Internet Appendix to "Intraday Patterns in the Cross-section of Stock Returns"

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May 17, 2010

Abstract

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Table IA.I
Cross-sectional Regressions

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. For every half-hour interval, we calculate multiple cross-sectional regressions of the interval return on past 65 lag interval returns (past five trading days), including all past lags in the same regression. The cross-sectional regressions are calculated for all half-hour intervals from January 2001 through December 2005 (16,261 intervals). The table reports the time-series averages of $\gamma_{k,t}$ as well as the respective Fama and MacBeth (1973) t-statistics. The analysis uses NYSE-listed stocks.

Lag	Estimate	t-statistic	Lag	Estimate	t-statistic	Lag	Estimate	t-statistic	Lag	Estimate	t-statistic	Lag	Estimate	t-statistic
1	-5.01	-71.76	14	0.10	2.29	27	0.20	4.47	40	0.10	2.41	53	0.27	6.15
2	-1.32	-22.01	15	-0.16	-3.32	28	0.05	1.20	41	0.07	1.56	54	0.10	2.25
3	-0.50	-8.63	16	-0.29	-6.06	29	-0.10	-2.20	42	-0.01	-0.28	55	0.00	-0.03
4	-0.35	-6.11	17	-0.24	-4.96	30	-0.01	-0.31	43	-0.12	-2.48	56	0.04	0.89
5	-0.44	-7.95	18	-0.24	-4.86	31	-0.18	-3.71	44	-0.02	-0.33	57	-0.04	-0.94
6	-0.32	-5.72	19	-0.29	-5.89	32	-0.24	-4.91	45	-0.09	-1.75	58	-0.01	-0.24
7	-0.22	-4.04	20	-0.34	-6.89	33	-0.20	-4.23	46	-0.08	-1.70	59	0.03	0.58
8	-0.10	-1.79	21	-0.20	-4.09	34	-0.05	-1.14	47	-0.04	-0.75	60	0.00	-0.05
9	-0.02	-0.30	22	-0.12	-2.51	35	-0.18	-3.96	48	-0.04	-0.78	61	0.05	0.98
10	0.01	0.26	23	-0.07	-1.51	36	0.01	0.20	49	-0.06	-1.29	62	0.10	2.26
11	0.15	3.27	24	-0.07	-1.46	37	0.00	-0.09	50	0.08	1.88	63	0.10	2.35
12	0.34	7.46	25	0.15	3.38	38	0.13	3.03	51	0.22	5.20	64	0.18	4.24
13	1.05	22.68	26	0.71	16.21	39	0.52	12.22	52	0.49	11.69	65	0.38	8.93

Table IA.II
Long-run Performance

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the lag 65 trading strategy ranks stocks according to their return during the historical lag half-hour interval 65. The portfolios are formed every half-hour. The average returns (per half-hour, in basis points) of the bottom and top decile portfolios as well as their portfolio return spread for trading strategies corresponding to each 13th lag from lag 13 through lag 520 for the period January 2001 through December 2005 (16,261 intervals) are reported below, as well as the corresponding simple t-statistics (in brackets). The analysis uses NYSE-listed stocks.

Strategy	1 (losers)		10 (winners)		10-1	
(lag)	Return	t-statistic	Return	t-statistic	Return	t-statistic
13	-1.35	-6.18	1.66	7.93	3.01	22.15
26	-0.90	-4.18	1.07	5.15	1.97	15.01
39	-0.63	-2.95	0.73	3.53	1.36	10.75
52	-0.58	-2.73	0.68	3.27	1.26	10.01
65	-0.43	-2.05	0.66	3.19	1.09	8.70
78	-0.53	-2.51	0.63	3.05	1.16	9.34
91	-0.52	-2.46	0.60	2.89	1.12	9.12
104	-0.32	-1.50	0.51	2.50	0.83	6.81
117	-0.33	-1.54	0.59	2.85	0.91	7.42
130	-0.45	-2.13	0.48	2.33	0.93	7.58
143	-0.35	-1.65	0.49	2.40	0.84	6.95
156	-0.30	-1.44	0.47	2.29	0.77	6.46
169	-0.35	-1.66	0.40	1.95	0.75	6.18
182	-0.31	-1.46	0.47	2.31	0.77	6.38
195	-0.14	-0.68	0.43	2.12	0.58	4.76
208	-0.24	-1.17	0.45	2.23	0.70	5.93
221	-0.26	-1.26	0.40	1.95	0.66	5.60
234	-0.08	-0.41	0.27	1.34	0.36	3.03
247	-0.06	-0.27	0.22	1.08	0.28	2.34
260	-0.30	-1.43	0.29	1.43	0.59	4.99
273	-0.27	-1.29	0.30	1.48	0.57	4.92
286	-0.18	-0.84	0.37	1.84	0.55	4.72
299	-0.16	-0.78	0.39	1.94	0.56	4.77
312	-0.19	-0.93	0.37	1.81	0.56	4.75
325	-0.17	-0.84	0.31	1.53	0.48	4.12
338	0.06	0.27	0.10	0.51	0.05	0.39
351	-0.21	-1.01	0.34	1.68	0.55	4.73
364	-0.04	-0.19	0.25	1.21	0.28	2.47
377	-0.05	-0.23	0.26	1.29	0.31	2.63
390	-0.18	-0.86	0.16	0.77	0.33	2.84
403	-0.02	-0.11	0.18	0.86	0.20	1.70
416	-0.09	-0.42	0.18	0.90	0.27	2.35
429	-0.16	-0.75	0.10	0.50	0.26	2.23
442	-0.13	-0.62	0.22	1.10	0.35	3.03
455	-0.13	-0.61	0.22	1.07	0.34	2.98
468	-0.07	-0.34	0.28	1.37	0.35	3.05
481	0.10	0.51	0.26	1.29	0.16	1.37
494	-0.11	-0.53	0.26	1.27	0.37	3.20
507	-0.21	-0.99	0.36	1.77	0.56	4.99
520	-0.19	-0.91	0.23	1.16	0.42	3.67

Table IA.III
Returns of Strategies Based on Past Performance in Different Half-hour Intervals of the Trading Day

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The average returns of the top-minus-bottom decile portfolios (per half-hour, in basis points) for each half-hour interval of a trading day for the period January 2001 through December 2005 (there are 1,255 observations for each half-hour interval of a trading day) are reported below, as well as the corresponding t-statistics (in brackets). The analysis uses NYSE-listed stocks.

