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Can analysts pick stocks for the long-run? ☆

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ABSTRACT

This paper examines post-revision return drift, or PRD, following analysts' revisions of their stock recommendations. PRD refers to the finding that the analysts' recommendation changes predict future long-term returns in the same direction as the change (i.e., upgrades are followed by positive returns, and downgrades are followed by negative returns). During the high-frequency algorithmic trading period of 2003–2010, average PRD is no longer significantly different from zero. The new findings agree with improved market efficiency after declines in real trading cost inefficiencies. They are consistent with a reduced information production role for analysts in the supercomputer era.

1. Introduction

For decades researchers have examined average long-run stock returns after sell-side security analysts revise their recommendations for buying and selling stocks. The universal finding is that the recommendation changes predict future long-term returns in the same direction as the change (i.e., upgrades are followed by positive returns, and downgrades are followed by negative returns). This phenomenon is known as post-revision return drift (PRD). This result has supported the hypothesis that PRD persists because investors typically underreact to analysts, responding partly at their revision announcements and slowly thereafter, perhaps taking months. It has also underpinned the nested hypothesis that security analysts are better-informed, skillful at information discovery from non-public sources (e.g., from insiders) and from neglected public information in inefficient markets, as noted by Grossman and Stiglitz (1980).[1]

This article provides new evidence about PRD that extends the literature in a number of ways. The primary

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[1] Givoly and Lakonishok (1979), Womack (1996), Hong, Lim, and Stein (2000), Gleason and Lee (2003), Jegadeesh, Kim, Krische, and Lee (2004), and Loh (2010) discuss underreaction to analysts.

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contribution is the finding that average PRD is no longer persistently different from zero in the May 2003 through 2010 sample post-period. A second contribution is new results that show a causal relationship between analysts' revisions and PRD is not supported in many tests of the PRD cross-section.

A third contribution is new evidence from the PRD cross-section regarding the investor underreaction hypothesis and the informed analyst hypothesis. Results from tests for underreaction that use proxies suggested by other researchers do not support the underreaction hypothesis in the post-period. For instance, one finding in this article shows there is no significant association between PRD and analysts' coverage, a widely used proxy for underreaction. Tests of the informed analyst hypothesis that employ proxies for better-informed analysts used in prior research, do not support the idea that analysts typically supply new information that correctly picks stocks for the long run. One example is that the PRD cross-section reveals no significant association with extreme revisions, a commonly used proxy for better-informed analysts.

A further contribution of this article is new findings supporting the alternative explanation for the persistence of PRD noted by Barber, McNichols, and Trueman (2001), that transaction costs, a real inefficiency, are high enough to fence PRD from profitable arbitrage trading strategies. The results agree with the explanation that PRD has broadly vanished due to a general decline in transaction costs, pushed down to historic lows by decimalization, the expanded use of supercomputers, and algorithmic trading. The PRD disappearance coincides with notable reductions in transaction costs that have attracted profit-taking arbitrageurs to PRD.[2]

The empirical findings in this article are robust to a number of concerns. First, the bad model concern is addressed by using PRD measures built with different asset pricing models and benchmark returns, including the market return and the return on a similar group of stocks identified by the four-characteristics model return of Daniel, Grinblatt, Titman, and Wermers (1997). Using these same models to estimate returns in both the post-period and the sample pre-period, 1997 through April 2003, suggests that the insignificance of the average PRD in the post-period is unlikely to be the result of switching expected return models. Still, the findings do not preclude that future research could yield expected return models that capture long-run drift effects. Second, the findings are not the result of a particular method for aligning the measurement of the PRD. Third, the conclusions are reinforced for refined types of revisions noted in the literature, which include consensus recommendations and extreme revisions. Lastly, out-of-sample tests confirm a general absence of PRD in the post-period. This test uses international analysts' revisions in the other Group of 7 countries: Canada, France, Germany, Italy, Japan, and the UK.[3] The findings show that drift after analysts' revisions in these countries also is not informative in the post-period, supporting similar findings for U.S. analysts.

PRD is examined from several perspectives, reflecting different ways that researchers have measured PRD, and a variety of samples that are employed for different tests. One PRD measure uses an event study approach in which the revisions are aligned on their announcement date, similar to that used by Womack (1996) and by Jegadeesh, Kim, Krische, and Lee (2004). This measure is examined in the *Event-time sample* (see Appendix A.1 for sample descriptions). A second measure evaluates PRD from a portfolio perspective in calendar time and examines the returns on buy portfolios of upgraded stocks and sell portfolios of downgraded stocks, and compares their differences. This drift measure is similar to that employed in Barber, McNichols, and Trueman (2001) and utilizes the *Portfolio sample*. PRD is examined from a third viewpoint first introduced in this article, which aligns firms on their earnings report announcement dates, and compares the drift for firms with upgrades to the drift for the other firms with continuations (i.e., those with unchanged recommendations), and similarly for the downgrades. This method controls for the influence of post-earnings announcement drift (PEAD) and uses the *Earnings sample*. Revisions in each of these three samples are examined in both the post-period and in the pre-period. This provides opportunities to replicate findings from the earlier studies, and to compare the pre- and post-period PRD behavior side-by-side. PRD is also examined in a sample of consensus recommendations within each period.[4]

Although average transaction costs are lower in the post-period, it is unlikely that they have entirely disappeared (for example, see Beneish, Lee, and Nichols, 2015; Boehmer and Wu, 2013). Under the transaction cost rationale, some PRD is likely present for stocks with relatively high transaction costs. In agreement, after sorting the *Event-time sample* into trading volume deciles, some statistically significant average PRD exists in the lowest decile, or 10% of the revisions. Significant average PRD is also present in the lowest deciles in sorts by firm size and by analysts' coverage of the firm. The *Volume*, *Size*, and *Coverage* (*VSC*) *revisions* that are common to the lowest deciles for all three characteristics, and make up 3% of all revisions, are expected to have high transaction costs. In agreement *VSC revision* stocks have a number of characteristics that are consistent with high transaction costs. Their stock prices are among the lowest, so trading a certain weight of these shares in a given portfolio will be more costly (i.e., requiring the sale of many

[2] In the supercomputer era, the equity trading market was transformed into the supercomputer intermediated market (Angel, Harris, and Spatt, 2012). Along with decimalization that cuts the bid-ask spread increments to 1¢ per share from 6.25¢ (a 16th of a dollar), supercomputers cut electronic transaction costs, institutional commissions, and arbitrage costs to historic lows, enabling high-frequency trading (hundreds and thousands of buy and sell transactions per minute) using complex algorithmic models and software at low cost, fueling growth in hedge funds and trading volume, as well as attenuation of some anomalies (Korajczyk and Sadka, 2004; French, 2008; Chordia, Roll, and Subrahmanyam, 2011; Chordia, Subrahmanyam, and Tong, 2014; Hendershott, Jones, and Menkveld, 2011; Beneish, Lee, and Nichols, 2015).

[3] We thank the referee for suggesting this out-of-sample test.

[4] Dimson and March (1984), Elton, Gruber, and Grossman (1986), Stickel (1992), and Mikhail, Walther, and Willis (2004) also study PRD. Cowles (1933, 1944) does not find evidence of PRD in a much earlier sample period.

more shares). They are twice as likely to be listed on the Nasdaq, where bid-ask spreads are larger than for NYSE-listed firms in the post-period (Angel, Harris, and Spatt, 2012). Furthermore, *VSC revision* stocks are among the smallest firms, with other firms' average equity valued 50 times higher. Also, their trading volume is the lowest, showing they are in limited short-run demand and supply.

The findings also allow that some PRD could be the unintended result of the way in which the long-run abnormal returns are measured. For example, the small sample evidence of PRD is ever-present in the lowest deciles in a number of sorts for the *Event-time sample*, while the evidence is inconsistent in the lowest deciles of the *Portfolio* and *Earnings samples*.

While PRD may come from analysts' new information discovery and asset pricing model effects, this article documents a third potential source: drift that is associated with other recent news and events about the covered firm. A number of studies find that analysts often piggyback their reports on recent events and news, which contribute to magnifying return reactions measured during the days around the revision announcements, and to masking how much of the return reaction can be credited to analysts' new information (Altınkılıç and Hansen, 2009; Altınkılıç, Balashov, and Hansen, 2013; Kim and Song, 2015). Similarly, recent events and news themselves can be associated with their own return drift which could confound the average PRD and consequently raise the question of how much of the PRD can be credited to analysts' revisions. This issue is addressed in this article through examination of concurrent event drift from the notable reported earnings event using the *Earnings sample*, which allows for control of the well-known post-earnings announcement drift (PEAD) that could enlarge measures of average PRD. The new findings using the *Earnings sample* reveal that after controlling for PEAD, the PRD contains little incremental information that can be credited to analysts in the post-period, confirming the third source of drift.[5]

The new findings contribute to research related to analysts' performance in the market for new information in their role as information intermediaries. The results show that, on average, analysts' revisions are not highly correlated with subsequent long-run returns, indicating that analysts do not provide new information that is relevant for the long-run for typical investors. Analysts face greater competition in the market for new information in the post-period, as lower transaction costs have enabled arbitrageurs to quickly harvest more mispricing opportunities, shrinking the potential pool of neglected information. Therefore, to the extent that analysts' supply of new information is derived from their discovery of neglected public information, in the post-period they are confronted with greater scarcity of such information. The heightened competition for neglected information would seem to imply that analysts may now allocate less of their time and effort producing such new information.[6]

The new findings should also be relevant for researchers interested in market efficiency. Jensen (1978) suggests that markets are efficient as long as economic agents cannot profit from the analysts' information. Fama (1970) notes that markets are efficient as long as agents cannot reliably predict long-run common stock returns. The findings from the post-period support both definitions of market efficiency. The general decline in transaction costs has allowed information to be incorporated more quickly and completely into security prices, eliminating both profit opportunities from strategies that use analysts' revisions, as well as the predictability of long-run returns based on the revisions. The disappearance of PRD therefore exemplifies how rational pricing of securities interacts with changes in real inefficiencies to extend market efficiency.

One alternative explanation for the lack of significant PRD in the post-period, which conserves the view that analysts supply ample new information, is that investors no longer underreact to new information from analysts' revision announcements. Perhaps the profound economic forces of the supercomputer era, which greatly accelerated trading frequency at minimal cost, also elevated investor attention to all stocks, thereby significantly expanding investor awareness and hastening their reaction to news that affects stocks' prices. An important implication of this increased awareness theory, if the revisions supply analysts' new information, is that announcements of analysts' revisions should be met quickly with widespread investor reaction that quickly impounds most of the new information, if not all, into stock prices. Thus, in the post-period, the average return reaction to revision announcements should contain economically significant evidence of analysts' new information, all else the same. However, this implication is not supported by recent studies, which report that the announcement period price reaction to analysts' reports contains little new information that can be attributed to the analysts themselves (Altınkılıç and Hansen, 2009; Loh and Stulz, 2011; Altınkılıç, Balashov, and Hansen, 2013). The findings in this article widen the empirical evidence indicating little average investor reaction to analysts' reports.

The remainder of the article proceeds as follows; Section 2 describes the sample; Section 3 examines PRD in side-by-side comparisons of the post-period and the pre-period; Section 4 examines evidence of PRD in the 3% sample of the *Event-time sample* revisions; Section 5 examines the underreaction hypothesis and the informed analyst hypothesis; Section 6 examines PRD in a sample of international stocks; the article concludes with final thoughts and implications for future research in Section 7.

[5] Barber, McNichols, and Trueman (2001) note that PRD could also be an anomaly.

[6] Analysts' sources for new information have also likely been reduced by reforms that limit their access to non-public information. Such reforms (*footnote continued*) and rules enacted in the pre-period include the Global Settlement, National Association of Securities Dealers (NASD) Rule 2711, and Regulation Fair Disclosure. Still, the reforms' impact is likely to be mixed, so some analysts may not be barred from some sources of non-public information in the post-period. For example, analysts' access to information from informed parties through school-ties declined following the reforms (Cohen, Frazzini, and Malloy, 2010), while they continue to have access to some non-public information from firm management through conference hostings (Green, Jame, Markov, and Subasi, 2014). The reforms could contribute to lower transaction costs by reducing information asymmetry (Eleswarapu, Thompson, and Venkataraman, 2004).

2. Sample description

The samples used in this article draw from real time or no source code needed recommendation revisions from First Call Historical Database (FCHD) from 1997 through 2010 (batch recommendations, initiations, and resumptions are excluded), which have the control variables used in this study as identified from the literature. Recommendation levels range from one to five respectively: strong buy, buy, hold, sell, and strong sell. If the new recommendation level is lower (higher) than the previous recommendation level, it is an upgrade (downgrade). Recommendations issued after 4 PM are taken as issued the next trading day. If one brokerage issues multiple recommendations on the same day for the same company, only the latest is retained. If there are multiple upgrades (downgrades) for the same company on the same day, the upgrade (downgrade) is counted only once. Conflicting revisions for the same stock on the same day and on stocks with no earnings announcement in the prior year are deleted. The Center for Research in Security Prices (CRSP) provides daily stock prices and volume. Industry classifications are from Ken French's website.

Revision annual frequency is usually higher over 2005–2007 for both upgrades and downgrades. Covered firms and brokerage firms in the sample follow a similar pattern (Table 1).

3. Post-revision return drift

The first measure of PRD is in revision event-time, using the long-term average abnormal buy and hold returns aligned on the third trading day after the revision announcement day. Measuring drift starting three days after the announcement avoids return shocks from confounding events immediately around the revision announcement. Initially, PRD is calculated two ways that use different asset pricing models: the Market Model, denoted *MM*, and the characteristics model of Daniel, Grinblatt, Titman, and Wermers (1997), denoted *DGTW*. The sample for these estimations is the *Event-time sample*.

The drift for firm i, with a duration of d trading days that starts three trading days after the recommendation announcement, denoted $PRD^{\pi}_{i,d}$, is firm i's raw return during the duration period, $R_{i,d}$, less that period's return from the asset pricing model, R^{π}_{d};

$$PRD^{\pi}_{i,d} = R_{i,d} - R^{\pi}_{d} = \prod_{t=3}^{d+3}(1+r_{i,t}) - \prod_{t=3}^{d+3}(1+I^{\pi}_{t}), \quad (1)$$

where π denotes the *MM*or*DGTW*measures (see Appendix A.2 for variable definitions). For Market Model returns, I^{MM}_{t} is the CRSP value-weighted market index return. For characteristic-adjusted returns, I^{DGTW}_{t} is the return on the characteristics' portfolio of firms matched on market equity, market-to-book, and on prior one-year return quintiles. In both cases, reported durations include 20, 60, and 120 trading days.

