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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-weak* 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 (H_0) and the alternative hypothesis (H_a) 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 tradings 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 Ratner (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 week 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 Aprilrespectively 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-1. 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
Wed	42.57619	2.35125	0.01870

Thu	-20.54498	-1.12547	0.26040
Fri	-17.57769	-0.95338	0.34040

Appendix-B: Table-2. Beta Values show the significance of Implementation Shortfall (IS) with different month's trading

Months	Coefficient	t-Statistics	Probability
Jan	48.60856	1.53462	0.12490
Feb	-17.07045	-0.55170	0.58120
Mar	26.12053	0.88430	0.37650
Apr	122.68660	4.25002	0.00000
May	26.92315	0.93103	0.35190
Jun	-22.01596	-0.94367	0.34540
Jul	-27.83683	-1.04196	0.29740
Aug	-25.25809	-0.95438	0.33990
Sep	2.66101	0.09911	0.92110
Oct	-24.15503	-0.87616	0.38100
Nov	-29.72093	-1.27720	0.20160
Dec	-33.14187	-1.17039	0.24190

Appendix-C: Table-3. Beta Values show the significance of Implementation Shortfall (IS) with different half of the month's trading

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

Appendix-D: Table 4. Beta Values show the significance of Implementation Shortfall (IS) with different time of the month's trading

Phases	Coefficient	t-Statistics	Probability
Jan-3P1	194.97010	2.95915	0.00310

Jan-3P2	-14.36841	-0.27690	0.78190
Jan-3P3	20.37891	0.42566	0.67040
Feb-3P1	-4.18106	-0.08849	0.92950
Feb-3P2	-23.11195	-0.43959	0.66020
Feb-3P3	-27.01986	-0.45306	0.65050
Mar-3P1	121.28520	2.39085	0.01680
Mar-3P2	-9.63977	-0.19103	0.84850
Mar-3P3	-31.69659	-0.65151	0.51470
Apr-3P1	420.23850	7.17876	0.00000
Apr-3P2	112.94150	2.21713	0.02660
Apr-3P3	-32.03724	-0.77371	0.43910
May-3P1	-28.04029	-0.55417	0.57950
May-3P2	44.54620	0.97342	0.33040
May-3P3	56.01005	1.10697	0.26830
Jun-3P1	1.73373	0.04543	0.96380
Jun-3P2	-27.21088	-0.53924	0.58970
Jun-3P3	-33.87710	-1.02400	0.30580
Jul-3P1	-24.50010	-0.50925	0.61060
Jul-3P2	-26.11689	-0.67189	0.50170
Jul-3P3	-28.26327	-0.56086	0.57490
Aug-3P1	-30.38472	-0.67986	0.49660
Aug-3P2	-26.45783	-0.60428	0.54570
Aug-3P3	-14.13475	-0.31560	0.75230
Sep-3P1	71.38527	1.45999	0.14430
Sep-3P2	-27.58421	-0.61265	0.54010
Sep-3P3	-22.32987	-0.52955	0.59640
Oct-3P1	-30.25531	-0.60684	0.54400
Oct-3P2	-9.61647	-0.21674	0.82840
Oct-3P3	-30.49612	-0.67006	0.50280
Nov-3P1	-29.91150	-0.73512	0.46230
Nov-3P2	-34.02983	-0.84631	0.39740
Nov-3P3	-19.97558	-0.56122	0.57470
Dec-3P1	-31.25710	-0.59889	0.54930
Dec-3P2	-31.28946	-0.63090	0.52810
Dec-3P3	-31.63971	-0.73628	0.46160

Appendix-E: Table-5. Beta Values show the significance of Implementation Shortfall (IS) with the different turn of the month's trading

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

Jul last 3 days	-29.09776	-0.38691	0.69880
Aug 1st 3 days	-30.53169	-0.41097	0.68110
Aug last 3 days	-30.33023	-0.40949	0.68220
Sep 1st 3 days	133.91690	1.85631	0.06340
Sep last 3 days	-36.09175	-0.51700	0.60520
Oct 1st 3 days	-26.39112	-0.38795	0.69810
Oct last 3 days	-30.66680	-0.48466	0.62790
Nov 1st 3 days	-30.65247	-0.45846	0.64660
Nov last 3 days	-15.63201	-0.30297	0.76190
Dec 1st 3 days	-30.76547	-0.42520	0.67070
Dec last 3 days	-31.15447	-0.46027	0.64530

Appendix-F: Table 6. Beta Values show the significance of Implementation Shortfall (IS) with different Weeks 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	-0.24085	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	-30.90423	-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	-24.81633	-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	-0.300374	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	-0.46476	0.64210
Sep-w4	-20.49916	-0.42241	0.67270
Oct-w1	-29.08045	-0.54153	0.58810

Oct-w2	-30.28485	-0.55518	0.57880
Oct-w3	3.83571	0.06650	0.94700
Oct-w4	-30.21730	-0.61876	0.53610
Nov-wI	-30.92384	-30.92384	-30.92384
Nov-w2	-28.73635	-0.63070	0.52820
Nov-w3	-28.82792	-0.73990	0.45940
Nov-w4	-20.78995	-0.48379	0.62850
Dec-wI	-31.06385	-0.52881	0.59690
Dec-w2	-30.95732	-0.44814	0.65410
Dec-w3	-31.49558	-0.67363	0.50060
Dec-w4	-31.23320	-0.59756	0.55010

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-WI Day 4	-30.83712	-0.20061	0.84100
Jan-WI Day 5	76.30603	0.52797	0.59750
Jan-WI Day 6	857.22550	6.00644	0.00000
Jan-WI Day 7	-34.55855	-0.26786	0.78880
Mar-WI Day I	-29.06229	-0.23141	0.81700
Mar-WI Day 2	-4.75753	-0.03404	0.97280
Mar-WI Day 3	-6.19436	-0.04621	0.96310
Mar-WI Day 4	1998.24100	9.92698	0.00000
Mar-WI Day 7	25.02373	0.17112	0.86410
Apr-WI Day I	-30.82730	-0.18692	0.85170
Apr-WI Day 4	-30.75195	-0.17780	0.85890
Apr-WI Day 5	-81.15404	-0.44517	0.65620
Apr-WI Day 6	1885.84200	15.78191	0.00000
Apr-WI Day 7	-22.94574	-0.21495	0.82980
Apr-WI Day 8	-30.82926	-0.18973	0.84950
Apr-WI Day II	295.62160	1.81953	0.06890
Apr-WI Day I2	-50.23514	-0.38212	0.70240
Apr-WI Day I3	544.04430	4.01962	0.00010
Apr-WI Day I4	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