Strategy	1 (first) [9:30-10:00]	2 [10:00-10:30]	3 [10:30-11:00]	4 [11:00-11:30]	5 [11:30-12:00]	6 [12:00-12:30]	7 [12:30-13:00]	8 [13:00-13:30]	9 [13:30-14:00]	10 [14:00-14:30]	11 [14:30-15:00]	12 [15:00-15:30]	13 (last) [15:30-16:00]	2-12 [10:00-15:30]
Day 1														
Nondaily	-8.36	0.62	-1.00	-2.01	-1.96	-2.89	-4.88	-2.83	-3.38	-8.17	-5.96	-8.75	-11.24	-3.74
lags 2-12	[-8.80]	[0.77]	[-1.55]	[-3.61]	[-3.83]	[-5.99]	[-10.84]	[-6.38]	[-7.49]	[-16.08]	[-12.08]	[-17.27]	[-18.32]	[-22.60]
Daily	11.48	5.02	2.66	1.20	1.38	1.35	1.53	0.76	1.19	0.81	0.89	2.46	8.42	1.75
lag 13	[12.58]	[7.97]	[5.01]	[2.87]	[3.71]	[3.92]	[4.69]	[2.16]	[3.72]	[2.12]	[2.45]	[6.48]	[14.90]	[14.06]
Day 2														
Nondaily	-2.96	0.68	0.68	-0.06	-0.50	0.05	-0.42	-0.24	0.78	-1.94	-1.75	-2.58	-3.79	-0.48
lags 14-25	[-3.52]	[1.04]	[1.22]	[-0.13]	[-1.08]	[0.13]	[-1.10]	[-0.65]	[1.99]	[-4.88]	[-4.30]	[-6.03]	[-7.25]	[-3.44]
Daily	10.48	2.59	1.32	0.51	-0.06	0.35	0.84	0.06	0.27	0.22	1.35	1.10	6.52	0.78
lag 26	[12.32]	[4.22]	[2.67]	[1.21]	[-0.17]	[1.08]	[2.61]	[0.20]	[0.80]	[0.62]	[3.99]	[2.91]	[11.43]	[6.45]
Day 3														
Nondaily	-4.87	-0.24	0.88	-0.07	0.21	0.04	0.04	0.06	0.19	-1.31	-1.10	-0.63	-1.29	-0.17
lags 27-38	[-6.03]	[-0.39]	[1.59]	[-0.15]	[0.48]	[0.10]	[0.09]	[0.18]	[0.50]	[-3.33]	[-2.89]	[-1.58]	[-2.64]	[-1.31]
Daily	6.32	1.55	0.23	0.34	0.40	0.38	0.65	-0.18	0.57	0.06	1.19	0.56	5.57	0.52
lag 39	[7.59]	[2.70]	[0.46]	[0.80]	[1.06]	[1.14]	[2.07]	[-0.58]	[1.76]	[0.17]	[3.76]	[1.56]	[10.46]	[4.44]
Day 4														
Nondaily	-2.55	0.31	0.08	-0.89	0.08	-0.45	-0.58	0.34	0.28	0.00	0.27	-0.06	-1.26	-0.06
lags 40-51	[-3.31]	[0.51]	[0.15]	[-1.94]	[0.19]	[-1.13]	[-1.62]	[0.93]	[0.74]	[0.01]	[0.70]	[-0.14]	[-2.67]	[-0.43]
Daily	5.64	1.52	0.84	0.90	0.25	0.10	0.06	0.04	0.65	0.53	0.95	0.54	4.32	0.58
lag 52	[6.86]	[2.51]	[1.67]	[2.26]	[0.69]	[0.31]	[0.19]	[0.14]	[2.06]	[1.52]	[2.86]	[1.56]	[7.98]	[4.95]
Day 5														
Nondaily	-0.14	0.43	-0.43	-0.81	-0.28	-0.22	0.90	0.89	-0.31	-0.08	0.99	-0.49	-1.29	0.05
lags 53-64	[-0.18]	[0.72]	[-0.77]	[-1.76]	[-0.66]	[-0.57]	[2.44]	[2.50]	[-0.82]	[-0.21]	[2.66]	[-1.24]	[-2.83]	[0.42]
Daily	4.98	1.37	-0.68	0.89	0.18	0.45	0.34	0.88	0.64	0.62	0.25	0.78	3.50	0.52
lag 65	[6.13]	[2.34]	[-1.27]	[2.21]	[0.46]	[1.37]	[1.06]	[2.75]	[2.04]	[1.69]	[0.72]	[2.25]	[6.97]	[4.35]

Table IA.IV
Strategies Based on Past Performance of Liquid Stocks

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The average returns of the top-minus-bottom decile portfolios (per half-hour, in basis points) for the period January 2001 through December 2005 are reported below, as well as the corresponding t-statistics (in brackets). The strategies are performed separately for firms of price above $5 at the end of the previous calendar month (returns are value weighted, using firm market capitalization at the end of the previous calendar year) and firms of at least 10 trades per half-hour, on average, during the previous calendar month (equally weighted returns). The analysis uses NYSE-listed stocks.

Strategy	Stock above $5 (value-weighted returns)	Stocks with at least 10 trades per half-hour
Day 1		
Nondaily	-1.77	-3.17
lags 2-12	[-8.07]	[-19.44]
Daily	1.93	2.45
lag 13	[10.34]	[18.44]
Day 2		
Nondaily	-1.28	-1.21
lags 14-25	[-6.45]	[-8.65]
Daily	1.25	1.72
lag 26	[7.14]	[13.38]
Day 3		
Nondaily	-0.75	-0.56
lags 27-38	[-4.01]	[-4.26]
Daily	0.99	1.05
lag 39	[5.75]	[8.54]
Day 4		
Nondaily	-0.48	-0.20
lags 40-51	[-2.57]	[-1.58]
Daily	1.06	1.07
lag 52	[6.06]	[8.74]
Day 5		
Nondaily	0.24	0.09
lags 53-64	[1.32]	[0.72]
Daily	0.97	0.94
lag 65	[5.58]	[7.63]

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The average returns of the top-minus-bottom decile portfolios (per half-hour, in basis points) for the period January 2001 through December 2005 are reported below, as well as the corresponding t-statistics (in brackets). The strategies are performed separately for three equally sized groups sorted by firm market capitalization at the end of the previous calendar year. The returns are reported using all half-hour intervals of a day, as well as only the first, the last, and the rest of the intervals. The analysis uses NYSE-listed stocks.