3.1. The graphical view

Fig. 1 Panel A displays the post-period average PRD for the full 120 days for the *Event-time sample*. *MM* PRD after upgrades are announced is generally flat, while it is modestly positive after the downgrades. The *DGTW* PRD measure is negative over the 120 days after downgrades and even more so after upgrades. Thus, for both measures, the average PRD behavior is mixed: sometimes it agrees with the revisions, thus agreeing with the informed analyst thesis, and sometimes it is contrary to the revisions.

In the pre-period, the average PRD behavior is also mixed (Fig. 1, Panel B). PRD is positive after the upgrades under either asset pricing model, which agrees with the informed analyst view. For downgrades, however, rather than being negative, the PRD is positive, using either asset pricing model. This is contrary to the behavior anticipated when following the advice of informed analysts' revisions.

The irregular PRD behavior clearly shows that revisions do not reliably foretell future long-term return behavior, on average.

A further evaluation of the return performance uses a measure that is conditioned on the direction of analysts' revisions; called the "up-less-down" strategy, which seeks to capture the difference between PRD after upgrades and PRD after downgrades. In effect, this is a strategy that invests long in the upgraded stocks and short in the downgraded stocks, providing a gross assessment of the return from analysts' information. Note the up-less-down measure is not capable of evaluating expected profits; that is, the gross value from the entire investment strategy net of the likely transaction costs from executing the strategy. When the gross value from this up-less-down strategy is significantly positive, the average PRD only reveals that the recommendations have behaved, in combination, as if they are informative for the investment duration.

For the post-period, the up-less-down *MM* PRD generally is slightly negative over the 120 days after the revisions are announced, and so is the *DGTW* PRD (Fig. 2, Panel A). This does not agree with the informed analyst view. In contrast, in the pre-period the strategy yields positive PRD for both drift measures, which does not agree with the informed analyst view. While this positive drift resembles qualitatively similar findings from prior studies in earlier sample periods, the only source for this positive up-less-down drift in Fig. 2 is the long upgrade leg of the portfolio, because the short downgrade leg earns negative returns (Fig. 1). In other words, a strategy of going long stocks after *both* upgrades and downgrades, contrary to the strategy that strictly follows analysts' advice, would have earned a higher return than the up-less-down strategy. The PRDs computed using value-weighted returns are not materially different from the equally weighted case reported in Figs. 1 and 2 (unreported).

3.2. The decline of PRD

This section documents in more detail the behavior of PRD in the post-period and in the pre-period.

3.2.1. The event-time sample

Consider first the univariate regression of PRD on the revision upgrade indicator variable, *UP*, that is one if the recommendation is an upgrade and zero if it is a downgrade. The regression equation is thus

$$PRD^{\pi}_{i,d} = \alpha + \beta UP_i + \varepsilon_{i,d}, \quad (2)$$

where β registers the additional drift that is associated with analysts' upgrades relative to their downgrades.

In the post-period the regression estimate $\hat{\beta}$ shows the *MM* measure of PRD is positive over the first 20 days after day 3, although the coefficient estimates are not economically large at around 27–28 basis points (with significance at the 5% level). The two longer duration drifts are not

Table 1
Summary statistics. Annual frequency of recommendations, covered firms, and brokerage firms, for the *Event-time sample* described in Appendix A.1. Post-period (pre-period) era is May 1, 2003 through 2010 (1997 through April, 30, 2003).

Year	Event-time revisions	Upgrades	Downgrades	Covered firms	Brokerages
Panel A: Post-period					
2003, May, 1	622	292	330	351	72
2004	2,093	966	1,126	765	170
2005	4,228	2,036	2,192	1,023	211
2006	3,453	1,760	1,692	1,002	218
2007	3,503	1,632	1,871	1,005	209
2008	3,420	1,742	1,679	1,012	205
2009	3,321	1,494	1,827	964	185
2010	3,150	1,635	1,516	936	185
Panel B: Pre-period					
1997	1,416	712	704	495	122
1998	1,810	795	1,015	592	138
1999	1,878	1,044	834	622	141
2000	1,972	900	1,072	633	142
2001	2,382	1,009	1,373	710	146
2002	2,782	1,282	1,500	783	161
2003, April 30	432	203	229	243	50

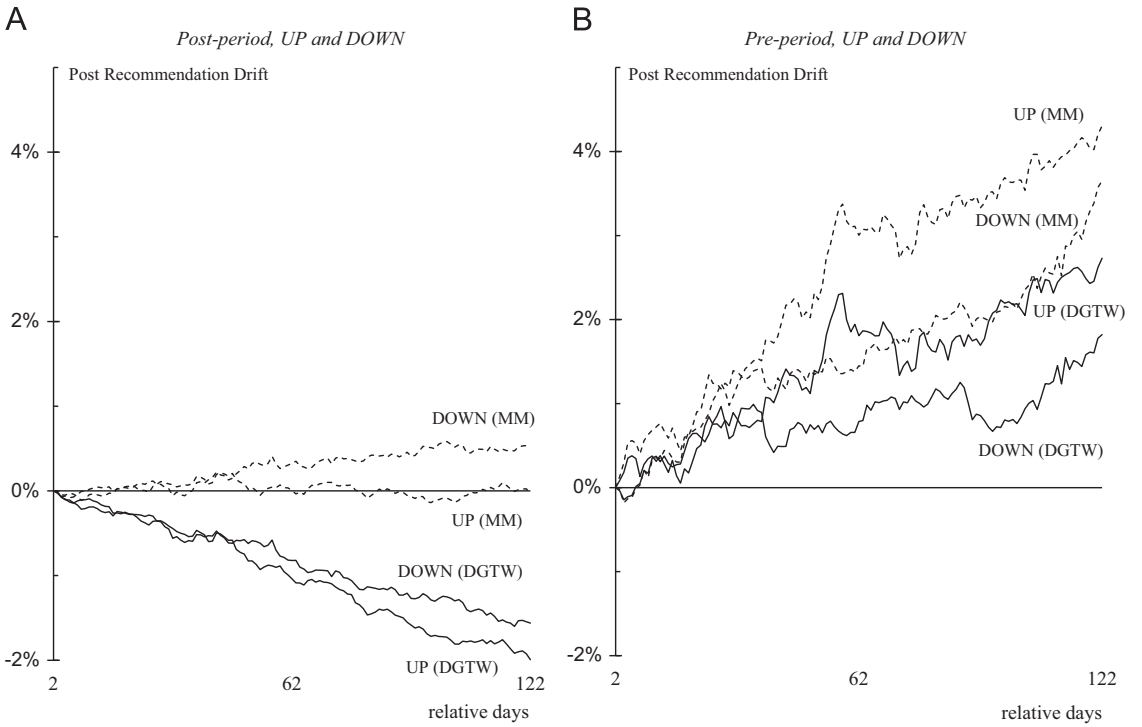

Fig. 1. Value weighted mean PRD following upgraded (downgraded) recommendations, *UP* (*DOWN*), computed using *MM* and *DGTW* characteristics, for the *Event-Time Sample*. Panel A shows post-period mean PRD, *UP* and *DOWN*, and Panel B shows pre-period mean PRD, *UP* and *DOWN*. Post-period (pre-period) era is May 1, 2003 through 2010 (1997 through April 30, 2003). Samples and variables are described respectively in Appendix A.1 and Appendix A.2.

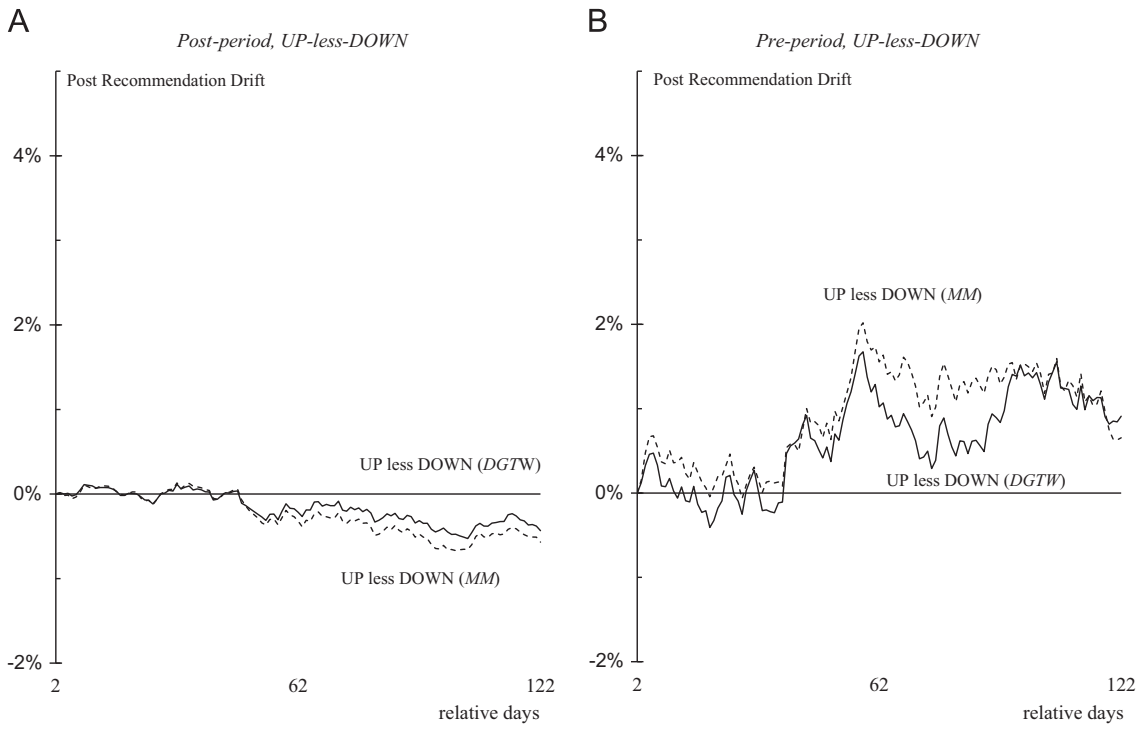

Fig. 2. Differences in value weighted mean PRD, for upgraded stocks and downgraded stocks, where PRD is computed using *MM* and *DGTW* characteristics, for the *Event-Time Sample*. Panel A shows post-period differences and Panel B shows pre-period differences. Post-period (pre-period) era is May 1, 2003 through 2010 (1997 through April 30, 2003). The samples and variables are described respectively in Appendix A.1 and Appendix A.2.

significant, diminishing in magnitude or turning negative (Table 2, Panel A). Qualitatively similar results are recorded for the *DGTW* PRD (Table 2, Panel A).

In contrast, the pre-period upgrade average PRD is significantly positive relative to the downgrade PRD, at all durations, typically at the 1% level, for both the *MM* and the *DGTW* measures. Moreover, the magnitude of the *UP* coefficient estimates for the pre-period are often large, over five times larger than the estimates for the post-period. The findings from the pre-period agree with the informed analyst hypothesis and are qualitatively similar to findings reported in earlier studies.

The second regression model is a multivariate specification that includes 12 exogenous binary variables that control for several other effects affecting the return behavior, similar to the measure employed by Jegadeesh, Kim, Krische, and Lee (2004):

$$PRD_{i,d} = \alpha_i + \beta UP_i + \sum_{i,j}^{12} \gamma_j X_{ij} + \varepsilon_{i,d}, \quad (3)$$

where for firm i the right-hand side includes *UP* and 12 exogenous binary variables, X_{ij}: *Retp*, *Ret2p*, *Frev*, *SUE*, *BP*, and *EP* equal one if the control variable is above the sample median, and *Turn*, *Size*, *LTG*, *SG*, *TA*, and *Capex* equal one if the control variable is below the sample median. Otherwise, each binary variable takes a value of zero (see Appendix A.2 for variable definitions).

Higher momentum stocks are expected to receive more favorable revisions, to the extent that analysts rely on momentum from prior earnings to generate their revisions. Lee and Swamanathan (2000) show that drift is inversely related to prior trading volume. Basu (1977) reports that high earnings-to-price multiple firms outperformed other firms. Fama and French (1992) report that subsequent returns for high book-to-price ratio (BP) firms outperform others. Lakonishok, Shleifer, and Vishny (1994) show that drift underperforms following high average long-term growth in sales, and La Porta (1996) shows that underperformance follows high forecasted earnings growth. Authors have also reported that drift is greater for small firms (Banz, 1981). Sloan (1996) reports that more negative accruals are associated with higher drift. In contrast, Chan, Chan, Jegadeesh, and Lakonishok (2006) report that higher accruals often support higher accounts receivable and inventory, in support of greater sales. Beneish, Lee, and Nichols (2015) report that high capital expenditures are typically followed by lower drift.

The estimates for the incremental impact of *UP* on PRD in the multivariate regression are similar to the estimates in the univariate regression (Table 2, Panels A and B). In the post-period, the informed analyst hypothesis is supported in only one case, the 20-day duration drift, and is not significant in the longer durations. In contrast, in the pre-period the incremental PRD associated with *UP* is significantly positive for all three durations, for both the *MM* and *DGTW* measures of PRD, consistent with the informed analyst hypothesis.

Additional post-period tests that exclude revisions during the financial crisis period (September 2008 through the sample period end), provide results that are qualitatively similar to the full sample results (Table 2, Panel C).

Table 2

Event-time sample: PRD regression tests.

The dependent variable is drift of 20, 60, and 120 trading days, measured using the *MM* and the *DGTW* methods, winsorized. *UP* is one for recommendation upgrades and zero for downgrades. Panel A reports univariate *UP* coefficients; Panel B reports *UP* coefficients from multivariate regressions that include 12 other control variables. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic. Panel C reports *UP* coefficients from multivariate regressions that include 12 other control variables in the post-period, excluding the crisis period, from September 2008 to the sample era end.

