960	0.2583	0.2484	0.2727	3.3585	0.4997	0.8150	<.0001
10:30	0.1634	0.1447	0.2281	0.1517	0.1782	0.1737	1.1665	0.8836	0.2440	<.0001
10:45	0.1626	0.1576	0.1499	0.1466	0.2042	0.1671	1.1385	0.8881	0.4953	<.0001
11:00	0.1468	0.1392	0.1442	0.1484	0.1246	0.1403	2.3471	0.6722	0.6200	<.0001
11:15	0.1316	0.1181	0.1160	0.1296	0.1055	0.1203	5.7276	0.2180	0.7697	<.0001
11:30	0.1382	0.1340	0.1165	0.1219	0.0960	0.1199	11.0685	0.0258	0.6652	<.0001
11:45	0.1360	0.1102	0.1188	0.1167	0.1348	0.1254	3.1840	0.5275	0.6148	<.0001
12:00	0.1241	0.1349	0.1245	0.1261	0.1258	0.1265	1.6582	0.7983	0.6375	<.0001
12:15	0.1186	0.1053	0.1239	0.1213	0.1529	0.1279	10.2976	0.0357	0.6564	<.0001
12:30	0.1166	0.1170	0.1136	0.1075	0.1059	0.1115	0.8719	0.9286	0.7321	<.0001
14:45	0.1588	0.1666	0.1591	0.1416	0.1532	0.1558	1.0280	0.9055	0.6268	<.0001
15:00	0.1430	0.1349	0.1309	0.1201	0.1398	0.1350	2.9433	0.5674	0.7430	<.0001
15:15	0.1390	0.1320	0.1268	0.1202	0.1263	0.1289	2.5666	0.6327	0.6879	<.0001
15:30	0.1384	0.1996	0.1210	0.1224	0.1374	0.1415	3.7129	0.4462	0.2336	<.0001
15:45	0.1406	0.1320	0.1398	0.1247	0.1316	0.1340	2.9350	0.5688	0.7077	<.0001
16:00	0.1861	0.1570	0.1691	0.1639	0.1917	0.1750	5.6497	0.2269	0.7135	<.0001
Total	0.1618	0.1544	0.1538	0.1450	0.1540	0.1543	1.0189	0.9069	0.6137	<.0001
CHISQ	133.9263	137.9007	115.266	134.0594	121.9131	609.8963				
P>CHISO	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001				
W:Normal	0.6861	0.5203	0.4254	0.7366	0.6077	0.1929				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each. For the model

$$STD_i = \left[\frac{\sum_{j=1}^{N_i^d} \left(PM_{i,j}^d - \overline{PM}_i^d \right)^2}{N_i^d - 1} \right]^{\frac{1}{2}}$$

for i = 1, 2, …, 80.

Table 4 Intraday and Intraweek Patterns of the 15-minute Interval Number of Transactions

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	75	46	43	52	69	285	5.3882	0.2497	0.0965	<.0001
10:30	64	34	43	44	60	245	3.9681	0.4103	0.0945	<.0001
10:45	45	27	36	38	50	196	5.9743	0.2011	0.0917	<.0001
11:00	55	27	37	29	45	193	5.5806	0.2327	0.0949	<.0001
11:15	45	26	44	28	35	178	2.1005	0.7173	0.0961	<.0001
11:30	32	23	30	25	36	146	3.1727	0.5294	0.0919	<.0001
11:45	40	21	31	25	34	151	10.6948	0.0302	0.0944	<.0001
12:00	35	20	24	26	35	140	3.6298	0.4584	0.0944	<.0001
12:15	25	17	20	30	36	128	5.9061	0.2063	0.0995	<.0001
12:30	26	13	22	17	33	111	6.2124	0.1838	0.0993	<.0001
14:45	57	40	54	43	65	259	4.0880	0.3942	0.0920	<.0001
15:00	56	30	41	38	61	226	5.0983	0.2774	0.0951	<.0001
15:15	49	25	45	39	53	211	8.2791	0.0819	0.0962	<.0001
15:30	45	28	34	31	49	187	4.6774	0.3220	0.0898	<.0001
15:45	47	28	50	44	55	224	5.3020	0.2577	0.0912	<.0001
16:00	51	40	60	46	61	258	3.8714	0.4237	0.0892	<.0001
Total	747	445	614	555	777	3138	5.6086	0.2303	0.0880	<.0001
CHISQ	132.1364	140.7307	141.2142	135.2996	116.2292	677.2073				
P>CHISO	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001				
W:Normal	0.0705	0.0664	0.0671	0.0682	0.0709	0.4777				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each.

Table 5 Intraday and Intraweek Patterns of the Average of Positive Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	0.5681	0.5693	0.5573	0.6405	0.6026	0.5902	0.7854	0.9404	0.8927	<.0001
10:30	0.5705	0.5036	0.6137	0.5374	0.5861	0.5678	1.6545	0.7990	0.8614	<.0001
10:45	0.5541	0.5241	0.5047	0.5774	0.5608	0.5479	1.1213	0.8909	0.8672	<.0001
11:00	0.5527	0.4810	0.4989	0.5674	0.5454	0.5330	2.3385	0.6738	0.8654	<.0001
11:15	0.5386	0.5376	0.5220	0.5625	0.5445	0.5382	0.5823	0.9650	0.8660	<.0001
11:30	0.5916	0.5800	0.5469	0.5585	0.5269	0.5582	0.7247	0.9483	0.8781	<.0001
11:45	0.5155	0.5954	0.5438	0.6106	0.5620	0.5586	0.8944	0.9254	0.8821	<.0001
12:00	0.5805	0.5632	0.5758	0.5772	0.5613	0.5723	0.3137	0.9889	0.8783	<.0001
12:15	0.5675	0.5772	0.5258	0.5239	0.5473	0.5440	0.7800	0.9411	0.8655	<.0001
12:30	0.6037	0.5569	0.5388	0.6075	0.5619	0.5729	0.3364	0.9873	0.8863	<.0001
14:45	0.5194	0.5747	0.4869	0.5741	0.5928	0.5480	1.9646	0.7423	0.8744	<.0001
15:00	0.5656	0.5809	0.5538	0.6008	0.5388	0.5642	0.6869	0.9529	0.8864	<.0001
15:15	0.5534	0.5957	0.5441	0.5943	0.5351	0.5594	0.7566	0.9442	0.8814	<.0001
15:30	0.5461	0.6269	0.5597	0.5828	0.5625	0.5694	0.3780	0.9842	0.8970	<.0001
15:45	0.5319	0.5998	0.4907	0.5869	0.5626	0.5502	1.1001	0.8943	0.8817	<.0001
16:00	0.5819	0.6252	0.5387	0.5834	0.5648	0.5727	1.2439	0.8708	0.8874	<.0001
Total	0.0002	0.5696	0.5360	0.5822	0.5620	0.4347	0.7593	0.9438	0.8302	<.0001
CHISQ	7.6134	12.2708	12.1623	10.4171	3.4566	27.6007				
P>CHISO	0.9741	0.7835	0.7902	0.8852	0.9998	0.0498				
W:Normal	0.8785	0.8890	0.8778	0.8788	0.8735	0.1606				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each. For the model

$$\overline{PM_i^d} = \frac{1}{N_i^d}\sum_{j=1}^{N_i^d} PM_{i,j}^d \qquad \text{for i =1,2, …, 80.}$$

N^d_i = Number of transactions recorded for interval i on day d.

$$\overline{PM} = \frac{1}{d_i}\sum_{d=1}^{N_i^d} \overline{PM}_i^d \qquad \text{for i = 1,2,…, 80.}$$

for d_i = Number of days that transaction is recorded in interval i.

Table 6 Intraday and Intraweek Patterns of the Range of Positive Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	0.7124	0.5773	0.7883	0.7142	0.5689	0.6731	1.2088	0.8767	0.7261	<.0001
10:30	0.4207	0.3215	0.6901	0.4264	0.3797	0.4537	4.3555	0.3600	0.2452	<.0001
10:45	0.4030	0.3486	0.3453	0.3566	0.6425	0.4344	2.0648	0.7238	0.2576	<.0001
11:00	0.3629	0.2725	0.3641	0.3316	0.3560	0.3460	5.1172	0.2755	0.8115	<.0001
11:15	0.2922	0.3282	0.2835	0.3259	0.2743	0.2975	1.6573	0.7985	0.7741	<.0001
11:30	0.3136	0.2931	0.3258	0.2648	0.2473	0.2905	2.9698	0.5629	0.7676	<.0001
11:45	0.3170	0.3013	0.3181	0.2626	0.2805	0.2984	2.0235	0.7314	0.7773	<.0001
12:00	0.2580	0.2594	0.3495	0.2924	0.2791	0.2897	4.3938	0.3553	0.7441	<.0001
12:15	0.2624	0.2328	0.2744	0.2474	0.2493	0.2553	0.9575	0.9162	0.7274	<.0001
12:30	0.2653	0.2360	0.2755	0.2137	0.2334	0.2460	2.1978	0.6994	0.7002	<.0001
14:45	0.3866	0.3721	0.3691	0.4050	0.4220	0.3931	0.9169	0.9221	0.8381	<.0001
15:00	0.3469	0.3299	0.3350	0.3193	0.3930	0.3494	1.0554	0.9013	0.8332	<.0001
15:15	0.3790	0.3232	0.3180	0.3191	0.3788	0.3458	3.1106	0.5395	0.7985	<.0001
15:30	0.3628	0.3162	0.3127	0.3025	0.3600	0.3362	1.7595	0.7799	0.8029	<.0001
15:45	0.3662	0.3666	0.3384	0.2869	0.4216	0.3591	6.4172	0.1701	0.8328	<.0001
16:00	0.5053	0.4459	0.4466	0.4342	0.4766	0.4620	2.3763	0.6669	0.7127	<.0001
Total	0.3939	0.3554	0.3894	0.3679	0.3966	0.3836	2.1250	0.7128	0.4695	<.0001
CHISQ	81.0923	69.0909	51.7331	67.1903	65.5493	319.3262				
P>CHISO	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001				
W:Normal	0.7320	0.8161	0.3353	0.6820	0.3830	0.2532				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each.