Strategy	Small				Medium				Large			
	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)
Day 1												
Nondaily	-9.92	-10.89	-8.69	-22.55	-2.98	-12.11	-1.93	-5.45	-1.15	1.18	-0.94	-5.88
lags 2-12	[-30.94]	[-6.33]	[-26.73]	[-18.55]	[-16.16]	[-10.55]	[-10.62]	[-9.00]	[-6.24]	[1.03]	[-5.08]	[-10.77]
Daily	5.16	20.43	3.15	11.98	2.20	9.36	1.11	7.08	1.88	6.67	0.86	8.38
lag 13	[16.71]	[11.90]	[10.26]	[9.77]	[14.47]	[8.72]	[7.90]	[12.78]	[12.43]	[6.30]	[5.95]	[20.58]
Day 2												
Nondaily	-1.04	-4.55	-0.20	-6.82	-1.05	-2.22	-0.78	-2.77	-1.28	-3.70	-0.91	-2.91
lags 14-25	[-3.64]	[-2.95]	[-0.70]	[-6.12]	[-6.61]	[-2.19]	[-5.09]	[-4.76]	[-7.78]	[-3.37]	[-5.66]	[-6.19]
Daily	2.87	12.06	1.51	8.70	1.72	10.01	0.55	6.30	1.36	7.78	0.29	6.65
lag 26	[9.70]	[7.52]	[5.07]	[7.38]	[11.69]	[10.01]	[4.01]	[11.86]	[9.55]	[8.00]	[2.15]	[16.80]
Day 3												
Nondaily	-0.89	-7.69	0.08	-4.78	-0.66	-3.68	-0.39	-0.53	-0.53	-3.85	-0.34	0.80
lags 27-38	[-3.15]	[-5.03]	[0.29]	[-4.60]	[-4.41]	[-3.92]	[-2.69]	[-1.01]	[-3.41]	[-3.83]	[-2.24]	[1.85]
Daily	2.10	7.26	1.04	8.59	1.16	6.39	0.34	5.06	0.88	4.88	0.13	5.14
lag 39	[7.01]	[4.63]	[3.41]	[7.32]	[8.07]	[6.27]	[2.52]	[9.75]	[6.34]	[5.15]	[0.94]	[14.04]
Day 4												
Nondaily	-0.72	-4.33	-0.14	-3.50	-0.13	-1.01	-0.07	0.12	-0.30	-0.75	-0.30	0.18
lags 40-51	[-2.59]	[-3.02]	[-0.49]	[-3.35]	[-0.85]	[-1.07]	[-0.46]	[0.24]	[-1.99]	[-0.75]	[-2.04]	[0.42]
Daily	1.67	7.03	0.75	6.41	1.01	5.29	0.39	3.57	0.94	5.05	0.28	4.07
lag 52	[5.59]	[4.20]	[2.51]	[5.49]	[7.23]	[5.61]	[2.97]	[6.71]	[6.60]	[5.12]	[2.02]	[11.22]
Day 5												
Nondaily	-0.19	0.35	-0.08	-2.00	-0.06	-0.56	0.11	-1.50	0.20	1.52	0.12	-0.25
lags 53-64	[-0.70]	[0.24]	[-0.28]	[-1.93]	[-0.44]	[-0.60]	[0.78]	[-3.00]	[1.33]	[1.58]	[0.80]	[-0.58]
Daily	1.86	6.46	1.13	5.27	0.78	4.65	0.19	3.40	0.80	4.06	0.24	3.61
lag 65	[6.24]	[3.76]	[3.79]	[4.70]	[5.55]	[4.82]	[1.44]	[6.78]	[5.66]	[4.22]	[1.79]	[10.10]

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The table reports long-short portfolio strategies: the daily strategies are calculated as top-minus-bottom decile portfolios, while the nondaily strategies are calculated as the bottom-minus-top decile portfolios. The average returns of the different strategies (per half-hour, in basis points), after accounting for transaction costs, for the period January 2001 through December 2005 are reported below, as well as the corresponding t statistics (in brackets). The strategies are performed separately for three equally sized groups sorted by firm market capitalization at the end of the previous calendar year. The post-transaction-cost return of buying a stock is calculated as the return from the first quoted offer price of a half-hour interval to its last quoted bid price. The post-transaction-cost return of selling a stock is calculated as the negative of the return from the first quoted bid price of a half-hour interval to its last quoted offer price. The returns are reported using all half-hour intervals of a day, as well as only the first, the last, and the rest of the intervals. In each given interval, only firms with the first quoted relative bid-ask spread (spread divided by the midpoint of quotes) no larger than 10 basis points in a given interval are used for the calculations. The analysis uses NYSE-listed stocks.

Strategy	Small				Medium				Large			
	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)
Day 1												
Nondaily	-25.03	30.56	-24.91	-27.41	-19.67	-17.60	-19.89	-17.58	-14.77	-27.92	-14.24	-9.74
lags 2-12	[-27.51]	[0.90]	[-26.05]	[-9.54]	[-45.23]	[-1.81]	[-45.33]	[-13.18]	[-44.97]	[-7.92]	[-53.48]	[-13.03]
Daily	-23.78	-28.26	-23.68	-24.41	-18.58	-11.49	-19.03	-15.07	-13.25	-13.43	-13.91	-5.84
lag 13	[-28.37]	[-0.72]	[-27.43]	[-8.75]	[-49.79]	[-1.34]	[-52.11]	[-12.10]	[-46.50]	[-4.24]	[-61.05]	[-8.96]
Day 2												
Nondaily	-25.17	9.90	-24.84	-29.03	-20.52	-31.97	-20.30	-20.60	-12.98	-6.42	-13.62	-11.21
lags 14-25	[-30.97]	[0.22]	[-29.47]	[-10.83]	[-53.45]	[-4.16]	[-52.20]	[-18.59]	[-33.13]	[-1.22]	[-56.95]	[-16.66]
Daily	-24.49	-84.59	-24.31	-23.41	-19.38	-11.39	-19.83	-15.99	-13.46	-11.02	-14.07	-8.79
lag 26	[-29.41]	[-2.89]	[-28.20]	[-8.37]	[-53.34]	[-1.46]	[-54.83]	[-13.54]	[-49.00]	[-3.61]	[-63.68]	[-14.60]
Day 3												
Nondaily	-25.26	-59.52	-24.99	-26.72	-20.84	-35.56	-20.49	-22.03	-14.40	-13.72	-14.33	-15.72
lags 27-38	[-32.59]	[-2.51]	[-30.75]	[-10.54]	[-56.43]	[-4.26]	[-55.07]	[-19.55]	[-50.33]	[-4.44]	[-60.54]	[-24.69]
Daily	-24.29	-35.03	-24.61	-21.30	-20.31	-16.53	-20.64	-17.49	-13.77	-8.75	-14.48	-10.02
lag 39	[-30.68]	[-1.03]	[-30.07]	[-7.62]	[-54.89]	[-1.79]	[-57.42]	[-15.04]	[-52.27]	[-3.15]	[-65.83]	[-17.25]
Day 4												
Nondaily	-25.23	5.24	-25.06	-28.06	-20.67	-23.26	-20.53	-21.75	-14.65	-15.63	-14.53	-15.27
lags 40-51	[-31.85]	[0.22]	[-30.15]	[-11.15]	[-55.56]	[-2.78]	[-54.38]	[-19.32]	[-54.40]	[-5.33]	[-65.76]	[-23.97]
Daily	-23.77	-15.34	-23.44	-26.96	-20.38	-20.71	-20.43	-19.76	-14.13	-13.56	-14.50	-10.52
lag 52	[-28.87]	[-0.46]	[-27.75]	[-9.26]	[-56.52]	[-2.44]	[-57.60]	[-18.08]	[-53.48]	[-4.85]	[-65.71]	[-18.27]
Day 5												
Nondaily	-25.31	-28.62	-24.94	-28.27	-20.61	-23.79	-20.42	-22.11	-14.92	-18.84	-14.72	-14.09
lags 53-64	[-33.95]	[-1.40]	[-31.87]	[-12.15]	[-56.15]	[-3.15]	[-54.63]	[-20.42]	[-55.45]	[-6.65]	[-64.02]	[-21.71]
Daily	-25.92	-21.21	-25.63	-28.77	-20.27	-22.00	-20.37	-18.85	-13.66	-8.08	-14.28	-11.40
lag 65	[-32.58]	[-0.64]	[-30.95]	[-10.51]	[-56.64]	[-2.96]	[-56.85]	[-16.12]	[-35.73]	[-1.58]	[-61.98]	[-18.29]