Variable	Post-period, *N*=23,790						Pre-period, *N*=12,672					
	MM drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Panel A: Univariate coefficient estimates												
Intercept	0.198**	0.917***	2.174***	−0.217***	−0.389***	−0.613***	0.272*	1.541***	4.375***	−0.368***	−0.421*	0.125
UP	0.275**	0.162	−0.269	0.266**	0.145	0.015	1.557***	2.123***	1.478***	1.596***	2.285***	2.399***
R-square	0.02	0.03	0.02	0.02	0.03	0.02	0.35	0.21	0.04	0.42	0.27	0.13
Panel B: Multivariate coefficient estimates												
Intercept	0.142	0.812**	2.175***	−0.287	−0.044	0.050	−0.295	0.344	3.510***	−0.491	−0.790	0.883
UP	0.277**	0.208	−0.180	0.270**	0.182	0.092	1.574***	2.123***	1.464**	1.603***	2.246***	2.301***
Retp	−0.417***	−0.129	−0.845***	−0.232**	−0.247	−0.848***	−0.295	0.727*	2.054***	−0.462**	0.185	1.266**
Ret2p	−0.310***	−0.870***	−2.017***	−0.303***	−0.733***	−1.449***	0.306	0.247	−1.173*	0.325	0.347	−1.214**
Turn	0.077	−0.139	−0.869***	0.090	−0.193	−0.738**	−0.197	−1.233***	−2.693***	−0.333	−1.560***	−3.319***
Size	0.041	0.206	0.818***	0.025	0.087	0.610*	0.735***	1.671***	3.445***	0.522**	0.964**	1.754***
Frev	−0.291**	−1.093***	−1.347***	−0.210*	−0.951***	−1.265***	−0.615***	−1.954***	−3.267***	−0.506**	−1.455***	−2.302***
LTG	0.112	0.411*	1.607***	0.002	0.352	1.493***	−0.072	0.005	−0.415	−0.027	0.046	0.127
SUE	0.212*	0.593***	0.619*	0.176	0.624***	0.598*	0.534***\	1.283***	1.664***	0.361	1.151***	1.542***
SG	−0.239*	−0.547**	−1.182***	−0.201*	−0.633***	−1.407***	−0.286	−0.161	−0.297	−0.243	0.078	0.029
TA	0.385***	0.717***	1.362***	0.392***	0.575***	1.042***	0.564**	1.086***	2.300***	0.611***	1.166***	2.221***
Capex	0.166	−0.238	−0.631**	0.160	−0.345*	−0.887***	0.407*	0.419	0.386	0.209	0.282	−0.028
BP	0.384***	1.019***	1.955***	0.269**	0.570***	1.029***	0.207	0.394	0.291	−0.039	−0.276	−0.995
EP	−0.012	0.233	0.437	−0.033	0.166	0.417	−0.168	−0.086	−0.538	−0.179	−0.152	−0.496
R-square	0.22	0.38	0.69	0.12	0.25	0.53	0.53	0.60	0.82	0.56	0.56	0.70
Panel C: Multivariate, UP coefficient estimates (other 12 coefficients unreported), crisis period removed												
UP	0.341**	−0.092	−0.776*	0.385**	0.024	−0.443						
R-square	0.11	0.53	0.18	0.12	0.36	0.87						
N	10,439	10,439	10,439	10,439	10,439	10,439						

3.2.2. Portfolio sample

The next measure of PRD uses a calendar portfolio approach, similar to Barber, Lehavy, and Trueman (2007), and focuses on three portfolio classes: the Buy portfolio of all upgraded stocks, the Sell portfolio of all downgraded stocks, and the Buy-less-sell portfolio, which is the difference between the upgraded and downgraded stocks. This sample is the *Portfolio sample*.

Portfolio drift is measured using the Carhart (1997) extension of the Fama and French (1992) expected returns model,

$$R_{jt}-R_{ft} = \alpha_j+\beta_j\left(R^v_{mt}-R_{ft}\right)+s_jSMB_t+h_jHML_t+w_jWML_t+\varepsilon_{jt}, \quad (4)$$

where for date t the dependent variable is the return on a portfolio j of recommendations less the risk-free rate, and the right-hand-side variables are, respectively: the return on the value-weighted market index less the risk-free rate; the return on a portfolio of small-cap stocks less the return on a portfolio of large-cap stocks; the return on a portfolio of high book-to-market value stocks less the return on a portfolio of low book-to-market value stocks; and the return on a portfolio of recent high return stocks (winners) less the return on a portfolio of low recent return stocks (losers). The factors and the risk-free interest rate are collected from Ken French's website.

The expected signs of the coefficients in Eq. (4) are: small-cap and small-value portfolios, respectively, have higher expected returns than the large-cap and growth portfolios. The holding period returns are measured over the 60 trading days starting on day three after the revision announcement. Drift performance is measured by the intercept estimate, $\hat{\alpha}$, in Eq. (4). The estimation results are reported in Table 3.

In the post-period, estimates for both the Buy portfolio and the Sell portfolio indicate no significant causation between the revisions and PRD. Similarly, Buy-less-sell portfolio PRD is not significant (Table 3, Panel A). Neither result is expected by the informed analyst view

In the pre-period the Buy portfolio drift estimate is positive and statistically significant, in agreement with the informed analyst hypothesis and some prior studies (Table 3, Panel B). However, the Sell portfolio estimate indicates no significant post-revision return drift, which is inconsistent with the view that downgrades anticipate lower prices in the future. The Buy-less-sell portfolio PRD remains significant, however, registering the strong relative performance of the Buy portfolio.

Results from further tests in the post-period, after removing revisions issued during the financial crisis period (September 2008 through the sample period end), are weaker than the full post-period results (Table 3, Panel C), as none of the portfolios' PRD is significant.

Table 3

Portfolio sample: PRD regression tests.

The dependent variable is abnormal return drift of 60 trading days, measured using the four-factor model, winsorized. Buy, Sell, and Buy-less-sell denote the upgrade and downgrade portfolios, and their difference. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). The crisis period is from September 2008 to the sample era end. *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student t-statistic.

Variable	Buy	Sell	Buy-less-sell
Panel A: Post-period			
Intercept	0.010	0.006	0.003
R_m-R_f	1.091***	1.058***	0.033***
SMB	0.522***	0.542***	−0.020*
HML	0.003	−0.084***	0.087***
WML	0.039***	−0.104***	0.143***
Panel B: Pre-period			
Intercept	0.057***	0.015	0.042***
R_m-R_f	1.106***	1.069***	0.037***
SMB	0.414***	0.468***	−0.054**
HML	0.264***	0.288***	−0.024***
WML	−0.090***	−0.245***	0.155***
Panel C: Post-period, crisis period removed			
Intercept	0.054	0.001	−0.002
R_m-R_f	1.107***	1.079***	0.019**
SMB	0.402***	0.558***	−0.023
HML	0.263***	−0.039**	0.053***
WML	−0.105***	−0.031***	0.158***

3.2.3. The earnings sample

Thus far, the tests follow the custom of comparing PRD after all upgrades with PRD after all downgrades. However, these tests overlook the possible external influence in those revisions when analysts' decisions to upgrade or downgrade their revisions rely at least in part on publicly known factors that in and of themselves have some power to predict future drift. To the extent that analysts piggyback their revisions on drift predictors in this way, there may be a revision selection bias that could be influential enough to cause spurious agreement between the revisions and subsequent PRD, even when the analyst is not communicating new information. An important example taken up here is piggybacking the revisions on known predictors of PEAD, an enduring long-run drift anomaly (e.g., see Fama, 1998). For example, by upgrading (downgrading) after good (bad) earnings surprises, the revision could associate with subsequent positive (negative) PEAD, independent of any new information the analysts might deliver in the revision announcement. While some control for this bias is possible in the *Event-time sample* tests by including unexpected earnings (SUE) among the right-hand-side factors in the PRD regression estimations, spurious correlation could still be an operative that biases the revision PRD to agree with the informed analyst view, even though analysts may only be tracking PEAD alone, not seeking to offer new information.

To address this selection bias concern, further PRD tests use the *Earnings sample*, which contains all quarterly earnings announcement events from FCHD, where each announcement enters the sample once regardless of the frequency of analysts' revisions. Within this sample the relevant upgrade revisions and the downgrade revisions are identified from the *Event-time sample*. By construction, all other observations have no recommendation revision and are called continuations.

The *Earnings sample* therefore permits testing if PRD after upgrades and after downgrades, where both are associated with earnings announcements, differs from the

Table 4
Earnings sample regression tests.
The dependent variable is abnormal return drift for 1, 3, 6 months, using the *MM* and the *DGTW* methods. Panel A (B) reports coefficient estimates for *UP* and *DOWN* from multivariate regressions that include 12 other control variables in the post-period (pre-period). Panel B reports the coefficient estimates for *UP* and *DOWN* from multivariate regressions that include 12 other control variables in the post-period after removing the crisis period. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). The crisis period is from September 2008 to the sample era end. *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Variable	*MM* drift			*DGTW* drift		
	1 Month	3 Months	6 Months	1 Month	3 Months	6 Months
Panel A: Post-period multivariate estimate for UP and DOWN, N=36,963						
UP	−0.103	−0.547	−1.507**	−0.027	−0.176	−0.788
DOWN	0.096	-0.297	−0.829	0.157	0.026	0.164
Panel B: Pre-period multivariate estimate for UP and DOWN, N=18,793						
UP	0.949**	1.720**	2.261**	0.838***	1.840***	2.383**
DOWN	−0.457	−1.270**	−0.296	−0.593*	−1.253**	−0.543
Panel C: Post-period multivariate estimate for UP and DOWN, crisis period observations removed, N=24,495						
UP	0.186	0.228	−0.066	0.185	0.128	−0.356
DOWN	0.118	−0.079	−0.649	−0.004	−0.182	−0.567

drift for all continuations that are likewise associated with earnings announcements.

In the *Earnings sample*, drift for the continuations is measured starting on the third trading day after the earnings announcement. Thus, this drift after the firm's concurrent earnings announcement is PEAD, and it contains no drift that is attributable to a revision. Drift after each recommendation revision is also measured starting on the third trading day after the earnings announcement. By construction, the post-revision drift for the revisions includes the drift from the concurrent earnings announcement, PEAD, *plus* the incremental drift that is created as a result of new information released by the analyst's revision announcement.

To estimate the incremental drift impacts from the revisions relative to the drift from the earnings news, the upgrades, downgrades, and continuations are pooled in a single regression that includes two dummy variables; *UP* equals one for the upgrades and *DOWN* equals one for the downgrades, in addition to the 12 factors. The estimated regression is thus

$$PRD_{i,d} = \alpha_i + \beta UP_i + \delta DOWN_i + \sum_{i,j}^{12} \gamma_j X_{ij} + \varepsilon_{i,d}. \quad (5)$$

Regression (5) therefore tests if revisions produce incremental drift beyond what could be associated with the concurrent PEAD. If upgrades produce significant additional drift, then β is expected to be positive. Likewise, if downgrades create more negative drift beyond the PEAD, δ is expected to be negative.

In the post-period the average upgrade increment to PRD is not statistically significantly positive, for any of the three durations of the *MM* PRD measure (Table 4, Panel A). Similarly, for the downgrades the average increment to PRD is not statistically significantly negative, for any duration, for the *MM* PRD and *DGTW* PRD measures (Table 4, Panel A). These findings are not consistent with the informed analyst hypothesis. In light of these findings, it is plausible that evidence of significant PRD reported in the post-period *Event-time sample* could contain bias to the extent that revisions piggyback on predictors of future drift that are not fully reflected in the 12 factors.

In the pre-period, by contrast, the PRD for the upgrades is significantly positive, for both *MM* PRD and the *DGTW* PRD, for all three durations (Table 4, Panel B). For the downgrades, half of the *DOWN* coefficient estimates are significantly negative. Some of these findings agree with the informed analyst thesis, and are qualitatively similar to findings that are reported in prior studies whose sample period overlaps the pre-period.

For the post-period, further tests are conducted after removing observations during the financial crisis period (September 2008 through the sample period end). These estimates are never significant, qualitatively similar to the full post-period results (Table 4, Panel C).

Hereafter, because the reported post-period findings are not altered qualitatively by excluding crisis period revisions, to conserve space only results for the whole post-period sample are reported.

3.2.4. The matched-earnings sample

One concern is that by including all earnings announcements, the *Earnings sample* tests might not adequately control for the extent to which firms associated with analysts' revisions differ from other firms associated with continuations, in ways that are not controlled by the regression model despite the inclusion of the 12 factors. For example, perhaps PRD is not linear in some of the factors, or perhaps there are measurement concerns, like the fact that the inclusion of a momentum measure among the independent variables might not adequately control spurious correlation that could be attributed to earnings announcement news.

Further tests, therefore, use the *Matched-earnings sample*. In the *Matched-earnings sample*, each upgrade and each downgrade from the *Earnings sample* is matched to a similar continuation in the *Earnings sample*, where similarity is determined using the Propensity Score method. Thus, a Probit model is first estimated for the *Earnings sample* using

the set of twelve predictor variables to obtain propensity scores for all revisions and continuations. The *Matched-earnings sample* consequently consists of all upgrades and downgrades and their respective matched continuations using the closest Propensity Score. In the *Matched-earnings sample* the measured drift for the revisions includes PEAD in addition to the incremental PRD triggered by the informativeness of the analysts' revisions. The continuations, however, contain only PEAD and no incremental information effects from revisions (as in Eq. (5)).[7]

For the *Matched-earnings sample*, Panel A of Table 5 reports mean values for the 12 factors used to estimate the propensity scores, for the upgrades and their corresponding matched continuations, and likewise for the downgrades. The factor means show the propensity score identifies matched continuation firms that are similar to the firms, in terms of the 12 factors.

If analysts' revisions are informative for the long-run, there should be a significant difference between the revision firms' average PRD and the matched firms' average PRD, all else the same: positive between the estimated coefficients for *UP* and *UPmatched*, and negative between the estimated coefficients for *DOWN* and *DOWNmatched*.

In the post-period, there is positive drift measured by the *MM* PRD for both the upgrades and the upgrade matched firms. However, the difference between their PRD is not statistically significant (Table 5, Panel B), in each duration, for both the *MM* PRD and the *DGTW* PRD. The lack of a significant difference between the drift after the revisions and the drift after the continuations, points to drift observed after the revisions reflecting drift from concurrent earnings announcements, rather than from underreaction to analysts' information.