Table 7 Intraday and Intraweek Patterns of the Standard Deviation of Positive Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	0.1810	0.1935	0.2437	0.2252	0.1668	0.1999	5.1221	0.2750	0.7434	<.0001
10:30	0.1341	0.1060	0.2595	0.1218	0.1233	0.1505	3.9734	0.4096	0.1689	<.0001
10:45	0.1136	0.1170	0.1148	0.1103	0.1710	0.1276	1.9515	0.7447	0.4556	<.0001
11:00	0.1101	0.0955	0.1207	0.1217	0.1047	0.1113	3.6306	0.4583	0.8216	<.0001
11:15	0.0925	0.1013	0.0937	0.1114	0.0897	0.0969	3.0774	0.5450	0.8269	<.0001
11:30	0.1019	0.0986	0.1056	0.0971	0.0747	0.0956	5.0682	0.2804	0.7838	<.0001
11:45	0.1056	0.1062	0.0994	0.0830	0.0952	0.0981	4.4284	0.3511	0.8325	<.0001
12:00	0.0831	0.0953	0.1065	0.0947	0.0979	0.0954	2.5527	0.6352	0.7804	<.0001
12:15	0.0996	0.0964	0.0963	0.0952	0.0891	0.0953	0.4356	0.9795	0.7877	<.0001
12:30	0.0956	0.1058	0.0905	0.0893	0.0855	0.0920	2.3378	0.6739	0.8093	<.0001
14:45	0.1205	0.1085	0.1115	0.1330	0.1134	0.1173	1.0173	0.9072	0.7402	<.0001
15:00	0.1014	0.1137	0.1035	0.1023	0.1148	0.1068	1.0476	0.9025	0.8541	<.0001
15:15	0.1161	0.1180	0.0990	0.1043	0.1011	0.1059	4.0209	0.4032	0.8154	<.0001
15:30	0.1185	0.1097	0.1048	0.0971	0.1126	0.1093	3.5953	0.4635	0.8073	<.0001
15:45	0.1148	0.1095	0.1022	0.0872	0.1188	0.1070	6.5908	0.1592	0.8462	<.0001
16:00	0.1508	0.1330	0.1254	0.1363	0.1371	0.1358	4.0699	0.3966	0.8259	<.0001
Total	0.1193	0.1179	0.1244	0.1190	0.1170	0.1197	2.8792	0.5782	0.6548	<.0001
CHISQ	52.1677	47.3743	48.6368	80.2362	48.1098	235.1944				
P>CHISO	<.0001	0.0001	<.0001	<.0001	<.0001	<.0001				
W:Normal	0.8271	0.8214	0.2928	0.7813	0.6303	0.1748				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each. For the model

$$STD_i = \left[\frac{\sum_{i=1}^{N_i^d} \left(PM_{i,j}^d - \overline{PM}_i^d \right)^2}{N_i^d - 1} \right]^{\frac{1}{2}}$$

for i = 1, 2, …, 80.

Table 8 Intraday and Intraweek Patterns of the Number of Transactions of Positive Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	49	32	31	45	41	198	3.1674	0.5302	0.1175	<.0001
10:30	47	22	36	37	41	183	1.3457	0.8536	0.1169	<.0001
10:45	35	20	27	32	37	151	3.1524	0.5326	0.1131	<.0001
11:00	46	18	32	22	29	147	6.7708	0.1485	0.1139	<.0001
11:15	33	21	46	25	23	148	1.1117	0.8924	0.1204	<.0001
11:30	21	19	30	20	25	115	3.1306	0.5362	0.1152	<.0001
11:45	32	16	30	22	25	125	2.8569	0.5820	0.1233	<.0001
12:00	23	13	22	24	24	106	3.4324	0.4882	0.1168	<.0001
12:15	20	9	19	24	19	91	5.1306	0.2742	0.1273	<.0001
12:30	15	10	18	15	19	77	8.6146	0.0715	0.1258	<.0001
14:45	41	26	44	35	50	196	2.7709	0.5969	0.1181	<.0001
15:00	46	21	39	32	47	185	3.8862	0.4216	0.1214	<.0001
15:15	33	19	43	36	45	176	3.2569	0.5158	0.1219	<.0001
15:30	34	18	30	27	45	154	3.5004	0.4778	0.1156	<.0001
15:45	37	22	40	37	49	185	1.4357	0.8380	0.1150	<.0001
16:00	40	29	57	40	50	216	1.7764	0.7768	0.1141	<.0001
Total	552	315	544	473	569	2453	2.8384	0.5852	0.1005	<.0001
CHISQ	76.9478	69.0493	50.9494	57.7902	57.2651	308.3967				
P>CHISO	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001				
W:Normal	0.0852	0.0817	0.0811	0.0832	0.0858	0.4753				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each.

Table 9 Intraday and Intraweek Patterns of the Average of Negative Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	-0.5408	-0.3753	-0.3785	-0.3793	-0.4225	-0.4357	4.7835	0.3102	0.7088	<.0001
10:30	-0.2792	-0.2989	-0.2552	-0.2371	-0.3237	-0.2879	3.8541	0.4261	0.8965	<.0001
10:45	-0.3132	-0.3154	-0.2307	-0.2159	-0.3057	-0.2830	4.8644	0.3015	0.8018	<.0001
11:00	-0.3550	-0.2756	-0.1997	-0.2700	-0.2318	-0.2728	4.9671	0.2907	0.7342	<.0001
11:15	-0.3281	-0.3020	-0.2611	-0.2643	-0.2253	-0.2774	1.8270	0.7675	0.7767	<.0001
11:30	-0.3605	-0.3421	-0.2734	-0.2631	-0.2399	-0.2962	2.4779	0.6486	0.7097	<.0001
11:45	-0.4212	-0.3235	-0.2403	-0.2740	-0.2831	-0.3169	4.9696	0.2904	0.7707	<.0001
12:00	-0.2960	-0.3737	-0.2563	-0.2651	-0.2444	-0.2877	1.8599	0.7615	0.8387	<.0001
12:15	-0.2836	-0.2904	-0.2165	-0.2647	-0.3268	-0.2926	3.3390	0.5028	0.8136	<.0001
12:30	-0.3000	-0.2998	-0.2772	-0.2998	-0.2706	-0.2859	0.0865	0.9991	0.9007	<.0001
14:45	-0.3142	-0.3529	-0.2732	-0.3238	-0.2780	-0.3064	1.6818	0.7940	0.8291	<.0001
15:00	-0.3529	-0.3248	-0.2660	-0.2670	-0.2937	-0.3055	2.3427	0.6730	0.8192	<.0001
15:15	-0.3037	-0.3578	-0.2390	-0.2968	-0.3036	-0.3042	5.0743	0.2798	0.8622	<.0001
15:30	-0.2509	-0.3384	-0.2141	-0.3019	-0.2919	-0.2808	7.1259	0.1294	0.8470	<.0001
15:45	-0.2972	-0.2915	-0.2524	-0.3080	-0.2700	-0.2834	2.3601	0.6699	0.8073	<.0001
16:00	-0.3051	-0.3100	-0.3142	-0.3583	-0.3410	-0.3246	2.7161	0.6064	0.8483	<.0001
Total	-0.3368	-0.3254	-0.2632	-0.2889	-0.2975	-0.3061	2.2043	0.6982	0.6409	<.0001
CHISQ	30.8095	18.4116	26.7042	28.6717	32.0176	85.1036				
P>CHISO	0.0211	0.3633	0.0626	0.0377	0.0150	<.0001				
W:Normal	0.7101	0.8744	0.9024	0.7172	0.7707	0.1459				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each. For the model

$$\overline{PM_i^d} = \frac{1}{N_i^d}\sum_{j=1}^{N_i^d} PM_{i,j}^d \qquad \text{for i =1,2, …, 80.}$$

N^d_i = Number of transactions recorded for interval i on day d.

$$\overline{PM} = \frac{1}{d_i}\sum_{d=1}^{N_i^d} \overline{PM}_i^d \qquad \text{for i = 1,2,…, 80.}$$

for d_i = Number of days that transaction is recorded in interval i.

Table 10 Intraday and Intraweek Patterns of the Range of Negative Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	1.0235	0.6787	0.8950	0.4636	0.9868	0.8747	5.2277	0.2647	0.6212	<.0001
10:30	0.3160	0.4087	0.3381	0.2601	0.7043	0.4530	3.7492	0.4410	0.3219	<.0001
10:45	0.3751	0.2567	0.3769	0.2602	0.7385	0.4559	8.0656	0.0892	0.3583	<.0001
11:00	0.3798	0.2790	0.2640	0.2651	0.3320	0.3181	1.8702	0.7596	0.7240	<.0001
11:15	0.2480	0.3459	0.2250	0.2199	0.2546	0.2614	1.7831	0.7756	0.6325	<.0001
11:30	0.3065	0.4010	0.2603	0.3010	0.2233	0.2921	2.1509	0.7080	0.7444	<.0001
11:45	0.3022	0.2677	0.2372	0.3539	0.2672	0.2868	3.3859	0.4954	0.8363	<.0001
12:00	0.2889	0.3262	0.2483	0.3290	0.2456	0.2841	1.3939	0.8453	0.6317	<.0001
12:15	0.2575	0.2700	0.2123	0.2611	0.4212	0.3186	5.5817	0.2326	0.7733	<.0001
12:30	0.2811	0.2222	0.2504	0.1821	0.2444	0.2477	2.2553	0.6889	0.8097	<.0001
14:45	0.3534	0.4631	0.6151	0.3864	0.4763	0.4581	1.4660	0.8326	0.3974	<.0001
15:00	0.3014	0.4261	0.2641	0.3175	0.3446	0.3353	4.4215	0.3520	0.7766	<.0001
15:15	0.2779	0.3260	0.2524	0.2638	0.3173	0.2911	2.3327	0.6748	0.8907	<.0001
15:30	0.3508	0.9968	0.2253	0.2477	0.3956	0.4621	2.8985	0.5750	0.1790	<.0001
15:45	0.3375	0.2710	0.2972	0.3052	0.2811	0.3009	1.4159	0.8414	0.8536	<.0001
16:00	0.3847	0.3842	0.3067	0.3538	0.3748	0.3661	3.5587	0.4690	0.7855	<.0001
Total	0.3832	0.4182	0.3627	0.3061	0.4541	0.3951	8.0301	0.0905	0.4219	<.0001
CHISQ	32.6375	31.7077	40.4134	41.3572	30.6045	146.3525				
P>CHISO	0.0125	0.0164	0.0011	0.0008	0.0223	<.0001				
W:Normal	0.6213	0.2165	0.4061	0.7527	0.4152	0.3324				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each.