Table IA.VII
Controlling for Market Risk

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The returns of the top-minus-bottom decile portfolios (per half-hour, in basis points) for the period January 2001 through December 2005 are regressed on the equal-weighted market average return (along with its 1 through 13 leads and 1 through 13 lags). The regression intercepts and their corresponding t-statistics (in brackets) are reported below. The risk-adjusted returns are also partitioned using all half-hour intervals of a day, as well as only the first, the last, and the rest of the intervals. The analysis uses NYSE-listed stocks.

Strategy	Risk-adjusted returns			
	1-13 (all)	1 (first)	2-12	13 (last)
Day 1				
Nondaily	-4.65	-8.52	-3.71	-10.79
lags 2-12	[-28.26]	[-8.53]	[-22.62]	[-16.96]
Daily	3.03	11.64	1.76	8.40
lag 13	[22.33]	[12.24]	[14.17]	[14.17]
Day 2				
Nondaily	-0.90	-3.25	-0.45	-3.73
lags 14-25	[-6.44]	[-3.64]	[-3.27]	[-6.89]
Daily	1.98	10.30	0.79	6.92
lag 26	[15.14]	[11.52]	[6.56]	[11.53]
Day 3				
Nondaily	-0.61	-4.82	-0.17	-0.85
lags 27-38	[-4.57]	[-5.69]	[-1.26]	[-1.66]
Daily	1.38	6.82	0.55	5.96
lag 39	[10.94]	[7.80]	[4.67]	[10.61]
Day 4				
Nondaily	-0.34	-3.21	-0.06	-0.91
lags 40-51	[-2.58]	[-3.94]	[-0.43]	[-1.84]
Daily	1.25	5.96	0.57	4.26
lag 52	[9.96]	[6.92]	[4.86]	[7.46]
Day 5				
Nondaily	-0.04	-0.14	0.07	-0.53
lags 53-64	[-0.33]	[-0.17]	[0.56]	[-1.12]
Daily	1.10	4.84	0.53	3.42
lag 65	[8.76]	[5.63]	[4.42]	[6.40]

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The average returns of the top-minus-bottom decile portfolios (per half-hour, in basis points) for the period January 2001 through December 2005 are reported below, as well as the corresponding t-statistics (in brackets). The returns are reported separately using half-hour intervals of each day of the week. The returns are also partitioned using all half-hour intervals of a day, as well as only the first, the last, and the rest of the intervals. The analysis uses NYSE-listed stocks.

Strategy	Mondays				Tuesdays				Wednesdays				Thursdays				Fridays			
	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)
Day 1																				
Nondaily	-6.14	-10.78	-5.11	-12.89	-3.74	-5.75	-3.17	-8.10	-4.18	-5.92	-3.39	-11.15	-3.51	-7.35	-2.54	-10.29	-5.90	-12.22	-4.59	-13.98
lags 2-12	[-17.14]	[-4.88]	[-14.52]	[-10.42]	[-10.88]	[-3.09]	[-9.07]	[-6.25]	[-10.76]	[-2.81]	[-8.76]	[-6.71]	[-8.94]	[-3.24]	[-6.40]	[-8.34]	[-16.21]	[-5.67]	[-12.87]	[-10.49]
Daily	2.86	11.62	1.49	9.19	2.62	8.17	1.73	6.80	3.44	13.96	1.97	9.06	3.20	13.75	1.70	9.21	2.93	9.95	1.84	7.90
lag 13	[9.25]	[5.29]	[5.41]	[7.25]	[9.05]	[4.20]	[6.51]	[5.42]	[11.18]	[6.91]	[6.92]	[7.50]	[10.14]	[6.53]	[5.85]	[7.38]	[9.83]	[5.15]	[6.71]	[5.88]
Day 2																				
Nondaily	-0.68	-1.01	-0.53	-2.02	-0.95	-3.20	-0.50	-3.61	-0.88	-2.34	-0.48	-3.78	-0.94	-5.29	-0.25	-4.24	-1.15	-2.86	-0.63	-5.23
lags 14-25	[-2.25]	[-0.53]	[-1.78]	[-1.89]	[-3.18]	[-1.80]	[-1.69]	[-3.47]	[-2.72]	[-1.31]	[-1.48]	[-3.01]	[-2.95]	[-3.01]	[-0.77]	[-3.44]	[-3.55]	[-1.32]	[-2.04]	[-4.28]
Daily	1.95	10.13	0.84	5.88	1.40	7.58	0.45	5.77	2.28	12.94	0.95	6.28	2.28	12.59	0.96	6.47	1.92	9.17	0.70	8.20
lag 26	[6.38]	[4.69]	[3.05]	[4.97]	[5.07]	[4.16]	[1.77]	[4.39]	[7.69]	[7.01]	[3.41]	[5.15]	[7.51]	[6.32]	[3.48]	[4.84]	[6.81]	[5.46]	[2.63]	[6.27]
Day 3																				
Nondaily	-0.57	-6.48	0.03	-1.34	-0.59	-6.96	-0.06	0.05	-0.46	-5.11	0.05	-1.40	-0.53	-3.44	-0.12	-2.12	-0.97	-2.39	-0.77	-1.69
lags 27-38	[-1.85]	[-3.16]	[0.11]	[-1.32]	[-2.02]	[-4.11]	[-0.22]	[0.05]	[-1.49]	[-3.07]	[0.15]	[-1.21]	[-1.73]	[-1.92]	[-0.39]	[-1.81]	[-3.32]	[-1.31]	[-2.72]	[-1.53]
Daily	1.63	7.28	0.78	5.34	1.00	4.73	0.19	6.21	1.56	6.76	0.64	6.47	1.20	6.92	0.29	5.53	1.41	6.01	0.74	4.21
lag 39	[5.49]	[3.43]	[2.85]	[5.08]	[3.84]	[2.97]	[0.77]	[5.74]	[5.43]	[3.66]	[2.39]	[5.06]	[4.18]	[3.78]	[1.08]	[4.18]	[5.06]	[3.11]	[2.90]	[3.57]
Day 4																				
Nondaily	0.24	-3.20	0.66	-0.98	-0.48	-3.52	-0.30	0.59	0.02	-1.59	0.24	-0.74	-0.49	-3.68	-0.07	-2.00	-0.97	-0.81	-0.78	-3.24
lags 40-51	[0.80]	[-1.67]	[2.27]	[-0.89]	[-1.67]	[-2.14]	[-1.03]	[0.60]	[0.07]	[-0.95]	[0.77]	[-0.68]	[-1.69]	[-2.31]	[-0.23]	[-2.01]	[-3.39]	[-0.45]	[-2.81]	[-2.98]
Daily	1.53	7.44	0.55	6.34	1.16	5.05	0.59	3.53	1.11	6.47	0.43	3.19	1.23	4.52	0.78	2.85	1.28	4.84	0.54	5.88
lag 52	[5.39]	[3.75]	[2.16]	[5.18]	[4.25]	[2.93]	[2.26]	[3.14]	[3.84]	[3.62]	[1.57]	[2.58]	[4.40]	[2.55]	[2.97]	[2.25]	[4.60]	[2.49]	[2.15]	[4.97]
Day 5																				
Nondaily	-0.33	0.28	-0.28	-1.48	0.02	-0.58	0.15	-0.82	0.01	-1.22	0.32	-2.20	0.17	-0.60	0.26	-0.10	-0.20	1.46	-0.21	-1.86
lags 53-64	[-1.14]	[0.16]	[-0.97]	[-1.56]	[0.06]	[-0.36]	[0.53]	[-0.81]	[0.03]	[-0.69]	[1.01]	[-2.17]	[0.59]	[-0.36]	[0.92]	[-0.10]	[-0.69]	[0.78]	[-0.73]	[-1.78]
Daily	1.50	6.90	0.90	2.72	0.82	3.59	0.32	3.59	0.93	5.12	0.40	2.60	1.31	2.97	0.82	4.99	0.93	6.48	0.18	3.57
lag 65	[5.24]	[3.35]	[3.43]	[2.51]	[3.15]	[2.16]	[1.29]	[3.27]	[3.14]	[2.76]	[1.37]	[2.36]	[4.67]	[1.70]	[3.03]	[4.63]	[3.35]	[3.67]	[0.69]	[2.85]