In the pre-period significantly positive PRD is common for the *UP* revisions and their matched continuations, but the evidence indicating the two differ is weak for both asset pricing models, except in the 3-month duration. The findings are mixed for downgrades, as there is both significantly positive and significantly negative drift, which is not anticipated by the informed analyst hypothesis.

Most of the empirical results from the post-period *Earnings sample* and the *Matched-earnings sample* provide no consistent pattern of significant PRD from analysts' revisions, but some do. Similarly, in the pre-period, a pattern of significant PRD difference is typically uncommon.

To summarize the univariate and multivariate PRD cross-section findings reported in Tables 2–5, these tests reveal in the post-period that PRD, measured using methods reported in earlier research, is not economically meaningful and often it does not agree with the direction in which analysts have revised their stock recommendations. While the significant PRD for the 20-day duration in the *Event-time sample* is aligned with the informed analyst hypothesis, in that sample the evidence is generally mixed. Moreover, the finding does not appear to be robust in the other samples. In the *Portfolio* and *Earnings samples* there is no significant average PRD that agrees with the informed analyst hypothesis. Similarly, in the *Matched-earnings sample* there is no significant difference between average PRD for upgrades and their matches, or downgrades and their matches, across all three drift durations.

In the pre-period *Event-time sample*, the cross-section regression estimates show upgrades have statistically significant impact on PRD. This is confirmed with the Buy-less-sell findings in the *Portfolio sample*, as well as the *UP* findings and 3-month duration *DOWN* findings in the *Earnings sample*. There is also support for this conclusion among the mixed results using the *Matched-earnings sample* propensity score tests. A number of these pre-period results also agree with findings reported in earlier studies.

4. Has post-revision return drift totally disappeared?

If PRD persists because of high transaction costs, then economically significant PRD could still exist in post-period subsamples that are more likely to have relatively high transaction costs, even if the average PRD is not significant. This section reports results from several tests that are designed to determine if average PRD within subsample deciles is significant when the revision firm characteristics suggest large transaction costs are likely to be present. The tests focus on three characteristics: *Volume*, *Firm size*, and *Coverage*.

4.1. Volume

Everything else the same, low volume firms are likely to have higher costs of illiquidity than other firms, raising their trading cost (Amihud, 2002). To the extent that low volume indicates limited supply of stock at current prices, transaction costs are likely to be even higher when the trading strategies include shorting downgraded stocks.

Trading *Volume* in the firm's shares is measured by the average daily trading volume over the prior calendar year. For the post-period, in the *Event-time sample*, PRD is insignificant in most trading *Volume* deciles, however it is distinctly present in the lowest decile using either drift measure, across all three durations (Table 6, Panel A). This agrees with the transaction cost thesis, to the extent that the lowest *Volume* decile stocks typically have relatively larger costs. In contrast, for the *Portfolio sample*, significant PRD is not consistently present in the lowest decile (Table 6, Panel B); negative PRD is present in the lowest Sell portfolio decile, but significant PRD does not occur in the lowest deciles for the Buy, or the Buy-less-sell portfolios (Table 6, Panel B). Also, for the *Earnings sample*, there is little evidence of significant PRD across durations for the upgrades (Table 6, Panel C), while for the downgrades (Table 6, Panel D), there is evidence in the lowest decile only for the 20-day duration.

By contrast, in the pre-period *Event-time sample*, significant drift is broadly apparent up and down the *Volume*

[7] The propensity score matching test is common in financial settings, including underreaction events, where selection bias is a concern. Lee and Wahal (2004) look at initial public offering (IPO) underpricing and venture capital reputation; Drucker and Puri (2005) examine seasoned equity offerings (SEOs) by the firm's lending bank; Lee and Masulis (2009) look at underwriter and venture capitalist reputations and the firm's earnings management. For further discussion of the tests, see Heckman (1979), Heckman and Robb (1986), Heckman, Ichimura, and Todd (1997, 1998), and Roberts and Whited (2012).

Table 5

Matched-earnings sample propensity score tests.

Panel A reports means for the 12 control variables for the upward and downward recommendations, and their matched continuations. Panel B reports average PRD for *UP*, *UPmatch*, and their difference (*DOWN*, *DOWNmatch*, and their difference), for the post-period and the pre-period. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Panel A: Means for the 12 control variables

Variable	Post-period, *N*=36,963				Pre-period, *N*=18,793			
	MM drift		*DGTW* drift		*MM* drift		*DGTW* drift	
	UP	*UP match*	*DOWN*	*DOWN match*	*UP*	*UP match*	*DOWN*	*DOWN match*
Retp	0.486	0.479	0.467	0.468	0.532	0.548	0.465	0.462
Ret2p	0.517	0.515	0.460	0.445	0.518	0.530	0.495	0.511
Turn	0.378	0.382	0.386	0.393	0.358	0.351	0.370	0.359
Size	0.343	0.332	0.367	0.371	0.283	0.290	0.323	0.329
Frev	0.501	0.509	0.472	0.469	0.488	0.495	0.464	0.491
LTG	0.537	0.540	0.502	0.506	0.457	0.447	0.425	0.418
SUE	0.517	0.510	0.462	0.472	0.498	0.499	0.450	0.461
SG	0.551	0.547	0.517	0.509	0.504	0.502	0.466	0.442
TA	0.539	0.527	0.493	0.481	0.548	0.556	0.477	0.487
Capex	0.493	0.499	0.452	0.454	0.458	0.467	0.478	0.475
BP	0.462	0.446	0.489	0.504	0.381	0.381	0.393	0.396
EP	0.489	0.502	0.545	0.539	0.442	0.441	0.465	0.455

Panel B: Mean PRD

Variable	Post-period, *N*=36,963						Pre-period, *N*=18,793					
	MM drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	1 Month	3 Months	6 Months	1 Month	3 Months	6 Months	1 Month	3 Months	6 Months	1 Month	3 Months	6 Months
UP	0.359**	1.026***	1.851***	−0.036	−0.340	−0.985**	2.261***	4.104***	6.648***	1.563***	2.232***	2.917***
UP match	0.169	0.883***	2.547***	−0.219	−0.635**	−0.529	1.901***	2.587***	5.350***	1.399***	0.799	2.151***
UP differ	0.191	0.144	−0.697	0.183	0.295	−0.456	0.360	1.517*	1.298	0.164	1.432*	0.766
DOWN	0.593	1.324	2.660	0.161	−0.132	−0.019	0.805***	0.998*	3.922***	0.090	−1.016**	−0.343
DOWN match	0.687	1.122	2.159	0.308	−0.414	−0.707	1.708***	1.210**	3.009***	1.176***	−0.487	−0.439
DOWN differ	−0.093	0.202	0.501	−0.147	0.282	0.688	−0.904***	−0.212	0.913	−1.086***	−0.529	0.097

Table 6

Event-time, Portfolio, and *Earnings samples,* drift regressions within *Volume* deciles.

The *Event-time sample* in Panel A, reported are the coefficient estimates for the recommendation upgrade, *UP*, from multivariate drift regressions that include 12 other control variables. The dependent variable is drift of 20, 60, and 120 trading days, measured using the *MM* and the *DGTW* methods, winsorized. For the *Portfolio sample* in Panel B, reported are the intercept estimates, from multivariate drift regressions that include factors from the four-factor model. The dependent variable is abnormal return drift of 60 trading days, measured using the four-factor model. Buy, Sell, and Buy-less-sell denote the upgrade and downgrade portfolios, and their difference. For the *Earnings sample* in Panels C and D, coefficient estimates for a recommendation upgrade (downgrade), *UP* (*DOWN*), from multivariate drift regressions that include the 12 control variables. The dependent variable is abnormal return drift for 1, 3, 6 months, using the *MM* and the *DGTW* methods. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Panel A: Event-time sample

Volume	Post-period, *N*=23,790						Pre-period, N=12,672					
decile	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Lowest	1.394***	2.172***	3.116***	1.622***	2.280***	3.329***	3.362**	6.357***	7.607***	3.141***	6.505***	8.877***
2	0.302	0.836	0.712	0.341	0.333	−0.104	1.493**	0.900	0.675	1.978***	1.036	0.624
3	0.042	−0.248	−0.258	0.114	−0.147	0.280	1.267*	0.907	0.563	1.175*	1.217	2.106
4	−0.541	−1.135	−1.304	−0.508	−1.000	−1.071	1.890***	2.472**	2.541	2.155***	2.877**	3.289*
5	−0.294	−0.763	−1.542	−0.469	−1.200*	−1.423	2.027***	4.078***	1.768	2.034***	3.321***	2.626
6	0.438	0.385	−0.459	0.404	0.431	0.190	0.468	1.023	−0.017	0.442	0.727	0.553
7	0.652*	0.623	−0.522	0.585*	0.540	−0.290	2.732***	1.601	−0.445	2.572***	1.581	−0.190
8	0.277	0.851	0.509	0.370	0.975	1.357	0.928	1.169	−1.671	1.002	2.353**	0.466
9	0.384	−0.437	−0.979	0.192	−0.365	−0.715	1.773**	2.850**	−0.085	1.996***	3.024**	0.795
Highest	0.212	−0.206	−1.094	0.120	−0.038	−0.680	−0.423	−1.231	1.484	−0.691	−1.411	1.800

Panel B: Portfolio sample

Volume	Post-period			Pre-period		
decile	Buy	Sell	Buy-less-sell	Buy	Sell	Buy-less-sell
Lowest	0.013	−0.025*	0.007	0.058***	−0.045**	0.046***
2	0.012	−0.009	0.006	0.038*	0.027	0.026***
3	0.005	0.005	0.000	0.020	−0.010	0.007
4	0.004	0.013	−0.002	0.052**	0.008	0.041***
5	0.001	0.013	−0.004	0.054***	0.002	0.043***
6	0.033**	0.016	0.028***	0.009	−0.025	−0.002
7	0.016	0.004	0.011	0.039*	0.010	0.028***
8	0.024*	0.014	0.018***	0.041*	0.027	0.030***
9	0.008	0.013	0.003	0.127***	0.045	0.116***
Highest	0.009	0.013	0.003	0.075**	0.080***	0.063***

Volume	Post-period, N=36,963						Pre-period, N=18,793					
decile	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Panel C: Earnings sample, UP												
Lowest	0.606	0.792	0.386	0.673	0.443	0.250	2.205	3.805*	8.830**	2.621*	3.918*	8.222*
2	0.747	−2.288	−1.048	0.191	−2.516*	−0.256	2.678**	6.117**	3.476	2.034	6.814***	5.310
3	−0.048	0.886	2.189	0.169	1.261	3.270	−0.676	3.599	4.063	0.085	4.973**	4.651
4	−0.169	0.612	2.957	−0.322	−0.180	2.192	2.390**	1.219	3.680	2.310**	0.646	3.058

5	−0.007	−0.698	−0.199	0.260	−0.174	0.082	3.521***	6.235***	4.048	2.241**	5.305***	3.199
6	−0.388	−0.374	−2.262	−0.219	−0.030	−2.115	0.672	1.841	3.313	0.579	1.840	3.072
7	−0.843	−0.339	−1.387	−0.750	0.070	−1.055	0.622	2.008	2.698	1.294	2.438	2.024
8	−0.206	−1.511*	−3.387**	−0.478	−1.375	−2.780**	−0.150	0.822	1.430	−0.170	0.429	1.743
9	0.015	0.415	−0.026	0.197	0.424	−0.326	0.127	−2.078	−4.777**	−0.252	−2.241*	−5.070***
Highest	0.309	0.541	−0.027	0.290	0.751	0.511	0.438	3.707***	6.955***	0.086	2.565**	5.571***
Panel D: Earnings sample, DOWN												
Lowest	−1.280*	−0.655	−3.913	−1.855**	−0.746	−3.159	−1.531*	−5.421***	−7.362**	−0.670	−4.249*	−4.704*
2	−0.466	−0.678	−1.728	−0.448	0.013	0.312	0.463	−0.523	−2.194	−0.345	−2.158	−4.375
3	0.041	0.198	−2.690	−0.250	0.531	−1.213	−0.301	−2.805	−1.438	−0.822	−2.843	−1.623
4	−0.102	−0.816	−0.142	−0.135	−0.425	1.681	−0.624	−1.233	2.137	−0.138	−1.843	0.641
5	0.760	1.143	1.304	0.615	1.209	2.088	−1.173	−2.709	−1.395	−1.280	−2.201	−1.581
6	1.099**	−0.025	−0.906	1.124**	0.021	−0.509	−1.326	−1.235	−4.599*	−1.161	−0.741	−2.684
7	−0.332	−0.704	0.956	−0.212	−0.127	1.636	−1.820*	−3.836**	−1.714	−1.149	−2.848*	−1.486
8	0.137	−0.206	−2.566***	0.137	−0.080	−1.844	−1.927**	−1.608	−0.872	−1.909**	−2.036	−1.545
9	0.065	−0.410	−0.092	−0.037	−1.075	−1.033	0.457	0.235	0.865	−0.156	−0.715	−0.948
Highest	−0.028	0.190	−0.186	0.276	0.421	0.301	0.139	2.815**	7.393***	−0.475	1.870	5.249***

deciles. For example, in seven of the 20-day deciles, for both *MM* and *DGTW*, PRD is noticeably strong statistically in the lowest deciles across all three durations and both drift measures (Table 6, Panel A). Under the transaction costs thesis, this pattern of significant average PRD over most deciles would suggest relatively high transaction costs range across far more revisions in the pre-period. In the *Portfolio sample* deciles, PRD is significant in eight Buy deciles, two Sell deciles, and eight Buy-less-sell deciles (Table 6, Panel B). In the *Earnings sample*, PRD is present in three deciles for most durations, while no obvious cluster pattern is present. For upgrades, PRD is evident in the lowest decile across the two estimation methods (Table 6, Panel C). The evidence is mixed in higher *Volume* deciles; in some cases it is statistically significant, but in one of those cases there is a wrong sign for the underreaction view (Table 6, Panel D).

4.2. Firm size

Firm size is also a relevant characteristic of trading costs, which are likely to be high for smaller firms. For example, Hendershott, Jones, and Menkveld (2011) find that while quoted and effective bid-ask spreads are significantly narrower in the supercomputer era, that outcome is weakest for the small firms.

