Investors' Trading, Market Timing, and Implementation Shortfall: Evidence from the US Financial Market

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Abstract
In this research, we evaluate the US investors' trading pattern and choice of market timing in the presence of implementation shortfall. Results show that when investors decide to trade, implementation shortfall is being ignored. It is observed that stock performance on Wednesday is positive in the presence of positive and significant implementation shortfall i.e., traders do not seem to manage implementation shortfall during trading on Wednesday. It is also observed that investors seem to ignore the implementation shortfall in April. This behavior seems to persist in other types of market times such as turn-of-the-month, week-of-the-month, and quarter-of-the-year effects on implementation shortfall. We conclude that investors behave aggressively to buy stocks during certain days and times of the year ignoring implementation shortfall.

Keywords: Stock Market, Transaction Cost, Implementation Shortfall, Calendar Anomalies.

I. Introduction
To estimate portfolio performance, one needs to consider trading costs that involve both cost of trading (hidden cost) and the cost of not trading (opportunity cost) along with commission - known as "Implementation Shortfall" (Perold, 1988; Wagner & Edwards, 1993; Kissell, 2014; Khandoker, Bhuyan, & Singh, 2016; Bhuyan & Khandoker, 2018). If implementation shortfall is large, it can adversely affect portfolio performance. We explore whether the trading behavior of investors is influenced by the implementation shortfall and if it can be related to stock market seasonality. Since the seminal work of Fama (1970), the calendar effects (seasonal anomaly) have been extensively investigated in the finance literature. There is extant literature that shows various stock market anomalies (Ariel, 1987; Gibbons & Hess, 1981; Kohers & Patel, 1999; Lakonishok & Smidt, 1988;
Rozeff & Kinney, 1976), such as the January effect, day of the week effect, and weekend effect, among others. Among different market anomalies, the Day of the week effect has been observed in different equity markets where returns are the highest on Friday and the lowest (even negative) on Monday (French, 1980; Iqbal, Kouser, & Azeem, 2013; Jaffe & Westerfield, 1985; Wong, Hui, & Chan, 1992). As different market anomalies are persistently observed and are followed by traders and portfolio managers, we believe that minimization of implementation shortfall should also be part of portfolio decision. We believe that implication of managing implementation shortfall considering different calendar anomalies has never been explored. It is, therefore, our belief that this would be the first research that links market anomalies and implementation shortfall in determining market trading time using real traders’ trading data. Our research contributes to the existing literature by shading light on the impact of the implementation shortfall period of market anomalies. Besides, it also highlights the issue of market timing for traders to engage in a market that can minimize implementation shortfall. We specifically address the following two questions in this research:

- Does any particular trading period offer any significant relationship with the implementation shortfall?
- Can investors manage the implementation shortfall in stock trading considering different calendar anomalies?

2. Data & Methodology

We have considered real-time, intra-day, buy-side trading data of clients of a major brokerage house during the period of January 2, 2018, to December 31, 2018. A total of 81 stocks have been carefully chosen to reflect the various industries that represent the S&P 500 index. Our sample consists of 15,745 trades of various sizes. We examine and identify the level of implementation shortfall during various trading times, such as day, week, month, and a quarter. The multiple regression model is applied to conduct our research. Using Perold (1988) model, we calculate the opportunity cost for the unexecuted shares. In this research, the trading periods have been classified into different phases. First, the daily trading data have been arranged and analyzed to measure the day-of-the-week effect. Then, the monthly data has been arranged and examined to measure the month-of-the-year effect, especially the January effect. We also divide the monthly data into two equal parts and examine the half-of-the-month effect. The monthly data have again been divided into three equal parts and examined for the time-of-the-month effect. The first and last three days of each of the month’s trades are taken and analyzed for determining the turn-of-the-month effect. The weekly data of different months have also been taken and examined to measure the week-of-the-month effect. Then, the specific days of the significant weeks have been identified and analyzed to explore the relationship with the implementation shortfall of those days. Lastly, the total data have been classified into different quarters to examine the relationship with the implementation of the shortfall.