Table 11 Intraday and Intraweek Patterns of the Standard Deviation of Negative Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISQ	W:Normal	P<W
10:15	0.3858	0.2044	0.2525	0.1750	0.2216	0.2612	3.9719	0.4098	0.7088	<.0001
10:30	0.0940	0.1172	0.1136	0.0981	0.1519	0.1199	2.1529	0.7077	0.8965	<.0001
10:45	0.1133	0.0958	0.1010	0.0945	0.1581	0.1200	2.1765	0.7033	0.8018	<.0001
11:00	0.1200	0.0990	0.0917	0.1011	0.0801	0.0981	1.1862	0.8804	0.7342	<.0001
11:15	0.0811	0.0954	0.0812	0.0794	0.0701	0.0804	1.0058	0.9089	0.7767	<.0001
11:30	0.0913	0.1364	0.0955	0.1020	0.0700	0.0953	3.3340	0.5036	0.7097	<.0001
11:45	0.1071	0.0868	0.0818	0.1338	0.0918	0.1005	1.6470	0.8003	0.7707	<.0001
12:00	0.1225	0.1116	0.0856	0.1025	0.0834	0.1023	1.7604	0.7797	0.8387	<.0001
12:15	0.0810	0.0883	0.0889	0.0946	0.1449	0.1095	4.7620	0.3126	0.8136	<.0001
12:30	0.1008	0.0866	0.0910	0.0757	0.0795	0.0878	1.1760	0.8820	0.9007	<.0001
14:45	0.1059	0.1674	0.1373	0.1115	0.1245	0.1289	0.3370	0.9873	0.8291	<.0001
15:00	0.0967	0.1344	0.0934	0.1008	0.1050	0.1063	3.4429	0.4866	0.8192	<.0001
15:15	0.1017	0.0988	0.0936	0.0965	0.0999	0.0990	0.2804	0.9910	0.8622	<.0001
15:30	0.1017	0.2243	0.0814	0.0949	0.1076	0.1248	2.7919	0.5932	0.8470	<.0001
15:45	0.1066	0.0917	0.0992	0.1068	0.0924	0.0998	2.2048	0.6981	0.8073	<.0001
16:00	0.1026	0.1165	0.1144	0.1186	0.1278	0.1158	3.7811	0.4364	0.8483	<.0001
Total	0.1279	0.1280	0.1123	0.1070	0.1202	0.1204	6.6741	0.1541	0.6409	<.0001
CHISQ	43.6667	38.4573	39.7784	33.3947	42.6622	166.1873				
P>CHISO	0.0004	0.0021	0.0014	0.0100	0.0005	<.0001				
W:Normal	0.4233	0.4095	0.7681	0.8226	0.6869	0.2084				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each. For the model

$$STD_i = \left[\frac{\sum_{i=1}^{N_i^d} \left(PM_{i,j}^d - \overline{PM}_i^d \right)^2}{N_i^d - 1} \right]^{\frac{1}{2}}$$

for i = 1, 2, …, 80.

Table 12 Intraday and Intraweek Patterns of the Number of Transactions of Negative Mean Premium

Time	Mon	Tue	Wed	Thur	Fri	Total	CHISQ	P>CHISO	W:Normal	P<W
10:15	49	30	24	21	60	184	1.7691	0.7781	0.1464	<.0001
10:30	42	30	25	24	58	179	5.2713	0.2606	0.1627	<.0001
10:45	29	19	22	19	41	130	5.9456	0.2032	0.1547	<.0001
11:00	36	21	17	20	42	136	2.3325	0.6749	0.1677	<.0001
11:15	31	21	13	16	32	113	4.5675	0.3346	0.1635	<.0001
11:30	30	20	16	19	33	118	1.3635	0.8505	0.1682	<.0001
11:45	27	20	15	19	29	110	2.4818	0.6479	0.1634	<.0001
12:00	30	21	14	14	30	109	0.2067	0.9950	0.1666	<.0001
12:15	21	22	9	21	44	117	5.4574	0.2435	0.1692	<.0001
12:30	30	13	17	9	38	107	2.6643	0.6155	0.1794	<.0001
14:45	39	35	33	30	48	185	0.8825	0.9271	0.1551	<.0001
15:00	37	28	17	28	46	156	4.4114	0.3532	0.1655	<.0001
15:15	40	23	16	21	35	135	2.1161	0.7144	0.1649	<.0001
15:30	34	27	19	20	28	128	2.2617	0.6877	0.1610	<.0001
15:45	33	21	28	26	30	138	1.9728	0.7408	0.1565	<.0001
16:00	31	33	19	24	29	136	3.2885	0.5108	0.1430	<.0001
Total	539	384	304	331	623	2181	2.1386	0.7103	0.1280	<.0001
CHISQ	17.8327	28.7238	30.0957	37.1931	34.6910	136.3053				
P>CHISO	0.3995	0.0372	0.0257	0.0032	0.0068	<.0001				
W:Normal	0.1126	0.1105	0.1043	0.1091	0.1165	0.4698				
P<W	<.0001	<.0001	<.0001	<.0001	<.0001	<.0100				

Notes: The study covers across a week. The trading day is divided into 16 divisions lasting 15 minutes each.

Table 13 Intraday Correlation of Premium

Time Interval	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	14:45	15:00	15:15	15:30	15:45	16:00
10:15	1.0000	0.9388	0.9350	0.9243	0.9208	0.9156	0.9160	0.9315	0.9197	0.9103	0.8967	0.8967	0.8915	0.8777	0.8823	0.8663
10:30	0.9388	1.0000	0.9465	0.9288	0.9220	0.9241	0.9232	0.9290	0.9216	0.9129	0.9014	0.8974	0.9054	0.8912	0.8932	0.8790
10:45	0.9350	0.9465	1.0000	0.9648	0.9511	0.9446	0.9433	0.9475	0.9425	0.9316	0.9245	0.9158	0.9128	0.9026	0.8976	0.8837
11:00	0.9243	0.9288	0.9648	1.0000	0.9610	0.9400	0.9445	0.9400	0.9360	0.9266	0.9180	0.9048	0.9089	0.8995	0.8986	0.8746
11:15	0.9208	0.9220	0.9511	0.9610	1.0000	0.9629	0.9534	0.9537	0.9488	0.9449	0.9277	0.9219	0.9238	0.9155	0.9134	0.8989
11:30	0.9156	0.9241	0.9446	0.9400	0.9629	1.0000	0.9710	0.9637	0.9555	0.9478	0.9410	0.9418	0.9441	0.9283	0.9277	0.9160
11:45	0.9160	0.9232	0.9433	0.9445	0.9534	0.9710	1.0000	0.9663	0.9559	0.9458	0.9402	0.9367	0.9382	0.9233	0.9190	0.9069
12:00	0.9315	0.9290	0.9475	0.9400	0.9537	0.9637	0.9663	1.0000	0.9676	0.9559	0.9424	0.9432	0.9390	0.9205	0.9145	0.9058
12:15	0.9197	0.9216	0.9425	0.9360	0.9488	0.9555	0.9559	0.9676	1.0000	0.9692	0.9497	0.9382	0.9364	0.9259	0.9192	0.9082
12:30	0.9103	0.9129	0.9316	0.9266	0.9449	0.9478	0.9458	0.9559	0.9692	1.0000	0.9542	0.9408	0.9373	0.9285	0.9221	0.9110
14:45	0.8967	0.9014	0.9245	0.9180	0.9277	0.9410	0.9402	0.9424	0.9497	0.9542	1.0000	0.9592	0.9573	0.9458	0.9375	0.9272
15:00	0.8967	0.8974	0.9158	0.9048	0.9219	0.9418	0.9367	0.9432	0.9382	0.9408	0.9592	1.0000	0.9703	0.9598	0.9487	0.9423
15:15	0.8915	0.9054	0.9128	0.9089	0.9238	0.9441	0.9382	0.9390	0.9364	0.9373	0.9573	0.9703	1.0000	0.9632	0.9553	0.9431
15:30	0.8777	0.8912	0.9026	0.8995	0.9155	0.9283	0.9233	0.9205	0.9259	0.9285	0.9458	0.9598	0.9632	1.0000	0.9624	0.9418
15:45	0.8823	0.8932	0.8976	0.8986	0.9134	0.9277	0.9190	0.9145	0.9192	0.9221	0.9375	0.9487	0.9553	0.9624	1.0000	0.9625
16:00	0.8663	0.8790	0.8837	0.8746	0.8989	0.9160	0.9069	0.9058	0.9082	0.9110	0.9272	0.9423	0.9431	0.9418	0.9625	1.0000

Notes: The study covers across a trading day which is divided into 16 divisions lasting 15 minutes each.

Pearson Correlation Coefficients

Prob > | r| under HO: Rho = 0 (All are .0001)