In post-period sorts by *Firm size*, measured by the logarithm of equity size at the fourth quarter-end of the last fiscal year, the *UP* coefficient in the *Event-time sample* is distinctly statistically significant in the lowest decile, for each duration and both estimation methods (Table 7, Panel A). Lowest decile impacts are also present in the *Portfolio sample* for the Buy and Buy-less-Sell portfolios, but not for the Sell portfolio (Table 7, Panel B). In the *Earnings sample*, the PRD evidence is weaker; the *UP* coefficient is not significant in the lowest decile for any asset pricing model and any duration, and the *DOWN* coefficient in the lowest decile is significant at the 5% level for the 20-day duration (Table 7, Panels C and D).

In the pre-period *Event-time sample,* PRD is present in several firm size deciles, including the lowest (Table 7, Panel A). In the *Portfolio sample*, PRD is apparent in the lower three Buy portfolio deciles (Table 7, Panel B), which is enough to make the Buy-less-sell portfolio drift significant. The Sell portfolio drift, however, shows little economic significance. In the *Earnings sample*, PRD is significant in some mid-level deciles for the upgrades, but not in the lowest or in the highest deciles. For the downgrades, PRD is significant for most durations in the lowest decile, and in a few other deciles up and down the firm size chain.

4.3. Analyst coverage

Average PRD is next examined in deciles after sorting by *Coverage*, the number of recommendations issued for the firm over the prior calendar year. Studies suggest that analysts' coverage could impact the firm's trading costs. For example, Kelly and Ljungqvist (2012) report that coverage reduces information asymmetry, thereby lowering the bid-ask spread. Chen, Harford, and Lin (2015) report coverage

Table 7

Event-time, Portfolio, and *Earnings samples*, drift regressions within *Firm size* deciles.

The *Event-time sample* in Panel A, reported are the coefficient estimates for the recommendation upgrade, *UP*, from multivariate drift regressions that include 12 other control variables. The dependent variable is drift of 20, 60, and 120 trading days, measured using the *MM* and the *DGTW* methods, winsorized. For the *Portfolio sample* in Panel B, reported are the intercept estimates, from multivariate drift regressions that include factors from the four-factor model. The dependent variable is abnormal return drift of 60 trading days, measured using the four-factor model. Buy, Sell, and Buy-less-sell denote the upgrade and downgrade portfolios, and their difference. For the *Earnings sample* in Panels C and D, coefficient estimates for a recommendation upgrade (downgrade), *UP* (*DOWN*), from multivariate drift regressions that include the 12 control variables. The dependent variable is abnormal return drift for 1, 3, 6 months, using the *MM* and the *DGTW* methods. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Panel A: Event-time sample

Firm size	Post-period, *N*=23,790						Pre-period, *N*=12,672					
decile	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Lowest	1.838***	2.346***	2.572*	1.903***	2.474***	3.013***	2.898***	5.102***	6.513***	2.636***	5.321***	7.366***
2	0.404	0.115	0.195	0.198	−0.425	−0.483	2.126***	3.235**	3.816*	2.345***	3.141**	4.775**
3	0.441	0.386	−0.897	0.251	0.128	−0.617	1.189	2.552*	0.880	0.940	2.169	1.136
4	−0.350	−0.127	−0.438	−0.207	−0.315	−0.317	1.057***	1.815	0.403	1.212*	1.224	0.774
5	−0.159	−0.153	−0.748	−0.155	−0.123	−0.503	2.083***	1.563	1.615	2.049***	3.019***	4.263***
6	−0.237	−0.738	−1.430	−0.194	−0.766	−0.890	1.914	1.455	0.035	2.098***	1.485	0.606
7	−0.364	−0.943	−1.800**	−0.357	−0.777	−1.081	1.132***	1.416	−0.249	1.027	1.381	0.259
8	0.674**	1.133**	0.633	0.700**	1.073**	0.854	1.987***	2.451**	1.741	2.304***	3.143***	2.958*
9	0.629**	0.410	0.784	0.714***	0.811	1.559**	1.549	0.436	−0.728	1.417**	0.009	−0.825
Highest	−0.055	−0.423	−0.380	−0.163	−0.431	−0.575	−0.327	0.789	−0.023	−0.269	0.920	1.194

Panel B: Portfolio sample

Firm size	Post-period			Pre-period		
decile	Buy	Sell	Buy-less-sell	Buy	Sell	Buy-less-sell
Lowest	0.032*	−0.013	0.026***	0.064***	−0.023	0.051***
2	0.011	0.008	0.006	0.068***	0.021	0.053***
3	−0.002	−0.002	−0.007	0.066***	0.014	0.052***
4	−0.006	0.000	−0.012**	0.043*	0.024	0.030***
5	0.002	0.002	−0.003	0.060***	0.016	0.047***
6	0.017	0.023*	0.011**	0.034	0.005	0.022**
7	−0.001	0.009	−0.006	0.042*	0.015	0.031***
8	0.029***	0.009	0.024***	0.076***	0.025	0.064***
9	0.017*	0.010	0.012**	0.031	−0.001	0.019**
Highest	0.001	0.007	−0.004	0.023	0.038*	0.011

Firm size	Post-period, N = 36,963						Pre-period, N = 18,793					
decile	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Panel C: Earnings sample, UP												
Lowest	0.307	2.953	4.135	0.757	2.854	4.532	−0.632	3.380	−0.354	0.373	5.578	−1.499
2	0.146	−1.533	0.633	0.044	−1.455	0.487	2.698	4.775	6.478	2.714*	6.216**	6.657

3	0.831	−1.618	−2.934	0.558	−1.499	−2.390	−0.350	0.840	−0.346	−0.060	1.707	1.057
4	0.561	0.930	1.595	0.307	0.186	1.243	1.878	4.322	7.183**	1.280	3.650*	6.323**
5	0.830	−0.327	−1.259	0.872	−0.051	−0.931	3.194***	5.503***	11.721***	2.339**	4.583***	9.713
6	−0.870	−1.967**	−4.487***	−0.390	−1.438	−3.964***	1.912**	2.305	2.634	2.156**	2.069	2.219
7	−0.904**	−0.950	−2.299*	−0.659	0.014	−1.060	−0.287	0.282	−1.161	−0.255	0.439	−0.591
8	−0.348	0.377	−0.120	−0.512	0.089	−0.467	1.155	1.588	2.524	0.753	0.527	2.362
9	−0.085	0.489	0.119	−0.232	0.536	0.245	0.362	2.036	2.293	0.307	1.787	1.709
Highest	0.091	0.595	0.767	0.045	0.649	1.110	0.180	0.935	1.277	−0.007	0.396	0.193
Panel D: Earnings sample, DOWN												
Lowest	−2.336**	−2.476	−4.583	−2.567*	−2.652	−2.848	−2.089	−6.878**	−9.234*	−2.910*	−6.793**	−6.961
2	−0.756	−1.979	−3.993	−0.228	−0.004	−0.623	0.961	−5.863*	−3.834	1.243	−5.828**	−2.389
3	−1.090	1.708	2.743	−1.158*	1.929	3.7	−3.012**	−3.134	−4.155	−2.852**	−2.134	−1.816
4	0.343	0.630	−0.204	0.224	0.540	1.173	−2.680**	−0.147	5.324*	−2.260**	0.265	3.493
5	1.128**	−0.786	−0.940	0.641	−0.617	−0.161	0.362	−3.072*	−1.939	0.563	−2.420	−1.890
6	0.921*	0.671	0.524	1.006**	0.624	0.759	−0.585	−0.142	0.468	−0.410	0.259	1.269
7	0.462	−1.001	−2.162	0.335	−0.676	−1.328	−1.001	−2.243	−4.969**	−1.046	−2.786*	−5.019**
8	0.505	0.791	−0.852	0.589	0.671	−0.959	−0.170	0.204	3.539*	−0.480	−0.208	2.365
9	0.023	−1.013	−1.789	0.098	−1.361*	−2.412**	0.557	0.783	3.898**	0.011	−0.276	0.475
Highest	−0.331	0.110	0.888	−0.178	0.153	1.302	−0.020	1.297	2.234	−0.529	0.757	1.263

increases monitoring of managers, reducing agency costs that also could impact trading costs.

In the post-period *Event-time sample*, there is again a distinct pattern of significant PRD in the lowest coverage decile, for both estimation methods and all three durations (Table 8, Panel A). In the other deciles, PRD is not significantly greater than zero, for both drift measures and all durations. The *Portfolio sample* again shows asymmetric evidence of PRD in the lowest Buy decile. The results are significant for the Buy portfolio at the 5% level, insignificant in the lowest Sell portfolio decile, and significant in the lowest Buy-less-sell portfolio decile. For the *Earnings sample,* 20-day drift is significant for the upgrades for both measures, but not for the longer durations (Table 8, Panel C). PRD also has a weaker presence in the lowest decile for the downgrades (Table 8, Panel D).

The pre-period PRD is significant in many of the bottom five *Coverage* deciles and in other higher deciles in the *Event-time sample* (Table 8, Panel A). It is also evident in the *Portfolio sample* across the Buy deciles, and the Buy-less-sell deciles (Table 8, Panel B). The *Earnings sample* similarly shows significant drift across the lower two deciles for the upgrades and the downgrades, though not widely across the lowest decile. Otherwise, some deciles show significant PRD in the direction of the revision, at varying levels of significance with no basic pattern (Table 8, Panels C and D).

4.4. VCS revisions

To further identify the nature of the revisions associated with the post-period PRD in some of the above sorts, the revisions in the lowest decile in sorts of each of the three characteristics are examined to determine how well these revisions account for the average PRD in the lowest respective decile in the sorts of the two other characteristics.

For the post-period *Event-time sample*, removing the lowest *Volume* decile revisions eliminates significant PRD in the lowest decile for both *Firm size* and *Coverage* (Table 9, Panel A). Removing the lowest *Firm size* decile revisions makes PRD in the lowest *Volume* decile insignificant for all three durations, and eliminates PRD in many but not all *Coverage* deciles (i.e., not 20-day) where significant drift remains at the 5% level (Table 9, Panel B). Dropping the lowest *Coverage* decile revisions also wipes out significant PRD in the lowest *Volume* and *Firm size* deciles (Table 9, Panel C).

This one-by-one comparison of the individual characteristics shows the lowest *Volume* decile revisions appear to account more effectively for the PRD: There is greater comparative loss of statistical significance of the remaining drift for the other two characteristics. Also, the removal of the lowest *Volume* decile revisions pushes down the remaining average drift in the other lower deciles more than does the removal of *Firm size* or *Coverage* (Table 9, Panels A-C).

However, it is unlikely that all of the small sample post-period PRD can be credited to just one of the three characteristics. To further identify this PRD, the influence of the revisions that are common in each of the lowest deciles in separate sorts of each characteristic is examined (*Volume*,

Table 8

Event-time, Portfolio, and *Earnings samples*, drift regressions within analyst *Coverage* deciles.

The *Event-time sample* in Panel A, reported are the coefficient estimates for the recommendation upgrade, *UP*, from multivariate drift regressions that include 12 other control variables. The dependent variable is drift of 20, 60, and 120 trading days, measured using the *MM* and the *DGTW* methods, winsorized. For the *Portfolio sample* in Panel B, reported are the intercept estimates, from multivariate drift regressions that include factors from the four-factor model. The dependent variable is abnormal return drift of 20, 60, and 120 trading days, using the *MM* and the *DGTW* methods, winsorized. Buy, Sell, and Buy-less-sell denote the upgrade and downgrade portfolios, and their difference. For the *Earnings sample* in Panels C and D, coefficient estimates for a recommendation upgrade (downgrade), *UP* (*DOWN*), from multivariate drift regressions that include the 12 control variables. The dependent variable is abnormal return drift for 1, 3, 6 months, using the *MM* and the *DGTW* methods. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Panel A: Event-time sample

Coverage	Post-period, *N*=23,790						Pre-period, *N*=12,672					
decile	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Lowest	1.814***	1.983***	2.161*	1.968***	2.065***	2.455**	2.984***	3.912***	5.086**	3.137***	4.350***	6.882***
2	0.099	−0.205	0.007	0.233	−0.225	0.184	2.624***	4.877***	6.487***	2.564***	4.428***	4.915***
3	0.186	−0.099	−0.478	0.195	−0.217	−0.363	1.744**	2.846**	1.747	1.898***	2.907***	2.238
4	−0.094	0.335	−0.480	0.116	0.354	−0.143	1.464*	0.764	−1.649	1.546**	0.966	0.155
5	−0.081	0.705	−0.245	−0.072	0.499	−0.582	1.641**	3.197***	1.290	1.479**	2.932***	1.902
6	0.034	−0.640	−2.095**	−0.026	−0.715	−1.505	0.599	2.414**	0.922	0.830	2.673**	2.203
7	0.472	0.285	0.233	0.228	0.026	0.440	0.846	−1.059	−0.594	0.874	−0.117	1.444
8	0.361	0.547	0.707	0.281	0.659	1.299	0.719	0.045	−3.804**	0.853	0.139	−2.757*
9	0.319	−0.251	−0.628	−0.009	−0.349	−0.108	1.006	0.395	−1.464	0.921	0.588	−0.267
Highest	−0.382	−0.634	−1.167	−0.257	−0.388	−0.986	1.673**	2.848**	4.999***	1.440	2.587**	4.359**

Panel B: Portfolio sample

Coverage	Post-period			Pre-period		
decile	Buy	Sell	Buy-less-sell	Buy	Sell	Buy-less-sell
Lowest	0.026**	−0.007	0.021***	0.050**	0.010	0.036***
2	−0.001	0.001	−0.006	0.046**	−0.031	0.031***
3	0.009	0.003	0.003	0.035	−0.024	0.022**
4	0.003	−0.005	−0.002	0.034	0.028	0.020**
5	0.005	−0.004	−0.001	0.060***	−0.014	0.047***
6	0.006	0.012	0.001	0.053**	−0.009	0.040***
7	0.016	0.021*	0.010**	0.019	0.031	0.003
8	0.031**	0.013	0.026***	0.032	0.032	0.019*
9	0.014	0.017	0.002	0.072**	0.064***	0.059***
Highest	−0.006	0.003	−0.011**	0.094***	0.050*	0.081***