Table IA.IX
Controlling for Calendar Month

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The average returns of the top-minus-bottom decile portfolios (per half-hour, in basis points) for the period January 2001 through December 2005 are reported below, as well as the corresponding t statistics (in brackets). The returns are reported separately for each calendar month (using all half-hour intervals in each calendar month). The analysis uses NYSE-listed stocks.

| Strategy	January	February	March	April	May	June	July	August	September	October	November	December
Day 1												
Nondaily	-4.74	-5.37	-5.90	-5.07	-3.79	-2.88	-4.71	-4.88	-3.32	-6.14	-3.74	-5.27
lags 2-12	[-6.98]	[-9.36]	[-10.20]	[-9.17]	[-7.71]	[-5.87]	[-7.82]	[-9.57]	[-5.20]	[-9.21]	[-6.72]	[-10.48]
Daily	3.82	3.40	1.70	2.52	2.45	2.95	3.07	3.02	3.25	3.38	3.80	2.90
lag 13	[7.14]	[7.27]	[3.64]	[5.23]	[5.79]	[7.24]	[6.50]	[7.16]	[6.88]	[6.27]	[7.80]	[6.44]
Day 2												
Nondaily	0.18	-1.23	-1.12	0.24	-1.11	-0.91	-1.56	-0.47	-0.77	-1.72	-1.16	-1.43
lags 14-25	[0.34]	[-2.43]	[-2.26]	[0.48]	[-2.53]	[-2.04]	[-3.03]	[-1.08]	[-1.53]	[-3.10]	[-2.31]	[-3.55]
Daily	2.58	2.58	2.22	1.55	2.06	1.14	1.46	2.07	2.09	2.44	2.05	1.38
lag 26	[5.27]	[5.57]	[4.92]	[3.38]	[5.05]	[2.89]	[3.15]	[4.99]	[4.49]	[4.59]	[4.46]	[3.28]
Day 3												
Nondaily	-0.98	-0.56	-0.57	-0.14	-0.37	-0.92	0.04	-0.32	-0.38	-1.21	-1.25	-0.80
lags 27-38	[-1.86]	[-1.16]	[-1.17]	[-0.30]	[-0.89]	[-2.09]	[0.07]	[-0.81]	[-0.82]	[-2.35]	[-2.55]	[-1.99]
Daily	1.41	1.30	1.50	0.94	1.87	1.48	1.60	0.95	1.66	1.26	1.24	1.08
lag 39	[2.94]	[3.00]	[3.51]	[2.04]	[4.67]	[3.91]	[3.57]	[2.43]	[3.64]	[2.52]	[2.64]	[2.89]
Day 4												
Nondaily	-0.88	0.20	-0.08	-0.27	0.04	-0.30	-0.80	-0.69	-0.82	-1.34	0.40	0.56
lags 40-51	[-1.74]	[0.42]	[-0.17]	[-0.58]	[0.11]	[-0.76]	[-1.70]	[-1.70]	[-1.69]	[-2.61]	[0.86]	[1.45]
Daily	1.98	1.33	1.53	1.46	0.92	0.94	1.18	1.36	1.07	0.99	0.88	1.45
lag 52	[4.21]	[2.86]	[3.21]	[3.18]	[2.51]	[2.40]	[2.58]	[3.53]	[2.54]	[2.06]	[2.06]	[3.62]
Day 5												
Nondaily	0.45	-0.10	-0.99	-0.53	-0.78	0.08	-0.04	0.36	0.56	-0.08	0.27	0.10
lags 53-64	[0.92]	[-0.22]	[-1.98]	[-1.20]	[-1.92]	[0.20]	[-0.08]	[0.90]	[1.22]	[-0.15]	[0.59]	[0.25]
Daily	1.44	1.22	1.63	2.19	0.74	1.00	0.79	0.78	1.12	0.82	0.92	0.49
lag 65	[2.96]	[2.86]	[3.60]	[5.04]	[1.90]	[2.55]	[1.81]	[1.88]	[2.68]	[1.59]	[2.16]	[1.25]

Table IA.X
Controlling for Turn-of-Month

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The average returns of the top-minus-bottom decile portfolios (per half-hour, in basis points) for the period January 2001 through December 2005 are reported below, as well as the corresponding t-statistics (in brackets). The returns are reported separately using half-hour intervals during turn-of-month trading days (first and last trading day of the month) and non-turn-of-month days. The returns are also partitioned using all half-hour intervals of a day, as well as only the first, the last, and the rest of the intervals. The analysis uses NYSE-listed stocks.