3. Analysis and Findings

Table 1 (Appendix-A) presents the results using daily transactions. We observe that, among different trading days, implementation shortfall is significantly and positively related to Wednesday's trading at a 5% significant level compared to any other trading days. We conjecture that buy-side trading flow is higher on Wednesday as opposed to other trading days causing higher implementation shortfall. In other words, trading on Wednesday can increase transaction costs, other things remaining the same. Current literature (Amanulla & Thiripalraju, 2001; Elango & Macki, 2008) shows that returns are higher on Wednesdays supporting the buying pressure and higher implementation shortfall. We also explore the monthly trading phenomenon and results are presented in table 2 (Appendix-B). Results show that none of the month's trading has a significant impact on implementation shortfall except for April trading. Implementation shortfall is positively influenced in April trading at a 1% significant level. These results indicate that traders stay on the sideline during the first quarter of the year and then engage in buying in April. We find no notable January effect in the sense that implementation shortfall is not affected during January. The results again support the findings of Friday and Hoang (2015) who find a higher positive return in April. We also break down the monthly trading data into two parts to examine any effect on implementation shortfall. The results of the half-of-the-month effect are provided in table 3 (Appendix-C). We find that trading of the first half of January (Jan-2P1), March (Mar-2P1), April (Apr-2P1), and the second of only May (May-2P2) are significantly positively related to the implementation shortfall. The findings are consistent with that of Iqbal et al. (2013). It should be mentioned that trading in January, March, and May have a positive effect on implementation shortfall at a 10% level whereas trading in April has a positive influence on implementation shortfall at a 1% level.

For each month's trading, data is classified into three categories to measure the relationship between implementation shortfall and 'time of the month' effect. Here, we also apply the null hypothesis testing methodology to test the existence of implementation shortfall. The results on the 'time of the month' effect are presented in table 4 (Appendix-D). The results indicate that the trading during the first phase of January (Jan-3P1), March (Mar-3P1), and April (Apr-3P1), and the second phase of April (Apr-3P2) are positively related with the implementation shortfall compared to other trading phases. Here, the null hypothesis is rejected and we find that there exists a positive relationship between trading at different times of the month and implementation shortfall, as also documented by Jebran and Khan (2014). It shows that the implementation shortfall has been influenced by trading during the first phase of April (Apr-3P1) at a 1% significance level. While the traders trade during
the first phase of April (Apr-3P1), they seem to be too busy to create more orders. As a result, implementation shortfall rises with less supply of stocks. Traders wait for three months and from the very beginning of April, they want to create more orders for early benefit. But it creates high implementation shortfall along with less portfolio return. For checking some robustness of the results, the trading data of different months have been divided into two categories based on the first and last three trading days of each month to examine the turn-of-the-month effect on implementation shortfall and the null hypothesis (H₀) and the alternative hypothesis (H₁) have been tested. The results of the turn-of-the-month effect are presented in table 5 (Appendix-E).

The results indicate that none of the trading during those periods has a positive impact on implementation shortfall except the first three days of January (Jan 1-3 days) and September (Sep 1-3 days). Trading during the first three days of January has a positive impact on implementation shortfall at a 1% significance level and trading during the first three days of September has a positive impact on implementation shortfall at a 10% significance level. Our results are similar to those of Cadsby and Ratten (1992), Hansen, Lunde, and Nason (2005), and Lean, Smyth, and Wong (2007). Therefore, we conclude that our study demonstrates a positive impact on implementation shortfall. We especially observe that during the first three trading days of January, traders make more orders causing higher implementation shortfall.

In our study, we also explore the week-of-the-month effect on implementation shortfall. Each month’s trading is divided based on weeks and the null and alternative hypotheses are tested. The results of the week-of-the-month effect are presented in table 6 (Appendix-F). The results show that the trading during the first week of January (Jan-W1), March (Mar-W1), and April (Apr-W1) along with the second week of April (Apr-W2) have a positive effect on implementation shortfall compared to the trading during the same week in other months. These results are significant at 1% level. We also observe that the trading during the first week of April has a more positive impact on implementation shortfall compared to other months. It implies that traders seem to be more interested to trade in the very first week of April than in other months. It is also worthwhile to note that there seems to be a shortage of enough sellers or enough supply of stocks due to which implementation shortfall rises.