	Post-period, *N*=36,963						Pre-period, *N*=18,793					
Coverage	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
decile	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Panel C: Earnings sample, UP												
Lowest	3.228***	2.262	4.707	2.733***	1.851	4.558	−0.679	5.122	9.153	0.187	6.363*	11.128***
2	−0.151	−1.562	0.498	−0.326	−2.016	0.012	3.698**	10.598***	15.919***	2.099	7.144***	11.242
3	0.142	0.047	−1.202	0.407	0.560	−0.653	2.890*	2.641	4.945	2.329	3.343	6.087
4	−0.436	−2.420**	−1.883	−0.389	−1.437	−0.382	0.594	−0.239	0.000	1.396	1.395	0.499
5	−0.374	−0.203	0.083	−0.013	0.171	0.602	2.588**	6.015***	5.311*	2.403**	5.596***	3.879
6	−0.484	0.092	−2.246	−0.285	0.065	−1.406	0.617	1.176	−3.608	1.494	2.209	−3.092
7	−0.183	0.328	1.076	−0.203	0.708	1.641	1.055	1.829	1.336	1.349	1.963	2.068
8	0.036	0.674	−0.144	−0.178	0.263	−0.618	−0.194	−1.555	2.702	−0.950	−2.184	1.553
9	−0.317	−0.338	−1.043	−0.284	−0.480	−1.428	0.028	2.092	2.384	−0.511	0.556	0.754
Highest	0.077	−0.139	−1.517	0.004	0.126	−1.038	0.497	1.597	0.545	0.490	1.746	0.909
Panel D: Earnings sample, DOWN												
Lowest	−1.335	0.448	0.779	−1.311	1.654	2.701	−2.175	−4.600	−8.966*	−2.460	−4.968*	−8.080*
2	−1.911***	−2.556*	−1.456	−2.344***	−2.718**	−1.019	−2.349*	−2.682	−2.122	−2.091	−2.846	−3.766
3	1.563**	0.668	−1.300	1.561**	1.114	0.065	−1.626	−6.415***	−3.057	−1.703	−6.960***	−4.437
4	0.596	0.936	1.791	0.694	1.583	3.597**	−1.670	0.064	−1.994	−2.085*	0.285	0.497
5	0.092	−0.436	−0.066	0.129	0.180	0.608	−0.765	−4.404**	−4.928	−0.993	−3.681*	−3.394
6	0.363	1.075	−0.016	0.258	0.729	0.373	−0.385	−1.006	1.652	0.213	−0.376	1.879
7	0.611	0.278	−0.101	0.671	0.284	0.467	−1.726**	−1.723	−3.381	−0.968	−0.476	−3.324
8	−0.013	−0.836	−1.754	−0.048	−1.120	−1.387	1.040	−0.424	2.710	0.578	−0.758	2.513
9	−0.226	−0.170	−1.139	−0.041	0.358	−0.390	−0.839	−0.862	−0.057	−1.833***	−2.764**	−2.314
Highest	0.064	−0.587	−1.436	0.047	−0.903	−1.466	0.082	1.546	3.835**	0.061	1.261	2.006

Table 9
Event-time sample variation in mean drift regression estimates after conditioning on lowest decile characteristics in sorts by *Volume*, *Firm size*, and *Coverage*. Reported is the *UP* coefficient estimates from multivariate drift regressions, for only the lowest deciles, sorted respectively by *Volume*, *Firm size*, and *Coverage*, for the post-period and pre-period. The dependent variable is abnormal return drift of 20, 60, and 120 trading days, using the *MM* and the *DGTW* methods, winsorized. Panel A (B, C) reports the *UP* coefficients in the respective lowest deciles, after removing observations in the lowest *Volume* (*Firm size*, *Coverage*) decile. Panel D reports for the *UP* coefficients for observations common to all three of the lowest deciles in the *Volume*, *Firm size*, and *Coverage* sorts. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 with maximum observations of 1,338) (1997 through April 30, 2003 with maximum observations of 8,73). *** (**. *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Variable	Post-period						Pre-period					
	MM drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Panel A: Observations in the lowest Volume decile removed												
Firm size	1.733*	0.483	0.793*	1.374	−0.088	0.874	1.338	2.537	2.187	1.571	3.018	3.897
Coverage	1.021*	0.575	0.094	1.120*	0.421	−0.070	2.091	−0.180	2.230	2.630**	0.528	3.555
Panel B: Observations in the lowest Firm size decile removed												
Volume	0.766	0.208	1.812	0.753	−0.450	1.309	2.452***	5.034***	4.883**	2.708***	5.406***	7.252**
Coverage	1.058*	1.066	1.501	1.089**	0.668	1.254	2.908***	1.975	1.999	3.348***	2.359	3.425
Panel C: Observations in the lowest Coverage decile removed												
Volume	0.012	0.913	1.907	0.260	0.766	1.535	3.153**	5.191***	6.852***	2.904***	5.428***	7.243***
Firm size	1.139	1.680	2.302	1.039	1.405	2.453	2.402**	4.070*	3.480	2.012*	3.928**	3.038
Panel D: Observations common to Volume, Firm size, and Coverage lowest deciles removed												
Volume	0.486	1.132	2.351	0.573	0.685	1.827	3.195***	5.459***	6.543***	3.043***	5.522***	7.683***
Firm size	1.218*	1.472	1.735	1.048*	1.062	1.623	2.247**	3.750**	5.150*	2.042**	3.800**	5.535**
Coverage	1.177*	0.886	0.944	1.134*	0.395	0.526	2.592***	1.936	3.246	2.981***	2.331	5.041**

Size, and *Coverage*; hereafter *VSC revisions*). *VSC revisions* are a small sample, making up 3% of all revisions.

Removing the *VSC revisions* from the sample eliminates significant PRD in the lowest *Volume* decile and in the lowest *Firm size* decile (Table 9, Panel D).

Under the transaction cost rationale for the PRD persistence, the *VSC revision* should have characteristics that are associated with high transaction costs. The *VSC revision* stocks are far less liquid, as the average *non-VSC revision* firm size is over 50 times larger in average market value of equity, and 22 times larger in terms of shares outstanding (Table 10, Panel A). The *VSC revision* firms have lower average stock price; their post-period mean price of $15.70 is less than half of the post-period mean price of $33.40 for the *non-VSC revision* firms. Furthermore, twice as many *VSC revision* firms are Nasdaq-listed than *non-VSC revision* firms. Angel, Harris, and Spatt (2012) note median quoted bid-ask spreads are larger in the supercomputer era for Nasdaq-listed firms than for NYSE-listed firms. Also, average coverage for the typical *VSC revision* firm is very low, at 1.75 analysts, versus 10.3 for the typical *non-VSC revision* firm. Also, the *VSC revisions'* subsample is small, consisting of only 3% of all revisions.

The low analyst interest in these firms could mean they expect to find little information with enough value to cover transaction costs, even though the average PRD is high relative to all firms. The characteristics also point to possible asset-pricing concerns. For example, the *VSC revision* characteristics include being among the smallest of firms, which have well-known asset pricing issues (see Banz, 1981; Fama and French, 1992; Fama, 1998).

The general evaluation for the post-period based on Tables 6–10 is that PRD, on average, does not play an important role. Across the three characteristics of *Volume, Firm size*, and *Coverage* in all three samples (Tables 6–8), excluding the lowest decile, average PRD is insignificant in the other bottom five deciles for all three durations for both the *MM* and *DGTW* measures. The lowest decile evidence is mixed: in the *Event-time sample* average PRD is significant for all durations and both drift measures. However, in the *Portfolio sample* average PRD in the lowest decile is inconsistent, and in the *Earnings sample* it is insignificant except for *DOWN* in the 20-day duration decile. In the higher deciles for each of the characteristics, average PRD is rarely statistically significant, and at times is significant but in the opposite direction anticipated by the underreaction and informed analyst hypotheses. Further study of the *VSC revisions* that are common to lowest deciles for each of the three characteristics (Tables 9 and 10), support the understanding that their average PRD is largely accounted for by small samples of 10% and 3% of the revisions that have characteristics that typify higher transaction costs. The results further show that this significant average PRD tends to be limited to the *Event-time sample*, as it is not common in the *Portfolio* and *Earnings samples*. One interpretation is that, in the supercomputer era, much of the PRD has been driven away by arbitrageurs.

In contrast, in reviewing the pre-period findings, average PRD is significant across many of the lowest five deciles and across all three holding period durations in the *Event-time sample*, for both the Buy and the Buy-less-sell portfolios in the *Portfolio sample*, as well as almost half the cases for the *Earnings sample*. Significant average PRD is present in many higher deciles, for all durations in the three samples. This shows the economic magnitude of the average PRD is greater in the pre-period than in the post-period. One

Table 10
Event-time sample mean (median) statistics for selected characteristics for *VSC revisions*.
Reported are revisions in the lowest deciles across three respective sorts of firm *Volume*, *Firm size*, and *Coverage*, and the remaining *Non-VSC* revisions. Samples, characteristics, and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003).

Variable	All	*VSC revisions*	*Non-VSC revisions*
Panel A: Post-period			
Volume (MM)	2,951.9 (889.1)	58.5 (38.2)	3,046.9 (943.0)
Firm size ($MM)	$10.5 ($2.4)	$0.2 ($0.2)	$10.8 ($2.6)
Shares outstanding	324.7	14.1	334.9
Stock price	$32.8 ($28.4)	$15.7 ($13.8)	$33.4 ($29.0)
Nasdaq-listed (%)	40.4%	80.4%	39.0%
Recommendations	23,790	756, or 3%	23,034, or 97%
Coverage	10.1 (8.9)	1.7 (1.6)	10.3 (9.2)
Turnover	2.5 (2.0)	1.1 (0.8)	2.6 (2.1)
Firms	1,222	231	1,138
Panel B: Pre-period			
Volume (MM)	1,518.2 (404.2)	24.8 (20.7)	1,564.7 (431.4)
Firm size ($MM)	$10.3 ($1.8)	$0.1 ($0.1)	$10.6 ($2.5)
Shares outstanding	234.4	9.8	241.4
Stock price	$34.0 ($19.3)	$14.4 ($13.8)	$34.6 ($29.8)
Nasdaq-listed (%)	36.6%	69.7%	35.6%
Recommendations	12,672	383, or 3%	12,289, or 97%
Coverage	8.1 (.0)	1.4 (1.3)	8.3 (7.2)
Turnover	1.9 (1.2)	0.8 (0.5)	1.9 (1.2)
Firms	987	169	921

interpretation is that high transaction costs are common across a range of revisions.

5. Are underreaction and informed analysts associated with significant PRD?

Although many findings in the post-period show that significant long-run drift is less common after revisions, except for the small sub-ample of high transaction costs stocks, the evidence still may not be enough to rule out that stock prices underreact to analysts' new information. In particular, underreaction could create drift in subsamples of the PRD cross-section. Subsamples could also contain evidence of analysts' ability to identify new information for the long-run. This section reports results from further testing for significant investor underreaction and better-informed analysts.

5.1. Underreaction tests

The underreaction hypothesis tests of the PRD cross-section use two proxies for investor underreaction that have been suggested in the literature: share turnover and analyst coverage.

5.1.1. Share turnover

Studies suggest stock prices tend to react more slowly to new information for low turnover stocks (i.e., those with low fractions of shares traded), as their investors are inclined to pay less attention to the stocks, all else the same. Thus, when new information about these firms is made public, that information is incorporated in the stock price more slowly, resulting in underreaction to the news, ceteris paribus. For example, Bhushan (1989) reports that when a firm announces earnings, there is greater underreaction over time to both good and bad earnings news for the stocks with lower turnover, hence greater PEAD in absolute value (see also Barber and Odean, 2008; Loh, 2010). Given this underreaction behavior, when revisions release analysts' new information, greater average underreaction is expected for the lowest turnover stocks, ceteris paribus. Upgrades will be associated with more positive drift and downgrades with more negative drift, in the respective lowest turnover deciles. Turnover does not predict PRD should be found in higher deciles, where investor reaction to new information is expected to be swift. Test results are reported for the *Event-time*, *Portfolio*, and *Earnings samples*.

In the post-period *Event-time sample*, PRD is statistically significantly positive and large for firms in the lowest turnover decile for all three durations, and for 20-day PRD in the second lowest decile, for both the *MM* and the *DGTW* drift measures (Table 11, Panel A). Farther up the turnover decile chain, irregular drift is present in a few deciles – sometimes significantly large positive, sometimes significantly large negative, and mostly neither. After removing the lowest *Volume* revisions from the *Event-time sample*, no significant PRD is present in any turnover decile (Table 11, Panel B). Qualitatively similar results are found when the smaller sample of *VSC revisions* are removed (Table 11, Panel C). The lack of significant PRD after removing these revisions indicates underreaction cannot be widespread. Mixed findings are evident for the *Portfolio sample*: Buy portfolio drift is high and significant in the lowest turnover decile but not for the Sell portfolio. The evidence of underreaction for the Buy-less-sell portfolio is inconsistent and weak. Indications of underreaction are also weak in the *Earnings sample* (Table 11, Panels D and E). For example, in the lowest five *UP*, deciles average PRD is not significant in any of the deciles. Relative to continuations, there is no significant drift in the lowest five *DOWN* deciles, except for the 120-day *MM* PRD measure (Table 11, Panel F).

While some of the lowest turnover cell evidence agrees with the underreaction prediction, the broader pattern from the turnover findings across the samples is not reconciled by underreaction.

In the pre-period *Event-time sample*, significantly large 20-day PRD is common in almost every turnover decile, in a number of lower deciles, and even more in upper deciles, across all three durations (Table 11, Panel A). Thus, there is no standout pattern of significant PRD in the lowest deciles versus others, as expected by significant underreaction alone. Sufficient transaction costs could exist across the deciles that could account for much of the drift. In the *Portfolio sample*, PRD in the lower Buy (Sell) decile portfolios is significantly positive (negative), while the upper three deciles also have significantly positive PRD (Table 11, Panel D). The Buy-less-sell portfolio has significant drift in the lowest and the highest deciles. These irregular patterns are not explained by the underreaction hypothesis. For the *Earnings sample*, there is no evidence of significant PRD in

Table 11

Event-time, Portfolio, and Earnings samples, drift regressions within *Turnover* deciles.