| Strategy	Non-turn-of-month trading days				Turn-of-month trading days			
	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)
Day 1								
Nondaily	-4.57	-8.38	-3.65	-10.84	-5.62	-8.10	-4.55	-14.97
lags 2-12	[-25.92]	[-8.25]	[-20.76]	[-16.86]	[-11.79]	[-3.19]	[-9.62]	[-7.45]
Daily	3.12	12.06	1.79	8.90	1.95	5.97	1.41	3.84
lag 13	[21.81]	[12.49]	[13.63]	[15.35]	[4.50]	[2.19]	[3.52]	[1.77]
Day 2								
Nondaily	-0.87	-2.74	-0.42	-3.99	-1.44	-5.11	-1.07	-1.83
lags 14-25	[-5.85]	[-3.05]	[-2.83]	[-7.36]	[-3.34]	[-2.15]	[-2.50]	[-0.97]
Daily	2.05	10.77	0.83	6.74	1.16	7.73	0.27	4.33
lag 26	[14.80]	[11.88]	[6.53]	[11.22]	[2.93]	[3.29]	[0.72]	[2.41]
Day 3								
Nondaily	-0.61	-5.11	-0.14	-1.28	-0.69	-2.53	-0.46	-1.40
lags 27-38	[-4.32]	[-5.96]	[-1.02]	[-2.52]	[-1.69]	[-1.11]	[-1.13]	[-0.80]
Daily	1.44	6.45	0.60	5.68	0.54	5.12	-0.24	4.50
lag 39	[10.84]	[7.29]	[4.87]	[10.20]	[1.36]	[2.12]	[-0.64]	[2.49]
Day 4								
Nondaily	-0.34	-2.78	-0.02	-1.42	-0.34	-0.40	-0.39	0.31
lags 40-51	[-2.47]	[-3.40]	[-0.15]	[-2.89]	[-0.84]	[-0.18]	[-0.97]	[0.20]
Daily	1.26	5.85	0.58	4.15	1.23	3.68	0.58	5.94
lag 52	[9.53]	[6.76]	[4.69]	[7.36]	[3.07]	[1.39]	[1.58]	[3.13]
Day 5								
Nondaily	-0.06	-0.65	0.12	-1.40	-0.10	4.68	-0.52	-0.25
lags 53-64	[-0.44]	[-0.79]	[0.83]	[-2.93]	[-0.24]	[2.14]	[-1.29]	[-0.16]
Daily	1.15	5.15	0.57	3.45	0.57	3.42	0.00	3.99
lag 65	[8.67]	[6.05]	[4.53]	[6.60]	[1.44]	[1.25]	[-0.00]	[2.23]

Table IA.XI
Controlling for Inclusion in the S&P 500 Index

We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. We analyze equal-weighted strategies with holding periods of one half-hour (i.e., one interval). Every half-hour interval, stocks are grouped into 10 portfolios (with an equal number of stocks in each portfolio) according to various categories based on past performance. For example, the Day 1 trading strategy that is formed based on a daily frequency ranks stocks according to their return during the historical lag half-hour interval 13, while the nondaily strategy ranks stocks according to their average returns over the lag half-hour intervals 1 through 12. The portfolios are formed every half-hour. The average returns of the top-minus-bottom decile portfolios (per half-hour, in basis points) for the period January 2001 through December 2005 are reported below, as well as the corresponding t-statistics (in brackets). The returns of the long-short portfolios are partitioned into the parts attributed to firms that are included in the S&P 500 index and those that are not included in the index. The returns are also partitioned using all half-hour intervals of a day, as well as only the first, the last, and the rest of the intervals. The analysis uses NYSE-listed stocks.

Strategy	Non-S&P500-index stocks				S&P500-index stocks			
	1-13 (all)	1 (first)	2-12	13 (last)	1-13 (all)	1 (first)	2-12	13 (last)
Day 1								
Nondaily	-5.58	-10.43	-4.48	-12.84	-0.72	1.32	-0.54	-4.81
lags 2-12	[-31.53]	[-10.58]	[-25.37]	[-18.62]	[-2.96]	[0.83]	[-2.26]	[-6.19]
Daily	3.28	12.95	1.93	8.56	2.19	8.23	0.98	9.42
lag 13	[22.18]	[13.25]	[14.07]	[14.13]	[10.93]	[6.74]	[5.17]	[10.43]
Day 2								
Nondaily	-0.86	-3.41	-0.37	-3.78	-1.10	-1.61	-0.77	-4.29
lags 14-25	[-5.71]	[-3.98]	[-2.43]	[-6.31]	[-5.00]	[-1.07]	[-3.60]	[-6.59]
Daily	2.09	10.93	0.90	6.37	1.81	9.58	0.52	8.27
lag 26	[14.66]	[12.09]	[6.69]	[10.70]	[9.25]	[8.11]	[2.81]	[8.66]
Day 3								
Nondaily	-0.65	-4.94	-0.15	-1.86	-0.52	-5.15	-0.24	1.00
lags 27-38	[-4.41]	[-5.84]	[-1.00]	[-3.32]	[-2.46]	[-3.56]	[-1.16]	[1.51]
Daily	1.47	6.67	0.63	5.56	1.19	5.44	0.26	7.09
lag 39	[10.62]	[7.42]	[4.80]	[9.80]	[6.18]	[4.62]	[1.44]	[8.08]
Day 4								
Nondaily	-0.37	-3.39	0.01	-1.44	-0.21	0.71	-0.25	-0.74
lags 40-51	[-2.56]	[-4.20]	[0.04]	[-2.73]	[-1.01]	[0.49]	[-1.24]	[-1.14]
Daily	1.29	5.93	0.62	4.04	1.07	5.00	0.49	3.58
lag 52	[9.42]	[6.78]	[4.76]	[7.03]	[5.59]	[4.28]	[2.67]	[4.05]
Day 5								
Nondaily	-0.16	-0.53	0.00	-1.55	0.20	0.90	0.16	-0.02
lags 53-64	[-1.09]	[-0.64]	[0.03]	[-2.97]	[0.95]	[0.61]	[0.78]	[-0.03]
Daily	1.17	5.14	0.61	3.39	0.60	3.35	0.13	2.97
lag 65	[8.56]	[6.01]	[4.58]	[6.33]	[3.08]	[2.83]	[0.70]	[3.40]
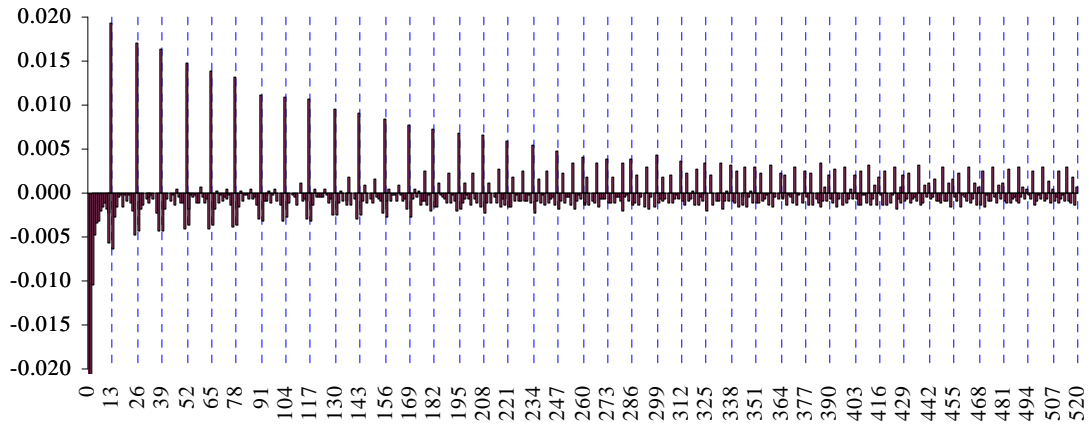
Panel A. Estimates of cross-sectional regressions
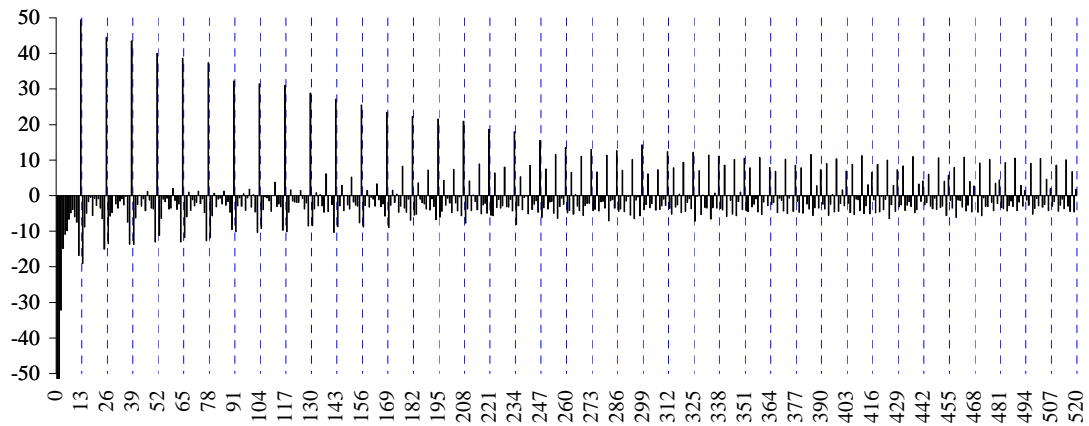
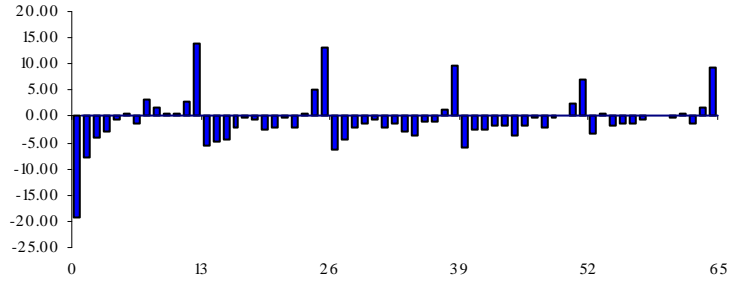
Panel B. Simple *t*-statistics of cross-sectional regression estimates