We also attempt to explore the significant trading days from the significant weeks to investigate the intense effect of trading on those days on the implementation shortfall. The result of the Significant days from the significant weeks is presented in table 7 (Appendix-G). In this case, the study finds that the trading on the 6th day of January (Jan-W1 Day 6), 4th day of March (Mar-W1 Day 4), 6th day (Apr-W1 Day 6), and 13th day (Apr-W2 Day 13) of April respectively are significantly related with implementation shortfall at 1% significance level. However, the trading on the 11th day (Apr-W2 Day 11) of April has a 5% significance level on implementation shortfall. It is also observed that the trading on the 6th day of April has more impact on implementation shortfall than other positive impactful trading days. Lastly, we attempt to examine the quarter-of-the-year effect on implementation shortfall throughout the year. All trading data has been divided based on quarters and the null and alternative hypotheses are tested. The results of the quarter-of-the-year effect are given in table 8 (Appendix-H). The results indicate that the trading during the second quarter (Q2) and the fourth quarter of the year (Q4) have a significant relationship with implementation shortfall at a 5% significance level. Of these two quarters, trading during the second quarter is positively related and the fourth quarter is negatively related to implementation shortfall. That means, the implementation shortfall during the second quarter is higher and it is lower during the last quarter of the year. These results imply that it will be a wise decision for the investors not to trade in the second quarter of the year. To earn a higher return and minimize the transaction cost, investors should trade during the fourth quarter of the year.

In conclusion, it may be mentioned that trading during the earlier days of April has a more positive impact on implementation shortfall than trading during all other periods. That means, if the traders trade during the earlier period of April, they are expected to face high implementation shortfall. Due to a shortage of enough sellers or supply of stocks, traders create a highly bidding competition in the market. As a result, implementation shortfall rises and traders should wait for the supply of stocks to increase to generate more buy orders.

4. Conclusion

Implementation shortfall can adversely affect portfolio performance if it is not appropriately managed with the proper implementation strategy. Our study attempts to examine the practical consequences of implementation shortfall on the trader’s trading decisions. It reflects real trading decisions of a sample of traders to examine the effect of implementation shortfall considering different calendar anomalies. The prominent findings of our study indicate the absence of the renowned January effect. It indicates that there is a significant positive relationship between the trading on Wednesday and trading in April and the implementation shortfall. The study also finds a significant half-of-the-month effect, time-of-the-month effect, turn-of-the-month effect, week-of-the-month effect, and the quarter-of-the-year effect on the implementation shortfall on a sample of stock taken from the S&P 500 index. In summary, April is the month during which trading has a more positive impact on implementation shortfall compared to any other months. Due to a shortage of sellers or supply of stocks, traders create a highly competitive bidding environment in the market in April. That is why if the traders trade early in April, they face high implementation shortfall. This implies that the traders should wait for the supply of stocks to increase to submit additional orders to avoid high implementation shortfall. This study contributes to the finance literature by studying the real trading data
to find a strategy to manage implementation shortfall considering different calendar anomalies. Investors would be able to control the implementation shortfall if they can formulate their investment strategies according to the seasonal transaction cost patterns observed in this study.

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Appendices

Appendix-A: Table I. Beta Values show the significance of Implementation Shortfall (IS) with different trading days

| Days  | Coefficient | t-Statistics | Probability |
|-------|-------------|--------------|-------------|
| Mon   | -2.56806    | -0.13187     | 0.89510     |
| Tue   | -13.10299   | -0.71520     | 0.47450     |
| Wcd   | 42.57619    | 2.35125      | 0.01870     |