Reported are the coefficient estimates for the recommendation upgrade, *UP*, from multivariate drift regressions that include 12 other control variables. The dependent variable is drift of 20, 60, and 120 trading days, measured using the *MM* and the *DGTW* methods, winsorized. Panel A reports the *UP* coefficients in the post-period and pre-period, and Panel B reports the *UP* coefficients in the post-period after removing all *VSC revisions*. For the *Portfolio sample* in Panel D, reported are the intercept estimates, from multivariate drift regressions that include factors from the four-factor model. The dependent variable is abnormal return drift of 60 trading days, measured using the four-factor model. Buy, Sell, and Buy-less-sell denote the upgrade and downgrade portfolios, and their difference. For the *Earnings sample* in Panels D and E, coefficient estimates for a recommendation upgrade (downgrade), *UP* (*DOWN*), from multivariate drift regressions that include the 12 control variables. The dependent variable is abnormal return drift for 1, 3, 6 months, using the *MM* and the *DGTW* methods. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1,, 2003 through 2010 (1997 through April 30, 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Turnover	Post-period, *N*=23,790						Pre-period, *N*=12,672					
decile	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Panel A: Event-time sample UP coefficient estimates, by turnover decile												
Lowest	1.038***	2.125***	2.961***	0.931***	1.737***	2.442***	2.633***	4.134***	5.333***	3.081***	4.821***	7.156***
2	0.512*	0.639	0.282	0.599*	0.736	0.386	2.535***	1.768	−0.227	2.699***	2.188*	1.304
3	−0.071	0.007	1.454	−0.028	−0.005	1.374	1.131*	1.913*	1.366	1.810***	2.335**	2.634*
4	0.309	−0.048	−0.459	0.448	−0.189	−0.666	1.327*	2.717**	3.121*	1.803***	3.474***	3.939**
5	0.142	0.191	−0.384	0.125	0.121	−0.517	2.216***	0.551	−1.312	2.052***	0.831	0.094
6	−0.425	−0.517	−1.532	−0.193	−0.231	−0.651	1.464**	−0.142	−1.359	1.756**	0.189	−0.372
7	0.357	0.383	−0.520	0.251	0.032	−0.323	2.111**	1.108	2.236	2.055***	1.234	2.831
8	0.053	−1.255	−1.275	−0.135	−1.235	−1.223	2.464***	3.742**	2.175	2.027**	3.468**	2.315
9	0.465	1.526*	1.325	0.470	1.598*	2.269*	0.483	3.902**	−0.994	0.141	2.513	−0.508
Highest	−0.088	−1.525	−3.431**	−0.172	−1.394	−2.292*	0.475	1.986	1.084	0.386	1.379	0.626
Panel B: Event-time sample UP coefficient estimates, by turnover decile, no lowest Volume revisions												
Lowest		0.054		−0.091		0.736		−0.209		−0.751		−0.103
2		0.256		0.542		0.951		0.385		0.573		1.032
3		0.170		−0.315		0.511		0.099		−0.433		0.320
4		0.418		0.200		−0.290		0.509		0.072		−0.524
5		0.125		0.287		−0.449		0.112		0.252		−0.462
6		−0.128		−0.204		−1.622*		0.022		−0.086		−0.824
7		0.262		0.214		−0.116		0.158		−0.096		−0.148
8		−0.404		−1.090		−1.459		−0.528		−0.924		−0.794
9		0.031		0.220		−0.573		0.178		0.459		0.358
Highest		0.360		−0.417		−2.121		0.244		−0.223		−1.151
Panel C: Event-time sample UP coefficient estimates, by turnover decile, no VSC revisions												
Lowest		−0.164		−0.373		0.898		−0.364		−0.798		0.536
2		0.401		0.495		0.701		0.469		0.514		0.901
3		0.138		−0.205		0.539		0.123		−0.412		0.304
4		0.394		−0.376		−1.224		0.496		−0.467		−1.479
5		0.171		0.265		−0.779		0.030		0.150		−0.909
6		−0.301		−0.211		−1.273		−0.119		−0.045		−0.609
7		0.309		0.094		−0.494		0.155		−0.278		−0.545
8		−0.403		−1.101		−1.025		−0.524		−0.993		−0.578
9		0.297		0.541		−0.650		0.406		0.829		0.334
Highest		0.317		−0.208		−2.144		0.174		−0.111		−0.967

Panel D: Portfolio sample

Turnover	Post-period			Pre-period		
decile	Buy	Sell	Buy-less-sell	Buy	Sell	Buy-less-sell
Lowest	0.023**	−0.010	0.011*	0.047***	−0.028	0.031***
2	0.007	−0.016*	0.004	0.032*	−0.034**	0.013
3	0.018	0.012	0.001	0.007	−0.026*	−0.010
4	0.013	0.013	0.009	0.035**	−0.004	0.018*
5	0.020**	0.004	0.015***	0.009	0.008	−0.008
6	0.001	0.009	−0.003	0.021	0.030	0.004
7	0.003	−0.004	−0.001	0.008	0.014	−0.011
8	0.008	0.023**	0.004	0.064**	0.036	0.046***

Table 11 (*continued*)

Panel D: Portfolio sample

Turnover	Post-period			Pre-period		
decile	Buy	Sell	Buy-less-sell	Buy	Sell	Buy-less-sell
9	0.023	0.020	0.002	0.116***	0.050	0.098***
Highest	−0.007	−0.004	−0.011	0.159***	0.137***	0.141***

Turnover	Post-period						Pre-period					
decile	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Panel E: Earnings sample, UP												
Lowest	−0.143	−0.901	−2.569	0.315	0.236	−0.923	0.606	−0.208	4.609	2.053	3.488	11.248
2	0.509	0.059	−0.724	0.389	0.445	0.614	2.050	4.481*	−1.160	2.662	4.973	0.620
3	−0.764	−0.441	−1.571	−0.656	−0.380	−1.354	−0.079	0.383	0.271	−0.292	1.048	1.425
4	−0.296	1.500	0.496	−0.165	1.784	1.394	0.211	2.741	2.461	0.235	2.285	2.156
5	0.273	0.375	0.080	0.297	0.430	−0.068	0.117	−0.880	−0.547	0.851	0.507	1.225
6	−0.226	0.984	1.719	−0.303	1.297	2.041	0.612	3.306*	2.636	0.278	3.130	1.383
7	−0.181	−1.151	−1.642	−0.103	−0.908	−0.902	0.837	1.134	0.049	0.864	1.685	0.126
8	−0.396	−0.484	−0.834	−0.344	−0.228	−0.673	0.986	−1.362	−2.667	0.514	−2.003	−3.321
9	−0.109	−1.534	−3.213	−0.085	−1.504	−2.746	2.410**	4.608**	5.695*	2.603	4.223	5.475
Highest	0.033	−0.987	−1.989	−0.016	−0.850	−1.977	0.145	2.060	7.137*	−0.091	1.241	5.744
Panel F: Earnings sample, DOWN												
Lowest	−0.863	−3.031	−5.530*	−0.404	−1.727	−3.618	−1.464	−4.572*	−7.830*	−0.595	−2.871	−5.850
2	−0.361	−1.721	−0.975	−0.394	−0.991	1.241	−1.143	−2.706	−4.715	−2.154**	−3.099	−5.290
3	−0.752	−0.893	−2.778	−0.549	−0.368	−1.611	−0.497	−1.608	−0.594	−0.551	−1.379	−1.321
4	−0.393	−0.361	−1.649	0.017	0.274	0.017	−1.681	−3.288	1.219	−1.718	−3.466*	0.442
5	−0.098	−1.394	−3.013*	−0.159	−0.532	−1.060	−0.687	−1.559	−3.588	−0.691	−1.253	−3.037
6	0.514	0.458	1.023	0.329	0.392	1.625	−0.167	−0.811	3.118	−0.374	−0.725	2.001
7	0.283	−0.007	1.508	0.367	0.174	1.821	−0.143	−0.656	−2.592	−0.365	−0.425	−2.801
8	1.205**	1.624	1.614	1.029**	1.507	2.096	0.257	−1.482	2.150	−0.551	−2.656	−0.374
9	0.519	0.862	1.220	0.384	0.869	1.763	0.131	0.344	2.218	0.218	−0.346	1.810
Highest	−0.545	−1.345	−3.797**	−0.418	−1.630	−3.961**	−1.938	−1.716	1.410	−1.905	-1.604	0.814

the lowest turnover deciles for the upgrades. Except for the lone case for 120 day, there is also no significant PRD for the lowest decile for downgrades (Table 11, Panels E and F).

5.1.2. Analysts' coverage

A second proxy for underreaction is analysts' coverage of the recommended stock. Authors suggest that when the stock has low coverage, information flows more slowly across investors and moves rapidly for the widely covered stocks. For example, Brennan, Jegadeesh, and Swaminathan (1993) report prices react slower to common information for less covered stocks. Hong, Lim, and Stein (2000) find positive drift when coverage is lower. Zhang (2008) reports greater underreaction by analysts themselves to earnings news for firms that have lower coverage. This understanding therefore predicts that greater drift should be evident for firms with the lowest analyst coverage, all else the same.

As reported earlier (Section 4.3), in the *Event-time sample* post-period significant PRD is present in the lowest *Coverage* decile but not in higher deciles (Table 10). However, the opposite result is found in the *Portfolio sample*, as significant PRD is not present in the lowest four deciles, but is present in two of the highest three deciles. In the *Earnings sample* the lowest decile evidence is weak.

In the pre-period, significant PRD exists in a number of deciles across the three samples, after sorting by *Coverage* (Tables 6–8). However, this evidence is mixed and its irregular patterns do not consistently agree with the hypothesis that underreaction is significant in the lowest decile and not in higher deciles.

5.2. Informed analyst hypothesis

A second test for evidence of underreaction in the PRD cross-section focuses on the nested hypothesis that in the first place requires that analysts possess new information that they will release with their revisions. While a number of results thus far show PRD is not regularly connected with analysts' new information, the hypothesis could still be relevant in subsamples of the PRD cross-section. Further tests therefore focus on the nested informed analyst hypothesis, using four different proxies for better-informed analysts that are reported by researchers.

5.2.1. Extreme revisions

Researchers find that analysts' extreme revisions tend to release more fresh information, on average (Stickel, 1992; Womack, 1996; Boni and Womack, 2006; Green, 2006; Kecskes, Michaely, and Womack, 2013). A revision to strong buy or to strong sell thus signals the typical analyst's strongest endorsement for buying or selling the stock. One test of the informed analyst hypothesis therefore examines the impact of six dichotomous extreme revision variables on the PRD, in the multivariate drift regression: *UPtoSB* for the upgrades to strong buy, *UPtoB* for the upgrades to buy, *UP* for all other upgrades, *DOWNtoS* for those downgrades to sell, and *DOWNtoSS* for the downgrades to strong sell, and *DOWN* for all other downgrades.

In the post-period the extreme revisions are not generally associated with unusual PRD. For the *MM* PRD measures, one of the 18 upgrade dummies (to *UP*) indicates a positive revision impact (significant at the 10% level), and two of the 18 downgrade dummy estimates (both to *DOWN*) show the revision impact is associated with a contradictory positive impact (Table 12, Panel A).

In contrast, in the pre-period a few of the extreme upgrades have statistically significant positive impacts on the drift, which is more evident for the *DGTW* method (Table 12, Panel B). For downgrades the results are weaker, as only two extreme downward revisions have a significantly negative impact and two have a significantly contrary positive impact.

5.2.2. Brokerage reputation

The second proxy for informed analysts is the brokerage firm's reputation in the securities market. Authors report that more prestigious brokerage firm analysts are better-informed (Stickel, 1992; Fang and Yasuda, 2014; Kecskes, Michaely, and Womack, 2013). To the extent that underreaction is triggered by new information released by analysts' revision announcements, underreaction should be more evident in the PRD after revisions by those analysts who are employed at the more reputable brokerage firms than those employed at less reputable brokerages, ceteris paribus. This hypothesis is tested in estimations of the multivariate PRD regression within each reputation decile, after sorting the revisions by brokerage firm reputation, measured by the historical market share of recommendations. To test for a PRD-reputation relationship when there is more than one revision, the reputation used is that of the most reputable brokerage.

For the post-period, the *Event-time sample* reveals no distinct consistent evidence in the PRD cross-section of a significant positive association between brokerage firm reputation and PRD, using either the *MM* or the *DGTW* PRD measures, for any of the three drift durations (Table 13, Panel A), as negative impacts are also present. Similarly inconsistent results, including significant wrong sign estimates, are reported using the *Portfolio sample* (Table 13, Panel B).

In the pre-period, there is evidence in the *Event-time sample* of significant PRD across a number of reputation deciles, for both methods of estimation, particularly for the 20-day duration, that tend to be larger in the lower deciles, but also in the highest two deciles. In the *Portfolio sample*, there is significant PRD over most of the deciles for the Buy portfolio. The Buy-less-sell portfolio reveals no particular relationship between PRD and brokerage firm reputation.

The *Earnings sample* has two types of earnings announcements: those that coincide with analysts'

Table 12

Event-time sample tests of analysts' *Extreme revisions*.

Reported are six coefficient estimates for six extreme recommendation revisions, from multivariate drift regressions that include 12 other control variables. The dependent variable is drift of 20, 60, and 120 trading days, measured using the *MM* and the *DGTW* methods. The revision indicators are; *UPtoB*, upgrades to buy, *UPtoSB*, upgrades to strong buy, *UP*, for other upgrades, *DOWNtoS*, for downgrades to sell, *DOWNtoSS*, for downgrades to strong sell, and *DOWN*, for other downgrades. The regressions include the 12 other control variables in Table 2. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Extreme revision	*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Panel A: Post-period, N=23,790						
UPtoSB	−0.012	−0.149	−0.120	0.161	0.216	0.272
UPtoB	−0.161	−0.204	−0.009	0.031	0.359	0.902
UP	0.399*	0.384	−0.059	0.219	−0.055	−0.490
DOWNtoS	0.260	0.009	0.044	0.185	−0.100	−0.583
DOWNtoSS	0.106	0.245	0.429	0.007	0.058	−0.235
DOWN	0.082	0.774*	2.101*	−0.319	−0.037	0.180
Panel B: Pre-period, N=12,670						
UPtoSB	1.085	1.691*	−1.504	1.908***	2.458**	1.625
UPtoB	0.724	1.633*	−0.432	1.437**	2.503**	2.727*
UP	0.746	0.563	2.528	−0.009	−0.222	0.188
DOWNtoS	0.264	−0.406	−1.223	−0.099	−1.886*	−3.119**
DOWNtoSS	1.570*	1.054	2.866	0.798	−0.739	−0.417
DOWN	−0.364	0.351	3.502***	−0.500	−0.603	1.156

Table 13

Event-time sample and Portfolio sample drift regressions within brokerage firm *Reputation* deciles.