Table 14 Intraday Correlation of Positive Premium

Time Interval	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	14:45	15:00	15:15	15:30	15:45	16:00
10:15	1.0000	0.8596	0.9105	0.9024	0.8922	0.9069	0.8957	0.9215	0.9014	0.9045	0.8870	0.8728	0.8598	0.8715	0.8713	0.8568
10:30	0.8596	1.0000	0.8853	0.8589	0.8529	0.8631	0.8547	0.8564	0.8440	0.8330	0.8434	0.8244	0.8423	0.8318	0.8255	0.8184
10:45	0.9105	0.8853	1.0000	0.9582	0.9460	0.9421	0.9402	0.9431	0.9362	0.9321	0.9220	0.9018	0.8668	0.8972	0.9007	0.8874
11:00	0.9024	0.8589	0.9582	1.0000	0.9622	0.9440	0.9493	0.9469	0.9353	0.9295	0.9160	0.9000	0.8763	0.9026	0.9148	0.8840
11:15	0.8922	0.8529	0.9460	0.9622	1.0000	0.9571	0.9433	0.9475	0.9347	0.9351	0.9254	0.9183	0.8773	0.9150	0.9218	0.9066
11:30	0.9069	0.8631	0.9421	0.9440	0.9571	1.0000	0.9588	0.9517	0.9489	0.9429	0.9256	0.9276	0.8989	0.9145	0.9109	0.8936
11:45	0.8957	0.8547	0.9402	0.9493	0.9433	0.9588	1.0000	0.9628	0.9496	0.9436	0.9165	0.9088	0.8805	0.9072	0.8969	0.8731
12:00	0.9215	0.8564	0.9431	0.9469	0.9475	0.9517	0.9628	1.0000	0.9564	0.9476	0.9245	0.9155	0.8787	0.8998	0.8851	0.8652
12:15	0.9014	0.8440	0.9362	0.9353	0.9347	0.9489	0.9496	0.9564	1.0000	0.9662	0.9443	0.9298	0.8906	0.9170	0.9138	0.9044
12:30	0.9045	0.8330	0.9321	0.9295	0.9351	0.9429	0.9436	0.9476	0.9662	1.0000	0.9432	0.9236	0.8826	0.9150	0.9104	0.8926
14:45	0.8870	0.8434	0.9220	0.9160	0.9254	0.9256	0.9165	0.9245	0.9443	0.9432	1.0000	0.9391	0.9052	0.9280	0.9149	0.8943
15:00	0.8728	0.8244	0.9018	0.9000	0.9183	0.9276	0.9088	0.9155	0.9298	0.9236	0.9391	1.0000	0.9157	0.9477	0.9281	0.9183
15:15	0.8598	0.8423	0.8688	0.8763	0.8773	0.8989	0.8805	0.8787	0.8906	0.8826	0.9052	0.9157	1.0000	0.9502	0.8946	0.9138
15:30	0.8715	0.8318	0.8972	0.9026	0.9150	0.9145	0.9072	0.8998	0.9170	0.9150	0.9280	0.9477	0.9502	1.0000	0.9518	0.9254
15:45	0.8713	0.8255	0.9007	0.9148	0.9218	0.9109	0.8969	0.8851	0.9138	0.9104	0.9149	0.9281	0.8946	0.9518	1.0000	0.9457
16:00	0.8568	0.8184	0.8874	0.8840	0.9066	0.8936	0.8731	0.8652	0.9044	0.8926	0.8943	0.9183	0.9138	0.9254	0.9457	1.0000

Notes: The study covers across a trading day which is divided into 16 divisions lasting 15 minutes each.

Pearson Correlation Coefficients

Prob > | r | under HO: Rho = 0(All are <.0001)

Table 15 Intraday Correlation of Negative Premium

Time Interval	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	14:45	15:00	15:15	15:30	15:45	16:00
10:15	1.0000	0.5839	0.4337	0.3498	0.4347	0.3775	0.3402	0.4244	0.3386	0.3750	0.3430	0.3602	0.3041	0.3049	0.3179	0.3203
10:30	0.5839	1.0000	0.7341	0.6145	0.7062	0.5935	0.7200	0.5705	0.6657	0.6704	0.5914	0.6222	0.6049	0.5852	0.6276	0.6354
10:45	0.4337	0.7341	1.0000	0.7169	0.8000	0.7885	0.7825	0.7532	0.7418	0.6309	0.7374	0.7240	0.7362	0.6325	0.5762	0.5963
11:00	0.3498	0.6145	0.7169	1.0000	0.7253	0.6917	0.8391	0.5842	0.5948	0.4384	0.5670	0.5407	0.5282	0.4915	0.5682	0.3707
11:15	0.4347	0.7062	0.8000	0.7253	1.0000	0.8970	0.8559	0.8094	0.8482	0.7774	0.7942	0.7506	0.7213	0.6989	0.6570	0.6017
11:30	0.3775	0.5935	0.7885	0.6917	0.8970	1.0000	0.8736	0.7374	0.8141	0.7219	0.7394	0.7203	0.7379	0.6679	0.6445	0.6333
11:45	0.3402	0.7200	0.7825	0.8391	0.8559	0.8736	1.0000	0.6760	0.8289	0.6817	0.7638	0.7894	0.7331	0.3906	0.4983	0.6552
12:00	0.4244	0.5705	0.7532	0.5842	0.8094	0.7374	0.6760	1.0000	0.8734	0.8006	0.7845	0.8261	0.7751	0.7295	0.6838	0.7084
12:15	0.3386	0.6657	0.7418	0.5948	0.8482	0.8141	0.8289	0.8734	1.0000	0.8017	0.8115	0.8493	0.7598	0.5706	0.6507	0.7095
12:30	0.3750	0.6704	0.6309	0.4384	0.7774	0.7219	0.6817	0.8006	0.8017	1.0000	0.8417	0.7975	0.7728	0.6991	0.7332	0.7202
14:45	0.3430	0.5914	0.7374	0.5670	0.7942	0.7394	0.7638	0.7845	0.8115	0.8417	1.0000	0.8305	0.8479	0.7452	0.7022	0.7960
15:00	0.3602	0.6222	0.7240	0.5407	0.7506	0.7203	0.7894	0.8261	0.8493	0.7975	0.8305	1.0000	0.8630	0.6768	0.8007	0.6534
15:15	0.3041	0.6049	0.7362	0.5282	0.7213	0.7379	0.7331	0.7751	0.7598	0.7728	0.8479	0.8630	1.0000	0.8419	0.8142	0.8187
15:30	0.3049	0.5852	0.6325	0.4915	0.6989	0.6679	0.3906	0.7295	0.5706	0.6991	0.7452	0.6768	0.8419	1.0000	0.8273	0.7244
15:45	0.3179	0.6276	0.5762	0.5682	0.6570	0.6445	0.4983	0.6838	0.6507	0.7332	0.7022	0.8007	0.8142	0.8273	1.0000	0.8218
16:00	0.3203	0.6354	0.5963	0.3707	0.6017	0.6333	0.6552	0.7084	0.7095	0.7202	0.7960	0.6534	0.8187	0.7244	0.8218	1.0000

Notes: The study covers across a trading day which is divided into 16 divisions lasting 15 minutes each.

Pearson Correlation Coefficients

Prob > | r | under HO: Rho = 0 (All are <.0001)

Table 16 Intraweek Correlation of Premium

Weekday	Mon	Tue	Wed	Thur	Fri
Mon	1	0.39458	0.74423	-0.49686	0.44033
		(-0.0946)	(-0.0003)	(-0.0305)	(-0.0592)
Tue	0.39458	1	0.56061	-0.23616	0.57653
	(-0.0946)		(-0.0125)	(-0.3304)	(-0.0098)
Wed	0.74423	0.56061	1	-0.39068	0.42967
	(-0.0003)	(-0.0125)		(-0.0982)	(-0.0664)
Thur	-0.49686	-0.23616	-0.39068	1	-0.58861
	(-0.0305)	(-0.3304)	(-0.0982)		(-0.0080)
Fri	0.44033	0.57653	0.42967	-0.58861	1
	(-0.0592)	(-0.0098)	(-0.0664)	(-0.0080)	

Notes: The study covers across a week. Each weekday includes 16 divisions lasting 15 minutes each.

Pearson Correlation Coefficients

Prob > | r | under HO: Rho = 0

Table 17 Intraweek Correlation of Positive Premium

Weekday	Mon	Tue	Wed	Thur	Fri
Mon	1	0.27372	0.41524	0.21966	-0.058
		(-0.2568)	(-0.0771)	(-0.3662)	(-0.8135)
Tue	0.27372	1	0.01722	0.40048	-0.18282
	(-0.2568)		(-0.9442)	(-0.0893)	(-0.4538)
Wed	0.41524	0.01722	1	0.63944	0.53288
	(-0.0771)	(-0.9442)		(-0.0032)	(-0.0188)
Thur	0.21966	0.40048	0.63944	1	0.03888
	(-0.3662)	(-0.0893)	(-0.0032)		(-0.8744)
Fri	-0.058	-0.18282	0.53288	0.03888	1
	(-0.8135)	(-0.4538)	(-0.0188)	(-0.8744)	

Notes: The study covers across a week. Each weekday includes 16 divisions lasting 15 minutes each.

Pearson Correlation Coefficients

Prob > | r | under HO: Rho = 0

Table 18 Intraweek Correlation of Negative Premium

Weekday	Mon	Tue	Wed	Thur	Fri
Mon	1.0000	0.73031	0.71344	0.66208	0.90441
		(-0.0004)	(-0.0006)	(-0.002)	(<.0001)
Tue	0.73031	1.0000	0.84887	0.80731	0.87446
	(-0.0004)		(<.0001)	(<.0001)	(<.0001)
Wed	0.71344	0.84887	1.0000	0.77708	0.80868
	(-0.0006)	(<.0001)		(<.0001)	(<.0001)
Thur	0.66208	0.80731	0.77708	1.0000	0.85011
	(-0.002)	(<.0001)	(<.0001)		(<.0001)
Fri	0.99441	0.87446	0.80868	0.85011	1.0000
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	

Notes: The study covers across a week. Each weekday includes 16 divisions lasting 15 minutes each.

Pearson Correlation Coefficients

Prob > | r | under HO: Rho = 0

Table 19 Correlation between Variances and Number of Transactions of Premium

Time	Mon	Tue	Wed	Thur	Fri
10:15	-0.086	-0.195	0.016	-0.064	0.398 b
	(0.555)	(0.165)	(0.910)	(0.647)	(0.004)
10:30	-0.135	0.081	-0.077	-0.068	0.453 b
	(0.359)	(0.563)	(0.587)	(0.630)	(0.001)
10:45	-0.137	-0.221	0.077	-0.148	-0.007
	(0.347)	(0.116)	(0.578)	(0.289)	(0.962)
11:00	-0.087	0.092	-0.165	-0.089	0.010
	(0.552)	(0.517)	(0.239)	(0.520)	(0.947)
11:15	-0.076	0.148	-0.050	0.122	0.104
	(0.605)	(0.291)	(0.721)	(0.387)	(0.469)
11:30	-0.018	-0.057	0.177	-0.004	0.025
	(0.901)	(0.693)	(0.206)	(0.976)	(0.864)
11:45	-0.082	-0.116	-0.100	-0.075	-0.130
	(0.584)	(0.427)	(0.486)	(0.607)	(0.379)
12:00	0.037	-0.048	0.015	0.090	-0.090
	(0.802)	(0.744)	(0.914)	(0.537)	(0.543)
12:15	-0.055	-0.097	-0.034	0.005	-0.096
	(0.712)	(0.499)	(0.805)	(0.973)	(0.532)
12:30	-0.068	-0.291 a	-0.078	0.200	0.039
	(0.655)	(0.040)	(0.585)	(0.159)	(0.792)
14:30	-0.143	-0.153	0.049	-0.068	-0.092
	(0.321)	(0.275)	(0.724)	(0.625)	(0.531)
14:45	-0.084	-0.055	0.003	-0.003	-0.187
	(0.576)	(0.697)	(0.983)	(0.984)	(0.193)
15:00	-0.092	-0.052	-0.077	0.167	-0.002
	(0.530)	(0.719)	(0.590)	(0.232)	(0.992)
15:15	0.084	0.034	-0.043	0.222	0.360 a
	(0.560)	(0.814)	(0.760)	(0.114)	(0.010)
15:30	-0.058	-0.120	-0.064	0.306 a	0.138
	(0.688)	(0.392)	(0.644)	(0.027)	(0.341)
16:00	-0.210	-0.069	-0.088	0.093	-0.157
	(0.143)	(0.625)	(0.526)	(0.502)	(0.276)