| Phases  | Coefficient | t-Statistics | Probability  |
|---------|-------------|--------------|--------------|
| Jan-2P1 | 75.4396     | 1.6899       | 0.0911       |
| Jan-2P2 | 20.1097     | 0.4616       | 0.6444       |
| Feb-2P1 | -9.0108     | -0.2093      | 0.8342       |
| Feb-2P2 | -23.9970    | -0.5579      | 0.5769       |
| Mar-2P1 | 77.4700     | 1.9220       | 0.0546       |
| Mar-2P2 | -30.9089    | -0.7404      | 0.4590       |
| Apr-2P1 | 326.6285    | 7.3515       | 0.0000       |
| Apr-2P2 | -24.1166    | -0.6559      | 0.5119       |
| May-2P1 | -29.0625    | -0.7019      | 0.4828       |
| May-2P2 | 74.4878     | 1.9135       | 0.0557       |
| Jun-2P1 | -3.6353     | -0.1068      | 0.9150       |
| Jun-2P2 | -34.0431    | -1.1271      | 0.2597       |
| Jul-2P1 | -32.5126    | -0.9556      | 0.3393       |
| Jul-2P2 | -18.1354    | -0.4449      | 0.6564       |
| Aug-2P1 | -27.1973    | -0.7153      | 0.4745       |
| Aug-2P2 | -21.4156    | -0.6078      | 0.5433       |
| Sep-2P1 | 27.4478     | 0.7351       | 0.4623       |
| Sep-2P2 | -21.7443    | -0.5897      | 0.5554       |
| Oct-2P1 | -30.2853    | -0.7834      | 0.4334       |
| Oct-2P2 | -16.3386    | -0.4338      | 0.6644       |
| Nov-2P1 | -31.6980    | -0.9508      | 0.3417       |
| Nov-2P2 | -24.6190    | -0.8056      | 0.4205       |
| Dec-2P1 | -31.6643    | -0.7599      | 0.4473       |
| Dec-2P2 | -31.9712    | -0.8592      | 0.3902       |
| Days of Months | Coefficient |  t-Statistics | Probability |
|----------------|-------------|---------------|-------------|
| Jan 1st 3 days | 320.26850   | 3.77000       | 0.00020     |
| Jan last 3 days | -31.11701   | -0.42760      | 0.66900     |
| Feb 1st 3 days | -19.85387   | -0.28890      | 0.77270     |
| Feb last 3 days | -31.23045   | -0.32065      | 0.74850     |
| Mar 1st 3 days | -14.37165   | -0.18691      | 0.85170     |
| Mar last 3 days | -30.39009   | -0.35615      | 0.72170     |
| Apr 1st 3 days | -46.07863   | -0.46056      | 0.64510     |
| Apr last 3 days | -31.72315   | -0.47448      | 0.63520     |
| May 1st 3 days | -28.36632   | -0.35924      | 0.71940     |
| May last 3 days | -17.16438   | -0.24782      | 0.80430     |
| Jun 1st 3 days | 63.56903    | 0.95081       | 0.34170     |
| Jun last 3 days | -33.50017   | -0.67988      | 0.49660     |
| Jul 1st 3 days | -33.23581   | -0.55406      | 0.57950     |

Appendix-E: Table-5. Beta Values show the significance of Implementation Shortfall (IS) with the different turn of the month's trading.
| Weeks       | Coefficient | t-Statistics | Probability |
|------------|-------------|--------------|-------------|
| Jan-w1     | 213.91780   | 3.00761      | 0.00260     |
| Jan-w2     | -5.53041    | -0.07985     | 0.93640     |
| Jan-w3     | -1.26931    | -0.02312     | 0.98160     |
| Jan-w4     | 25.34455    | 0.44332      | 0.65750     |
| Feb-w1     | -3.33495    | -0.05624     | 0.95520     |
| Feb-w2     | -14.82739   | -0.24058     | 0.80970     |
| Feb-w3     | -22.86741   | -0.41719     | 0.67650     |
| Feb-w4     | -24.79862   | -0.36454     | 0.71550     |
| Mar-w1     | 199.85380   | 3.09006      | 0.00200     |
| Mar-w2     | -0.00006    | 0.14471      | 0.88490     |
| Mar-w3     | -26.05552   | -0.50500     | 0.61360     |
| Mar-w4     | -36.42733   | -0.62011     | 0.53520     |
| Apr-w1     | 485.63050   | 7.75599      | 0.00000     |
| Apr-w2     | 190.40350   | 2.84855      | 0.00440     |
| Apr-w3     | -10.56863   | -0.18091     | 0.85640     |
| Apr-w4     | -31.90547   | -0.71089     | 0.47720     |
| May-w1     | 26.00173    | 0.43849      | 0.66100     |
| May-w2     | -26.09423   | -0.54341     | 0.58690     |
| May-w3     | 96.61589    | 1.62325      | 0.10460     |
| May-w4     | 56.01005    | 1.10697      | 0.26830     |
| Jun-w1     | 19.09985    | 0.40039      | 0.68890     |
| Jun-w2     | -24.91633   | -0.47961     | 0.63150     |
| Jun-w3     | -31.26492   | -0.66248     | 0.50770     |
| Jun-w4     | -33.82558   | -0.92937     | 0.35270     |
| Jul-w1     | -35.38517   | -0.67996     | 0.49650     |
| Jul-w2     | -27.14774   | -0.55731     | 0.57730     |
| Jul-w3     | -14.57702   | -0.30374     | 0.7639      |
| Jul-w4     | -29.08590   | -0.49143     | 0.62310     |
| Aug-w1     | -30.53787   | -0.54162     | 0.58810     |
| Aug-w2     | -29.89995   | -0.53031     | 0.59590     |
| Aug-w3     | -25.81679   | -0.55724     | 0.57740     |
| Aug-w4     | -11.50761   | -0.24036     | 0.81010     |
| Sep-w1     | 92.48028    | 1.48056      | 0.13870     |
| Sep-w2     | -5.23492    | -0.10719     | 0.91460     |
| Sep-w3     | -23.71147   | -0.46475     | 0.64210     |
| Sep-w4     | -20.49916   | -0.42241     | 0.67270     |
| Oct-w1     | -29.08045   | -0.54153     | 0.58810     |