Figure IA.1. Cross-sectional regressions of half-hour-interval change in volume. We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. For every half-hour interval *t* and lag *k*, we run a simple univariate cross-sectional regression of the form $v_{i,t} = \alpha_{k,t} + \gamma_{k,t}v_{i,t-k} + u_{i,t}$, where the variable $v_{i,t}$ is the percentage change in volume of stock *i* during interval *t*. Volume is defined as the number of shares traded. For the analysis, volume is the logarithm of the ratio of volume and its prior one lag value. The cross-sectional regressions are calculated for all combinations of half-hour interval *t*, from January 2001 through December 2005 (16,261 intervals), and lag *k*, with values 1 through 520 (past 40 trading days). Panel A plots the time-series averages of $\gamma_{k,t}$. Panel B plots the Fama and MacBeth (1973) respective *t*–statistics. The analysis uses NYSE-listed stocks.
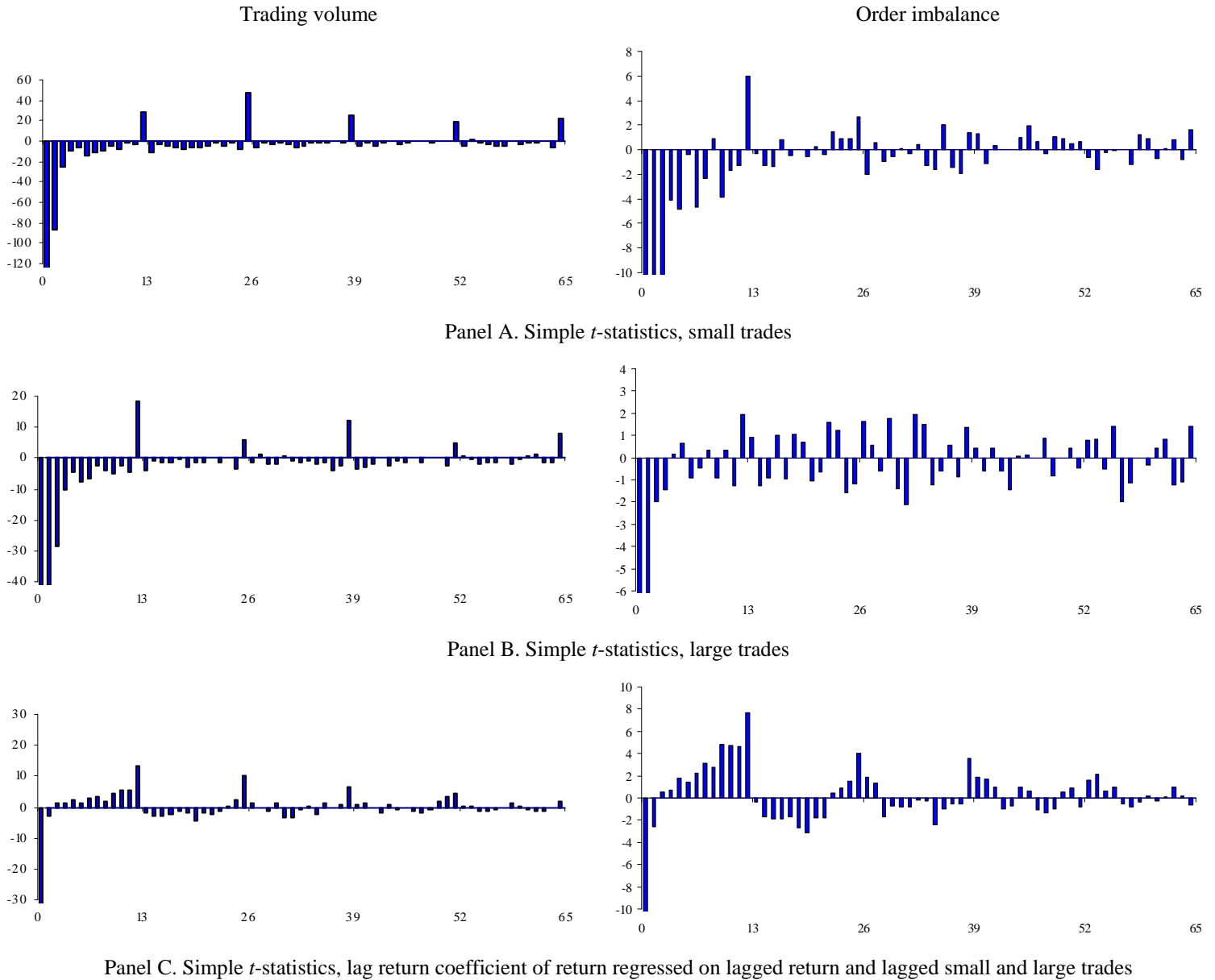
Trading volume