Notes:

The study covers across a trading day which is divided into 16 divisions lasting 15 minutes each.

a Correlation is significant at the 0.05 level (2-tailed)

b Correlation is significant at the 0.01 level (2-tailed)

Table 20 Correlation between Variances and Number of Transactions of Positive Premium

Time	Mon		Tue	Wed	Thur		Fri	
10:15	0.039		-0.147	-0.080	-0.049		0.046	
	(0.808)		(0.364)	(0.609)	(0.768)		(0.784)	
10:30	0.169		0.186	-0.090	0.061		0.032	
	(0.331)		(0.243)	(0.585)	(0.697)		(0.850)	
10:45	0.057		-0.057	-0.085	-0.005		-0.039	
	(0.725)		(0.722)	(0.582)	(0.975)		(0.820)	
11:00	0.000		0.255	-0.158	-0.045		0.136	
	(0.999)		(0.113)	(0.318)	(0.775)		(0.422)	
11:15	-0.084		0.186	0.004	0.317	a	0.289	
	(0.608)		(0.244)	(0.979)	(0.049)		(0.083)	
11:30	0.346	a	0.109	0.043	0.112		0.029	
	(0.036)		(0.521)	(0.796)	(0.490)		(0.861)	
11:45	-0.023		-0.066	-0.129	0.090		-0.005	
	(0.890)		(0.720)	(0.453)	(0.587)		(0.975)	
12:00	0.157		-0.171	0.055	0.219		0.050	
	(0.383)		(0.335)	(0.735)	(0.193)		(0.774)	
12:15	0.170		-0.054	0.056	0.052		0.274	
	(0.362)		(0.765)	(0.734)	(0.765)		(0.122)	
12:30	0.234		-0.253	0.154	0.020		0.021	
	(0.198)		(0.143)	(0.363)	(0.908)		(0.906)	
14:30	-0.143		0.144	-0.024	-0.100		0.165	
	(0.380)		(0.377)	(0.883)	(0.539)		(0.328)	
14:45	0.082		0.019	0.039	0.005		0.007	
	(0.635)		(0.912)	(0.818)	(0.975)		(0.965)	
15:00	-0.130		0.021	-0.139	0.107		0.194	
	(0.443)		(0.909)	(0.399)	(0.512)		(0.225)	
15:15	0.012		-0.062	0.111	0.284		0.522	b
	(0.942)		(0.718)	(0.512)	(0.072)		(0.001)	
15:30	0.163		0.008	0.146	0.459	b	0.171	
	(0.320)		(0.960)	(0.340)	(0.003)		(0.303)	
16:00	-0.043		0.055	0.013	0.147		-0.027	
	(0.796)		(0.752)	(0.932)	(0.360)		(0.866)	

Notes:

The study covers across a trading day which is divided into 16 divisions lasting 15 minutes each

a Correlation is significant at the 0.05 level (2-tailed)

b Correlation is significant at the 0.01 level (2-tailed)

Table 21 Correlation between Variances and Number of Transactions of Negative Premium

Time	Mon		Tue		Wed		Thur		Fri	
10:15	-0.150		-0.047		0.055		-0.082		0.775	b
	(0.421)		(0.806)		(0.766)		(0.685)		(0.000)	
10:30	0.332		0.224		-0.044		0.061		0.757	b
	(0.097)		(0.252)		(0.828)		(0.777)		(0.000)	
10:45	0.089		0.034		0.648	b	0.139		0.387	
	(0.659)		(0.868)		(0.000)		(0.497)		(0.056)	
11:00	-0.103		0.228		0.216		0.157		0.337	
	(0.640)		(0.252)		(0.289)		(0.463)		(0.108)	
11:15	0.155		0.222		0.356		0.097		0.461	a
	(0.469)		(0.321)		(0.081)		(0.644)		(0.024)	
11:30	0.197		-0.149		0.070		-0.198		0.324	
	(0.367)		(0.498)		(0.752)		(0.388)		(0.163)	
11:45	-0.138		0.291		0.508	b	-0.327		0.153	
	(0.561)		(0.200)		(0.008)		(0.147)		(0.475)	
12:00	-0.094		-0.083		0.046		0.393		0.307	
	(0.657)		(0.705)		(0.822)		(0.064)		(0.165)	
12:15	0.331		-0.053		0.080		0.264		-0.092	
	(0.114)		(0.806)		(0.696)		(0.224)		(0.685)	
12:30	-0.096		0.120		-0.015		0.415	a	0.296	
	(0.696)		(0.613)		(0.948)		(0.044)		(0.181)	
14:30	0.103		-0.138		0.263		0.121		-0.010	
	(0.608)		(0.484)		(0.177)		(0.547)		(0.962)	
14:45	0.214		-0.100		0.320		0.265		-0.133	
	(0.315)		(0.643)		(0.091)		(0.210)		(0.534)	
15:00	-0.018		0.127		0.608	b	0.295		-0.112	
	(0.350)		(0.545)		(0.002)		(0.152)		(0.618)	
15:15	0.501	a	0.035		0.357		0.659	b	0.256	
	(0.013)		(0.869)		(0.068)		(0.001)		(0.239)	
15:30	0.141		0.047		0.200		0.256		-0.058	
	(0.512)		(0.816)		(0.918)		(0.217)		(0.796)	
16:00	0.276		0.234		-0.077		0.275		0.095	
	(0.163)		(0.230)		(0.687)		(0.194)		(0.646)	

Notes:

The study covers across a trading day which is divided into 16 divisions lasting 15 minutes each

a Correlation is significant at the 0.05 level (2-tailed)

b Correlation is significant at the 0.01 level (2-tailed)