**Appendix-F:** Table 6. Beta Values show the significance of Implementation Shortfall (IS) with different Weeks of the month's trading.
Appendix-G: Table 7. Beta Values show the significance of Implementation Shortfall (IS) with the trading of specific days of significant weeks

| Days of weeks | Coefficient | t-Statistics | Probability |
|---------------|-------------|--------------|-------------|
| Jan-W1 Day 4  | -30.83712   | -0.20061     | 0.84100     |
| Jan-W1 Day 5  | 76.30603    | 0.52797      | 0.59750     |
| Jan-W1 Day 6  | 857.22550   | 6.00644      | 0.00000     |
| Jan-W1 Day 7  | -34.55855   | -0.26786     | 0.78880     |
| Mar-W1 Day 1  | -29.06229   | -0.23141     | 0.81700     |
| Mar-W1 Day 2  | -4.75753    | -0.03404     | 0.97280     |
| Mar-W1 Day 3  | -6.19436    | -0.04621     | 0.96310     |
| Mar-W1 Day 4  | 1998.24100  | 9.92698      | 0.00000     |
| Mar-W1 Day 7  | 25.02373    | 0.17112      | 0.86410     |
| Apr-W1 Day 1  | -30.82730   | -0.18692     | 0.85170     |
| Apr-W1 Day 4  | -30.75195   | -0.17780     | 0.85890     |
| Apr-W1 Day 5  | -81.15404   | -0.44517     | 0.65620     |
| Apr-W1 Day 6  | 1858.84200  | 15.78191     | 0.00000     |
| Apr-W1 Day 7  | -22.94574   | -0.21495     | 0.82980     |
| Apr-W1 Day 8  | -30.82926   | -0.18973     | 0.84950     |
| Apr-W1 Day 11 | 295.62160   | 1.81953      | 0.06890     |
| Apr-W1 Day 12 | -50.23514   | -0.38212     | 0.70240     |
| Apr-W1 Day 13 | 544.04430   | 4.01962      | 0.00010     |
| Apr-W1 Day 14 | 153.22720   | 0.94303      | 0.34570     |

Appendix-H: Table 8. Beta Values show the significance of Implementation Shortfall (IS) with different quarters of the year’s trading

| Quarters      | Coefficient | t-statistics | Probability |
|---------------|-------------|--------------|-------------|
| 1st Quarter (Q1) | 22.03791    | 1.15519      | 0.248       |
| 2nd Quarter (Q2)  | 40.48384    | 2.37095      | 0.0178      |
| 3rd Quarter (Q3)   | -20.9531    | -1.22291     | 0.2214      |
| 4th Quarter (Q4)    | -36.3078    | -2.15599     | 0.0311      |

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