Order imbalance

Panel A. Simple *t*-statistics, small trades

Panel B. Simple *t*-statistics, large trades

Panel C. Simple *t*-statistics, lag return coefficient of return regressed on lagged return and lagged small and large trades
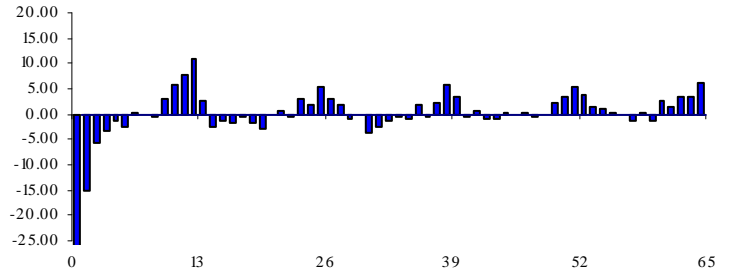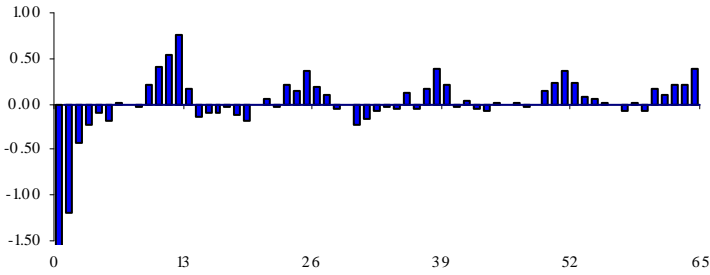
Figure IA.2. Cross-sectional regressions of half-hour-interval returns and small- and large-trade changes in volume and order imbalance (*t*-statistics). We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. For every half-hour interval t and lag k, we run cross-sectional regressions of the following forms: $sv_{i,t} = \alpha_{k,t} + \gamma_{k,t}sv_{i,t-k} + u_{i,t}$ (Panel A), $lv_{i,t} = \alpha_{k,t} + \gamma_{k,t}lv_{i,t-k} + u_{i,t}$ (Panel B), and $r_{i,t} = \alpha_{k,t} + \gamma_{k,t}r_{i,t-k} + \delta_{k,t}sv_{i,t-k} + \eta_{k,t}lv_{i,t-k} + u_{i,t}$ (Panel C), where $sv_{i,t}$ and $lv_{i,t}$ are small- and large-trade changes in volume (shares traded during the half-hour interval) or order imbalance (buyer-initiated volume minus seller-initiated volume divided by their sum) and $r_{i,t}$ is the return of stock i during interval t. Small trades are trades below 1,000 shares, and large trades those above or equal to 1,000 shares. For the analysis, each volume measure is the logarithm of the ratio of volume and its prior one lag value, while first differences are used for order imbalances. The cross-sectional regressions are calculated for all combinations of half-hour interval t, from January 2001 through December 2005 (16,261 intervals), and lag k, with values 1 through 65 (past five trading days). All panels plot the Fama and MacBeth (1973) *t*-statistics of the time-series averages of the regression coefficients. The analysis uses NYSE-listed stocks.
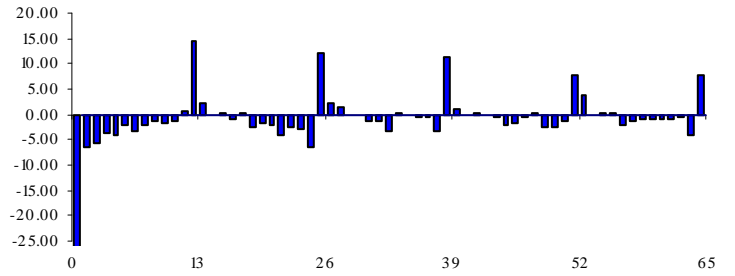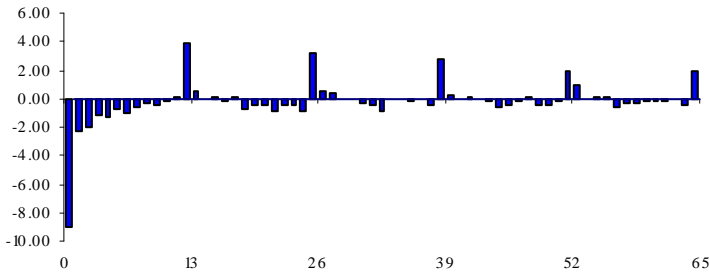
Half-hour interval 9:30–10:00
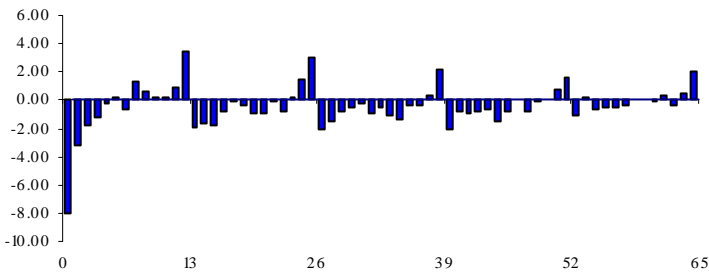
Half-hour intervals 10:00–15:30

Half-hour interval 15:30–16:00

Panel A. Estimates of cross-sectional regressions

Panel B. Simple *t*-statistics of cross-sectional regression estimates

Figure IA.3. Cross-sectional regressions of half-hour-interval returns per interval. We divide the 9:30-16:00 trading day into 13 disjoint half-hour return intervals. For every half-hour interval t and lag k, we run a simple univariate cross-sectional regression of the form $r_{i,t} = \alpha_{k,t} + \gamma_{k,t}r_{i,t-k} + u_{i,t}$, where $r_{i,t}$ is the return of stock i during interval t. The cross-sectional regressions are calculated for all combinations of half-hour interval t, from January 2001 through December 2005 (16,261 intervals), and lag k, with values 1 through 65 (past five trading days). Panel A plots the time-series averages of $\gamma_{k,t}$ (in percent) separately for the first and last half-hour intervals of a trading day, as well as the rest of the intervals. Panel B plots the respective Fama and MacBeth (1973) t–statistics. The analysis uses NYSE-listed stocks.