Figure 1 Mean of Premium

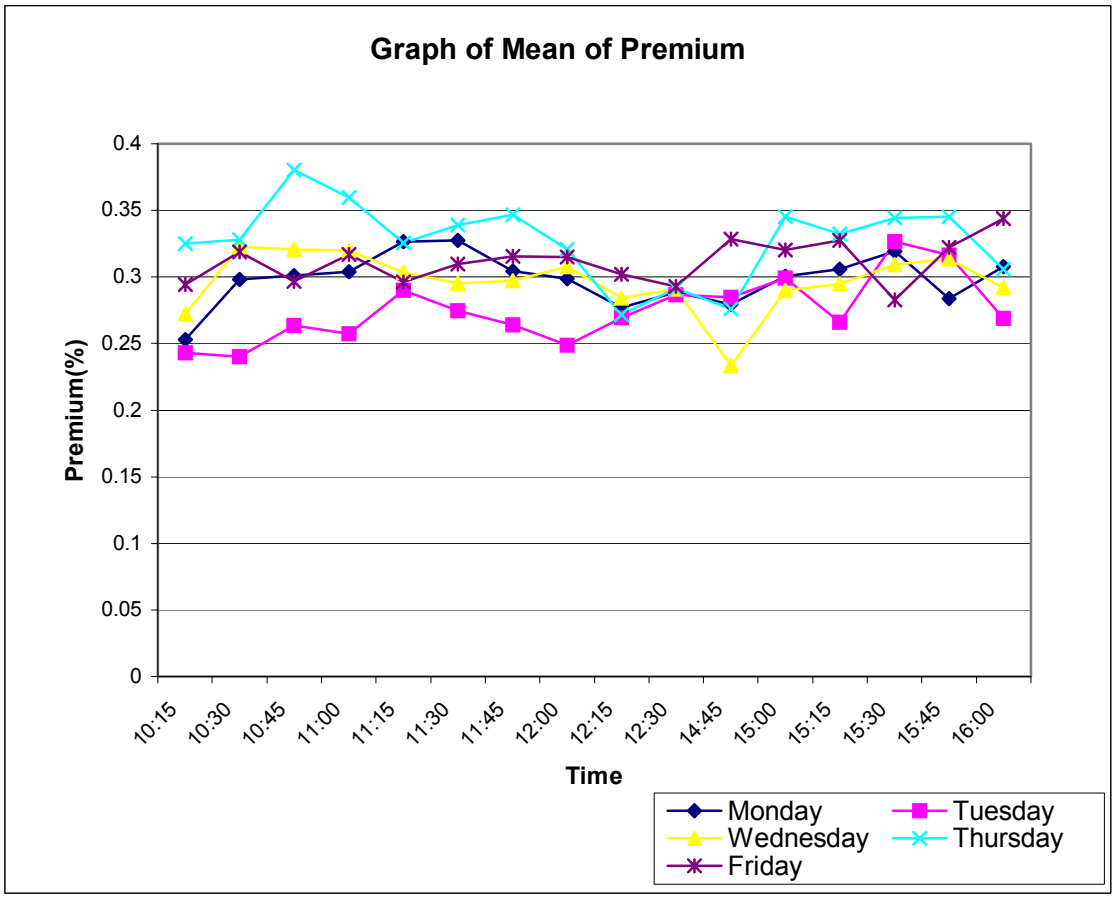


Figure 2 Range of Premium

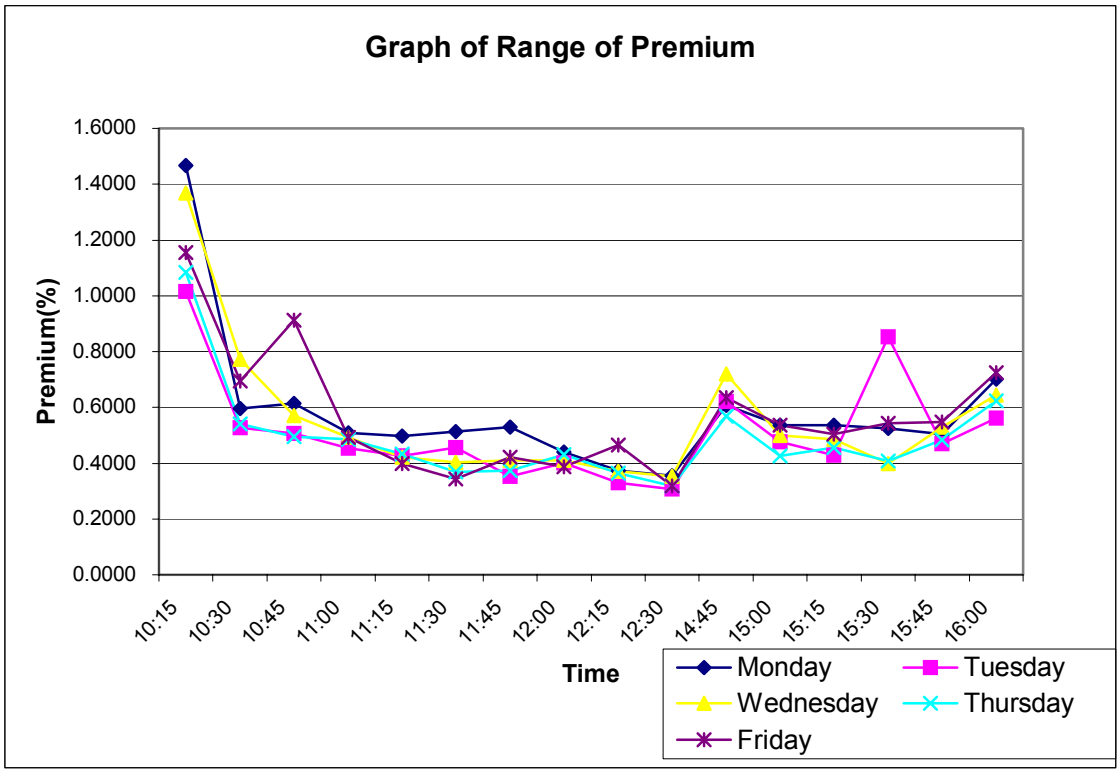


Figure 3 Standard Deviation of Premium

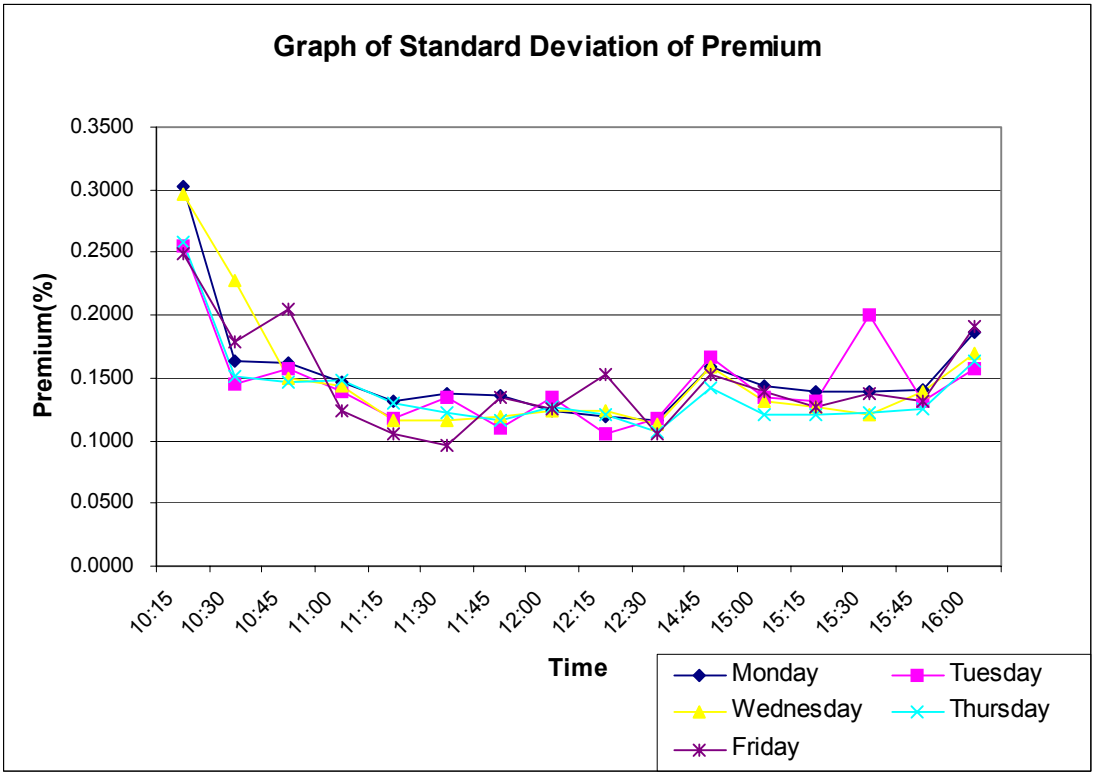


Figure 4 Number of Transactions of Premium

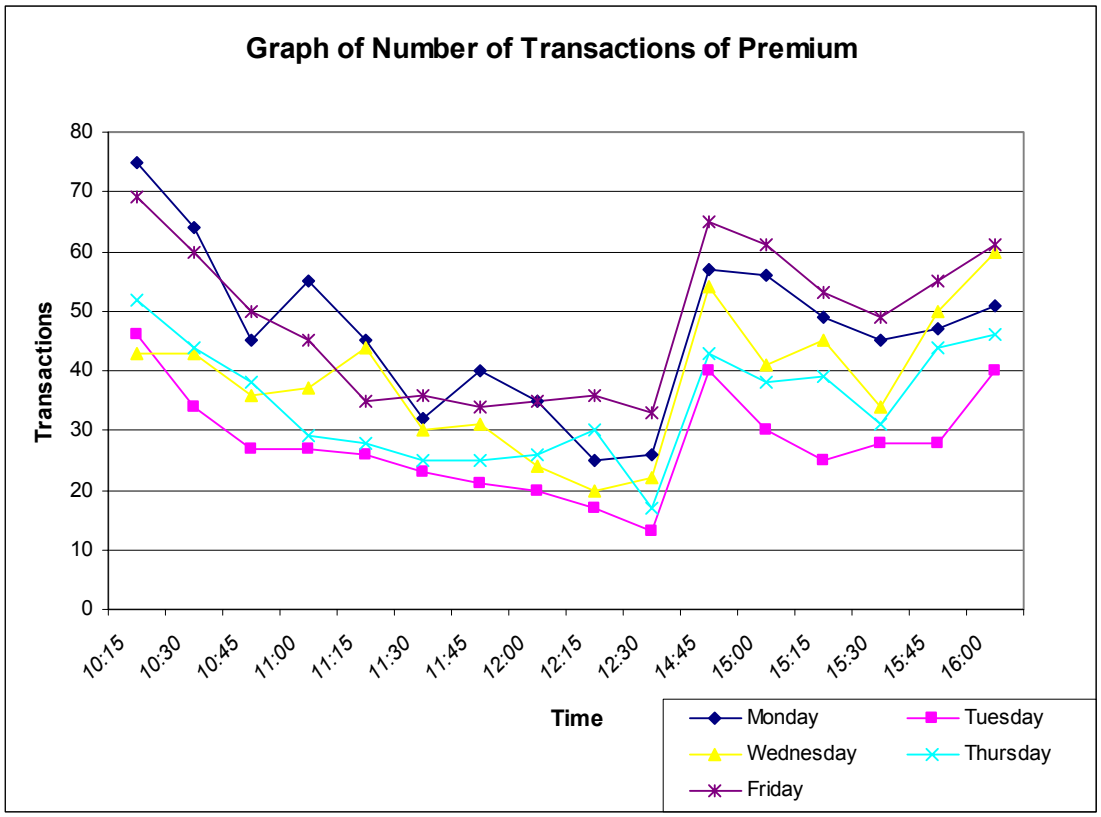


Figure 5 Mean of Positive Premium

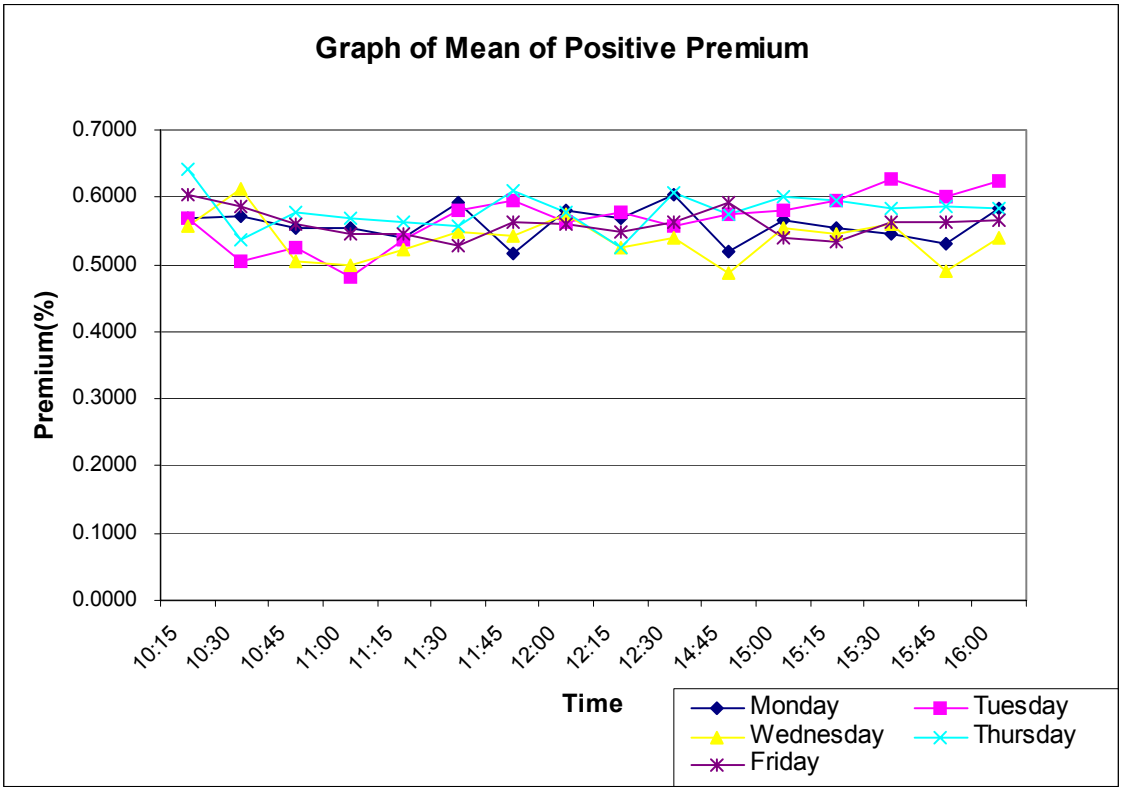


Figure 6 Range of Positive Premium

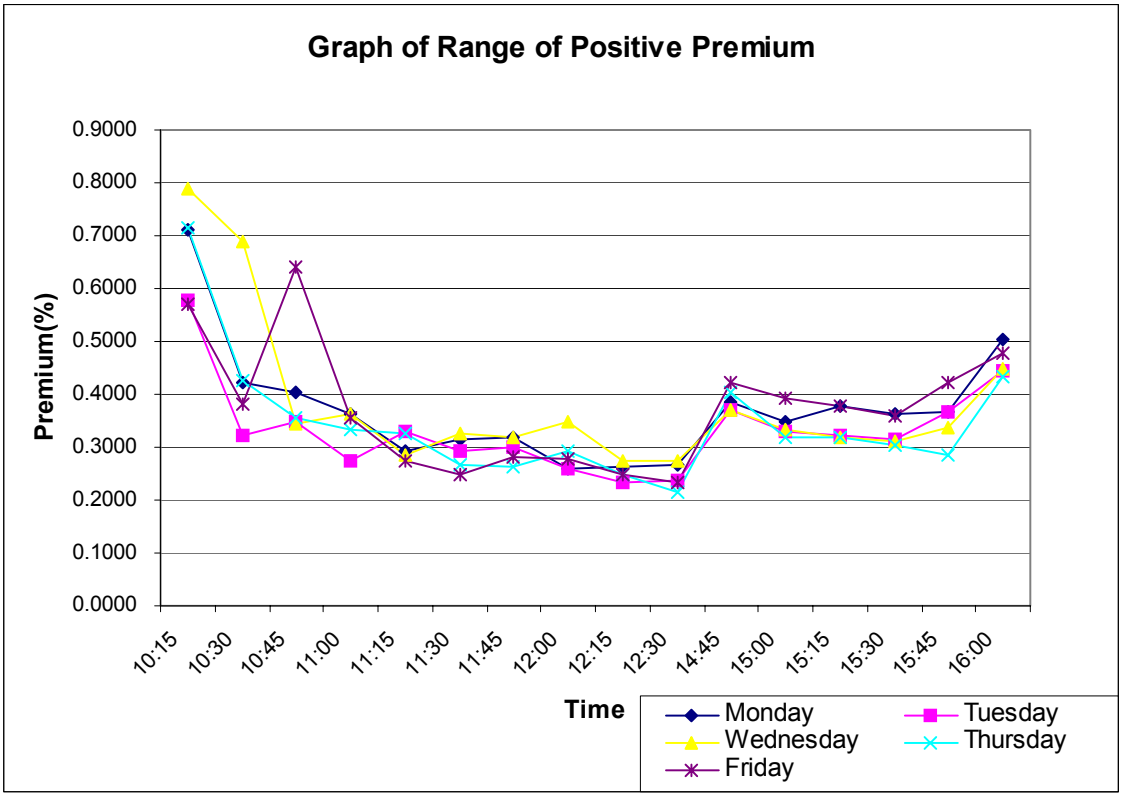


Figure 7 Standard Deviation of Positive Premium

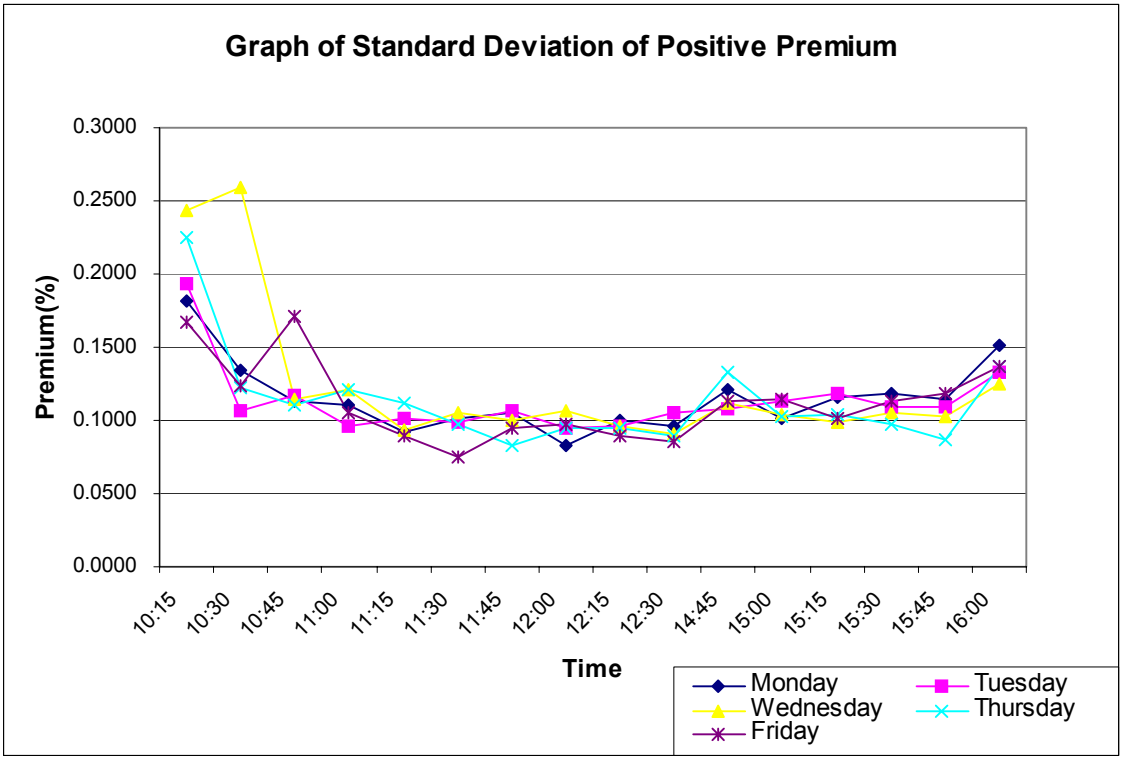


Figure 8 Number of Transactions of Positive Premium

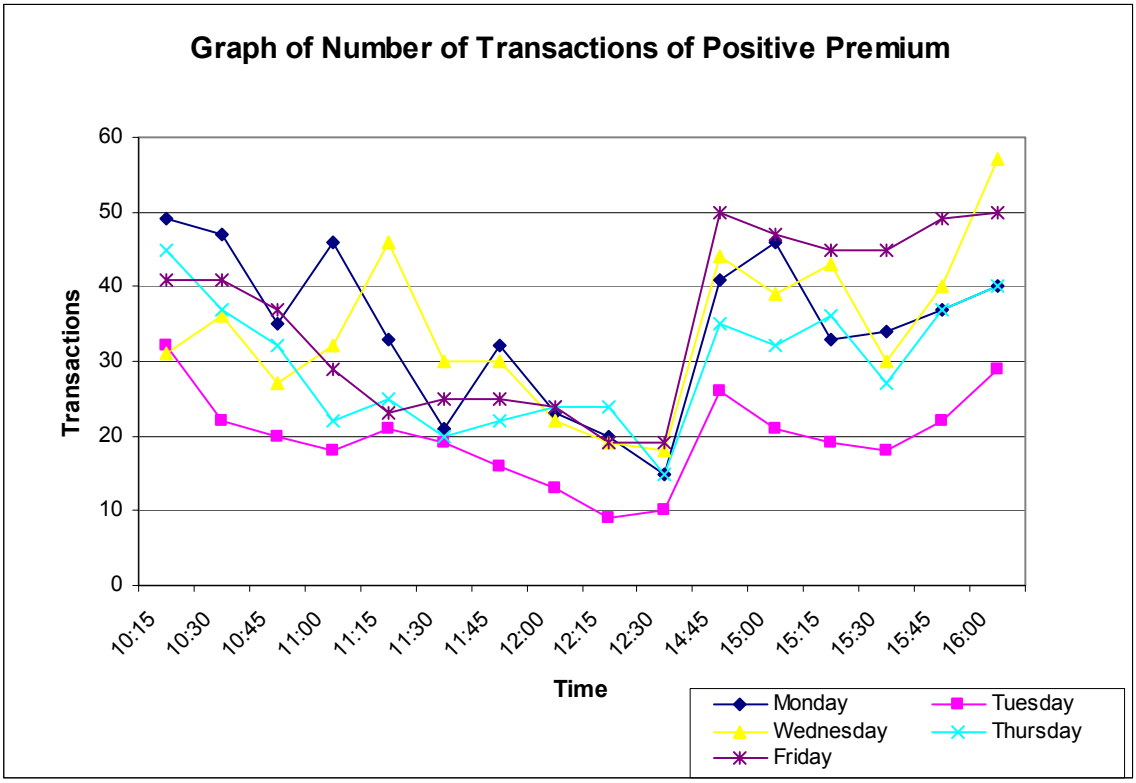


Figure 9 Mean of Negative Premium

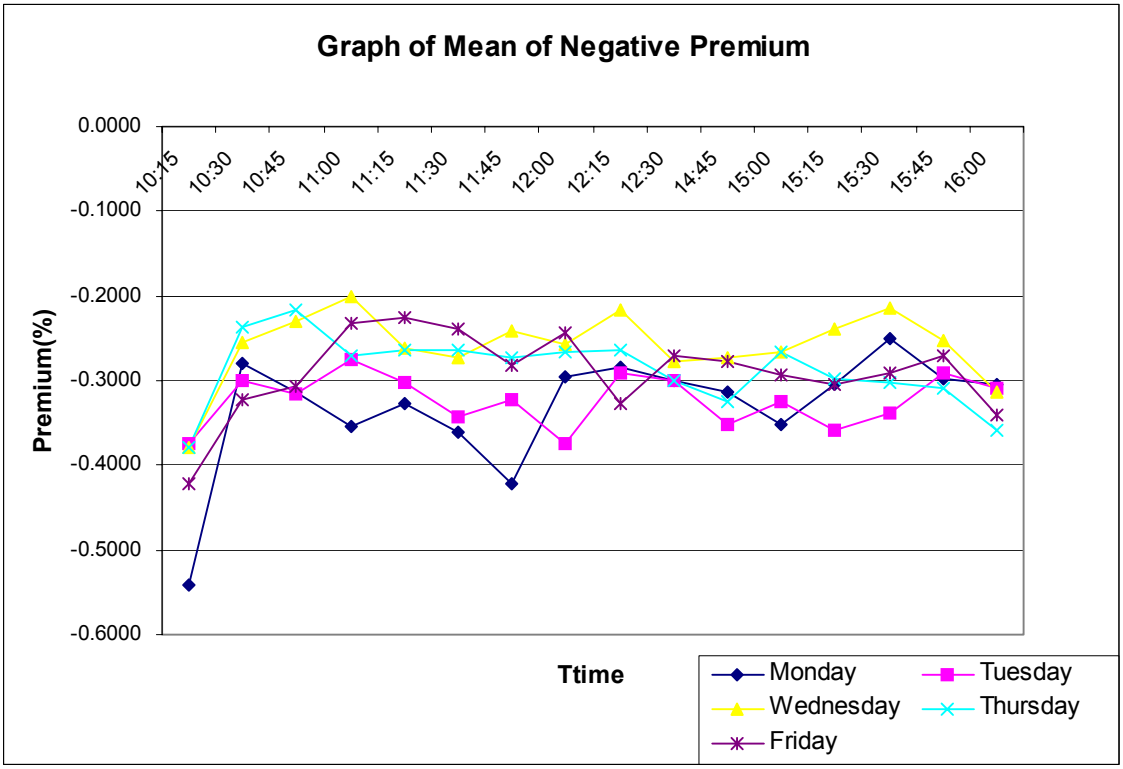


Figure 10 Range of Negative Premium

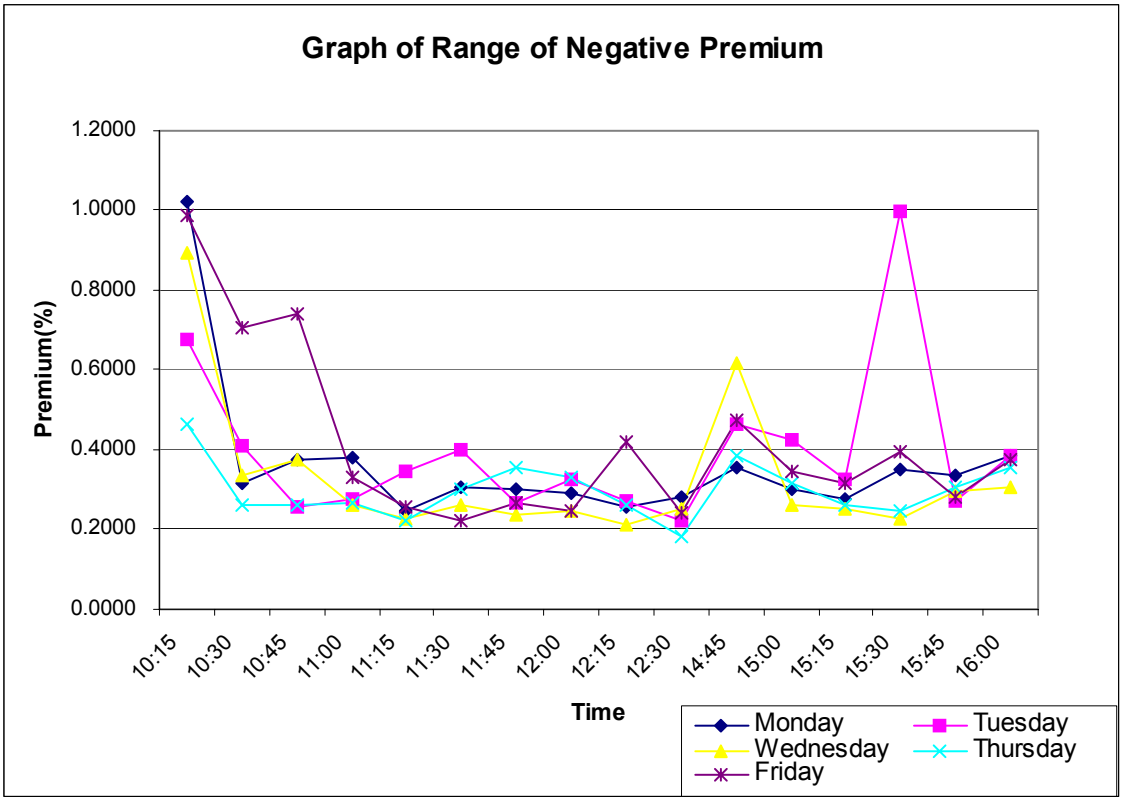


Figure 11 Standard Deviation of Negative Premium

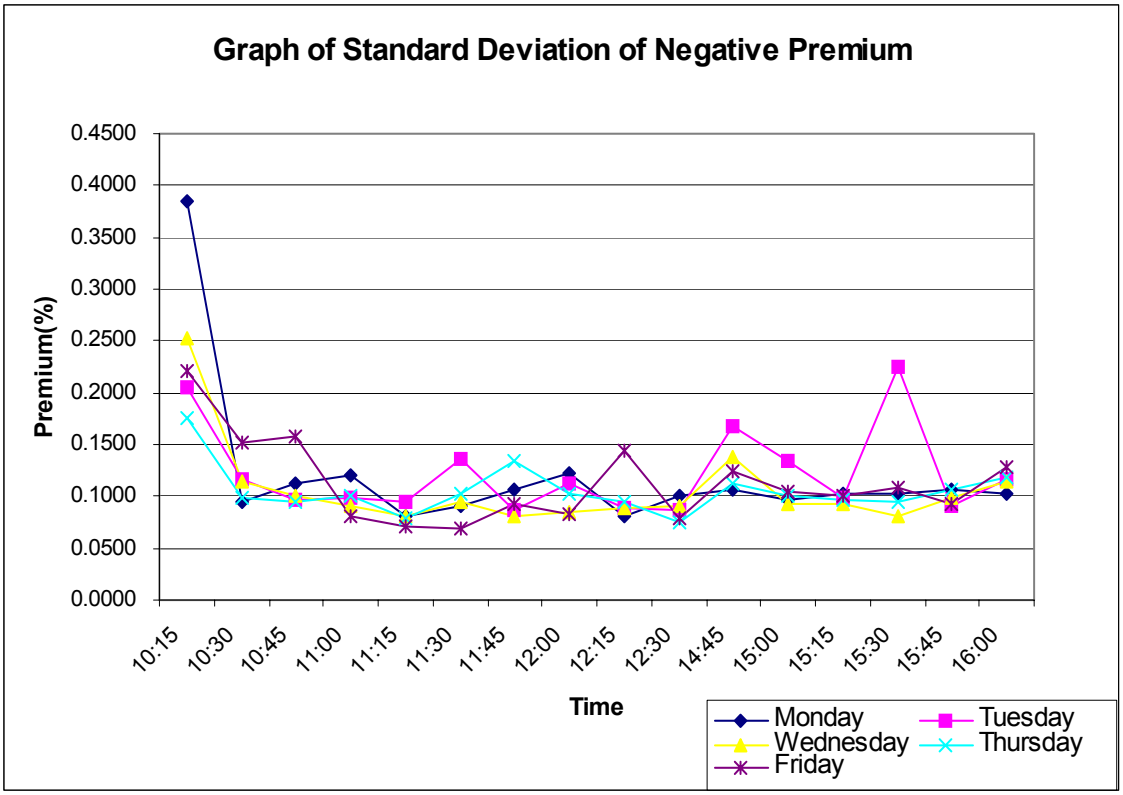
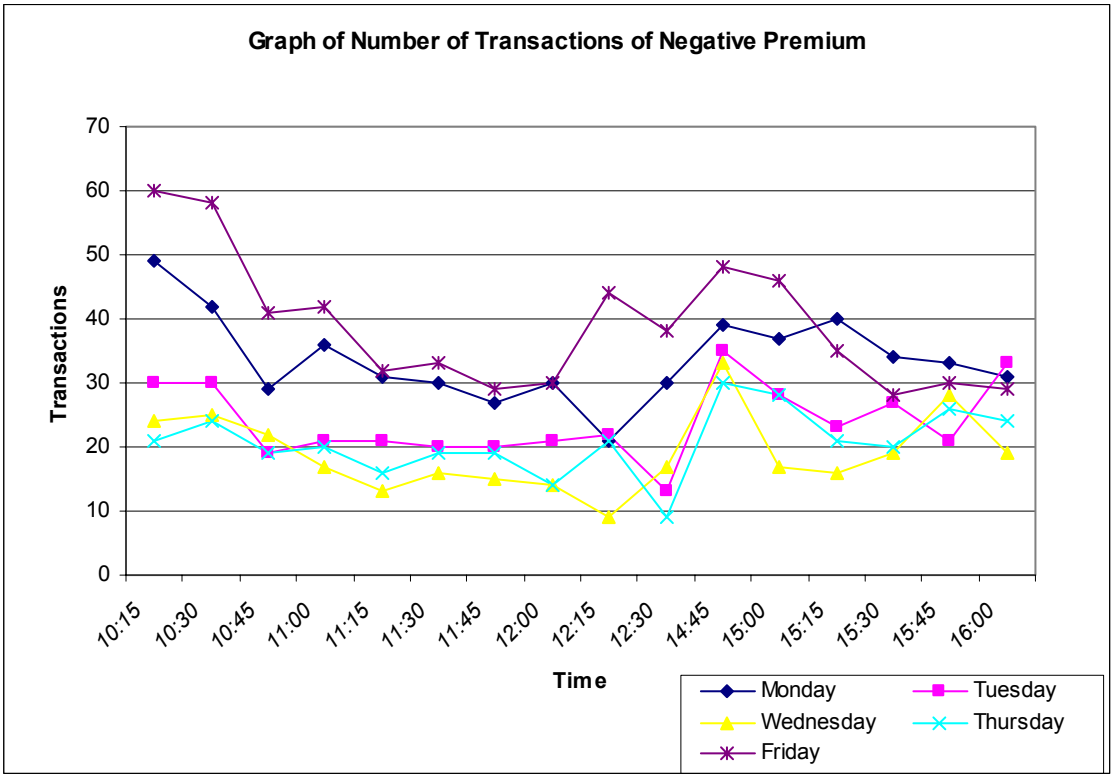


Figure 12 Number of Transactions of Negative Premium



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