Reported in Panel A (B) are *UP* coefficient estimates for the *Event-Time sample* (Buy and Sell coefficient estimates for the *Portfolio sample*), for the post-period and pre-period, from multivariate drift regressions estimated for all observations and within each decile sorted on brokerage firm *Reputation*. The dependent variable is abnormal return drift of 20, 60, and 120 trading days (60 trading days) using *MM* and *DGTW* (portfolio) methods, winsorized. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Panel A: Event-time sample by reputation decile

Reputation	Post-period, N=23,790						Pre-period, N=12,672					
decile	*MM* drift			*DGTW* drift			*MM* drift			*DGTW* drift		
	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day	20 Day	60 Day	120 Day
Lowest	0.459	0.512	−0.285	0.370	0.208	−0.428	−0.078	0.901	−0.260	0.284	1.344	0.721
2	0.977***	0.036	0.717	0.993***	0.330	0.970	2.526***	3.947***	3.407*	2.385***	3.383***	3.233*
3	0.143	−1.574**	−2.596***	0.002	−1.520**	−2.170**	2.392***	3.383***	2.963	2.402***	3.955***	3.324*
4	−0.469	−0.553	−0.637	−0.413	−0.408	−0.255	3.008***	3.939	3.532*	2.866***	2.584**	2.616
5	0.721*	1.553**	1.274	0.622*	1.386**	1.232	1.550**	1.612***	−0.378	1.670**	2.083*	1.391
6	0.420	0.884	0.912	0.725**	1.334**	1.775*	1.565**	0.148	−0.625	1.520**	0.773	0.295
7	0.255	0.721	−0.495	0.282	0.379	−0.265	0.343	1.557	0.064	0.526	2.278**	2.202
8	−0.483	0.044	−1.547	−0.392	−0.123	−1.121	0.877	1.011	1.458	0.615	1.302	2.582
9	0.131	−0.415	0.042	0.169	−0.340	0.616	1.716***	1.242	3.518*	1.678***	0.821	4.039**
Highest	0.594	0.966	0.860	0.341	0.695	0.545	2.070***	3.630***	1.612	2.341***	4.092***	3.356*

Panel B: Portfolio sample by reputation decile

Reputation	Post-period			Pre-period		
decile	Buy	Sell	Buy-less-sell	Buy	Sell	Buy-less-sell
Lowest	−0.010	−0.010	−0.015***	0.027	0.015	0.015
2	0.017	0.006	0.012**	0.091***	−0.011	0.079***
3	0.001	0.025**	−0.005	0.068***	0.003	0.055***
4	0.003	0.011	−0.002	0.052**	0.031	0.040***
5	0.024	−0.002	0.019***	0.051**	0.000	0.040***
6	0.003	−0.013	−0.002	0.012	0.016	0.000
7	0.026**	0.020*	0.009	0.044*	0.024	0.032***
8	0.016	0.008	0.010*	0.082***	0.048**	0.068***
9	−0.011	0.006	−0.016***	0.055**	0.009	0.043***
Highest	0.021	−0.001	0.017***	0.038*	−0.007	0.026***

revisions and those that coincide with continuations. Brokerage reputation cannot be identified in the second type. Therefore, it is not possible to make comparative evaluations of PRD across brokerage reputation for the *Earnings sample*.

5.2.3. Consensus recommendations and revisions

The third test of the informed analyst hypothesis uses consensus recommendations: the simple average of all outstanding analysts' recommendations over the recent quarter. As Barber, McNichols, and Trueman (2001), and Jegadeesh, Kim, Krische, and Lee (2004) report for revisions in sample periods that mostly precede the pre-period in this study, consensus changes are associated with significant drift: the consensus upgrades are followed by positive drift and the consensus downgrades are followed by negative drift.

The tests first focus on the incremental average PRD that is associated with the level of the consensus ranking, *Con*, which forms the average of all outstanding recommendations into discrete ranks from one (strong sell) to five (strong buy). Under the informed analyst interpretation, a higher consensus rank is expected to be associated with more positive PRD, ceteris paribus.

The fourth test of the informed analyst hypothesis focuses on the effect that a change in the consensus level, *Chgcon*, has on the PRD. A positive *Chgcon* (the current quarter level less the previous quarter level, sorted into quintiles) is perceived like a recommendation upgrade, and thus predicts a more positive PRD, and a negative *Chgcon* perceived as a downgrade, predicts a more negative PRD. The tests use the same multivariate PRD regression estimation, so to conserve space only the coefficients of *Con* and *Chgcon* are reported. In the *Consensus sample*, PRD duration is one, three, and six months, starting at month 1 relative to quarter-end month.

In the post-period the consensus level, *Con*, does not show a significant relationship with PRD (Table 14, Panel A). When the regressions are estimated using Fama and MacBeth (1974), which reports means of the quarterly consensus coefficient estimates, *Con* again is not followed by significant incremental drift (Table 14, Panel A). Nor is there evidence of a consistent significant drift relationship with *Con* after the crisis period revisions are removed from the tests (Table 14, Panel A). These conclusions hold for the *MM* and *DGTW* PRD, and for all three drift durations, except for the 6-month *MM* PRD in the post-period.

The coefficient estimates for the impact of a change in the consensus on the post-period PRD are reported in Panel A of Table 14, using the multivariate regression estimation. There is no evidence in the multivariate regressions of a significant PRD effect from *Chgcon* in the post-period, using either *MM* or *DGTW* PRD measures, for each duration. This finding is robust to using the Fama and MacBeth (1974) estimation method.

In the pre-period, the results show a significantly negative coefficient estimate for *Con*, which runs contrary to the information hypothesis (Table 14, Panel B). The impact of

Table 14

Consensus and *Event-time sample* tests of recommendation information.

Reported in Panels A–C are *Con* and *Chgcon* coefficient estimates, for the post-period and pre-period, from multivariate drift regressions for all observations and within each decile sorted on brokerage firm reputation, in the *Consensus sample*, and its Fama and MacBeth (1974) and no-crises subsamples. The dependent variable is the abnormal return drift of 1, 3, and 6 months, computed using the *MM* and the *DGTW* methods, winsorized. *Con* is an indicator variable for the consensus recommendation, ranging from 0 (sell) to 5 (buy). *Chgcon* is the change in the consensus recommendation. Panels A through C report the estimated *Con* (*Chgcon*) coefficients in multivariate regressions that include the 12 other control variables in Table 2 Panel B and their coefficient estimates are suppressed. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). *** (**, *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Variable	*MM* drift			*DGTW* drift		
	1 Month	3 Months	6 Months	1 Month	3 Months	6 Months
Panel A: Consensus sample, Post-period, N=31,940						
Con	−0.099	−0.222	0.163	−0.087	−0.157	0.219
Con Fama-MacBeth	−0.148	−0.469	−0.346	−0.160	−0.453	−0.385
Con no-crisis	−0.253	0.150	0.942**	0.051	0.052	0.684
Chgcon	0.100	3.640	0.371	0.090	0.062	0.282
Chgcon Fama-MacBeth	0.178	0.072	0.533	0.177	0.094	0.392
Chgcon no-crisis	−0.226	−0.320	0.066	0.202	−0.128	0.183
Panel B: Consensus sample, Pre-period, N=14,301						
Con	−0.618*	−1.860***	−3.670***	−0.667*	−1.500**	−3.616***
Con Fama-MacBeth	−0.735	−1.531*	−3.429**	−0.735	−1.491**	−3.967***
Chgcon	−0.007	0.186	−0.052	0.007	0.775	0.396
Chgcon Fama-MacBeth	0.157	0.878	0.453	0.202	1.245	0.701
Panel C: Consensus sample, 1997–1998, N=3,522						
Con	−0.858	1.055	−0.662	−0.819	0.768	−0.927
ChgCon	1.676**	3.883***	3.961**	1.689**	3.752***	3.662**

Table 15
International regression tests.
Market model coefficient estimates from drift regressions for the *International sample*. The dependent variable is the difference between the Buy and Sell portfolio returns, which are regressed on the within-country market return for durations of 20, 60, and 120 trading days. Samples and variables are described respectively in Appendix A.1 and Appendix A.2. Post-period (and pre-period) is May 1, 2003 through 2010 (1997 through April 30, 2003). *** (**. *) Indicates statistical significance at the 1% (5%, 10%) level for two-sided student *t*-statistic.

Country	Post-period				Pre-period			
	N	20 Day	60 Day	120 Day	N	20 Day	60 Day	120 Day
Canada	35	0.088	0.043	0.044	53	−0.019	0.026	0.035
France	181	−0.019	−0.017	−0.004	117	0.018	−0.017	−0.004
Germany	122	0.025	−0.005	−0.010	73	0.114**	0.056	−0.007
Italy	59	0.092	−0.067	−0.027	17	−0.002	−0.013	0.007
Japan	618	0.023	0.005	−0.007	285	0.123***	0.039	0.023
U.K.	136	0.042	0.027	0.117	83	0.004	−0.009	−0.007

Con is somewhat dampened when using the Fama and MacBeth estimates. The coefficient estimates for *Chgcon* are not significant (Table 14, Panel B) for any period.

The consensus change findings in the pre-period in this article show a different result than reported in the earlier studies. To reconcile this different finding of an insignificant effect of *Chgcon* in the pre-period with the earlier research, note first that a number of the findings documented in this article for the pre-period often reveal a pattern of irregular PRD behavior. We therefore breakout the pre-period PRD evidence for the two years of 1997–1998, which overlaps the end of the1985–1998 sample period studied by Jegadeesh, Kim, Krische, and Lee (2004). Table 14, Panel C reports the *Consensus sample* pre-period PRD behavior during the 1997–1998 interval. There is no statistically significant relationship between the level of the consensus, *Con*, and PRD in this 1997–1998 window. The change in the consensus over these two years, *Chgcon*, has a statistically significant positive impact on PRD, for both *MM* and *DGTW* measures, for all three durations (Table 14, Panel C). Therefore, in the early pre-period that overlaps the period studied in the other articles, there is distinct evidence of insignificant PRD behavior in 2000 that is qualitatively similar to the findings reported in those studies. Later in the pre-period the evidence becomes mixed and the PRD behavior is irregular.

Because the consensus measures are typically an average across a number of analysts' recommendations, each consensus and its change are not clearly associated with a unique analyst brokerage firm reputation, nor do the changes lend themselves to a workable definition for what could constitute extreme revisions. Therefore, the PRD cross-section tests of underreaction in the *Consensus sample* using reputation proxies or extreme revisions are not performed.

To summarize the results from the direct tests in the post-period, the findings using the *Event-time sample* do not agree with the underreaction hypothesis. Average PRD is significant only in the lowest turnover decile, and is not robust to removing the lowest volume stocks or the *VSC revision* stocks. Nor is it robust across the samples. In the *Portfolio sample* the Buy-less-sell coefficient estimate in the lowest decile is significant at the 5% level. However, average PRD in the coverage decile tests in the *Event-time, Portfolio,* and *Earnings samples*, does not consistently support the underreaction thesis.

Meanwhile, in the pre-period there are many significant results, some of which – but not all – agree with underreaction. Significant average PRD in the lowest turnover decile in the *Event-time sample* agrees with underreaction, but this trend is also common to many deciles, especially for shorter durations. The lowest decile for the Buy-less-sell coefficient for the *Portfolio sample* tests is significant, driven by the Buy portfolio. For the *Earnings sample*, average PRD in the lowest *UP* decile is not significant, but is significant in some of the lowest *DOWN* deciles.

Results from testing the nested informed analyst hypothesis add perspective for understanding the significance of the underreaction hypothesis. In the post-period *Event-time sample*, a number of the findings fail to support the informed analyst hypothesis, including the insignificant effect of extreme revisions on PRD, the brokerage firm reputation tests in the *Portfolio* and *Earnings samples*, and the tests that use *Consensus sample* recommendations. For the pre-period, evidence from tests of the informed analyst hypothesis is mixed in both the *Event-time sample* and the *Consensus sample*.

6. International post-revision return drift evidence

The benefits of significant trading cost reductions in the supercomputer era for stocks traded on the US exchanges should be corroborated by similar impacts for stocks traded on major exchanges in foreign markets of other large, industrialized countries. To test this hypothesis out-of-sample, analysts' revisions for stocks traded in the Group of 7 (G-7) countries are examined. Some evidence of declining trading costs on stock exchanges in Canada, Europe, and Asia has been reported by Angel, Harris, and Spatt (2012). Bris, Goetzmann, and Zhu (2007) report that all G-7 countries permit short selling.

One study of the international stocks by Jegadeesh and Kim (2006) examines the effects of analysts' recommendations for the G-7 countries over November 1993 through July 2002. One takeaway from their findings is that followed firms' drift after revisions by US analysts tends to be larger than the drift after revisions by the foreign analysts. The authors measure drift using a basic market model in a portfolio approach, and focus on the return difference between the buy portfolio and the sell portfolio. The buy-less-sell drift difference is therefore measured by the intercept estimated by regressing the return difference on the market return. They examine three holding period durations of 20, 60, and 120 days after the revision announcement, for the six countries, yielding 18 total estimates for PRD. Of their 18 PRD measures, the authors report two are statistically significant; the 60- and 120-day durations for France, and the 16 others are statistically insignificant (see the original authors' Table 10). Thus, another important takeaway from their findings is that little significant drift follows recommendation revisions by analysts' in the foreign countries.

The *International sample* spans the same period as the US sample, 1996–2010, for the following countries (and stock exchanges): Canada (Toronto), France (NYSE Euro.), Germany (Deutsche), Italy (Borsa), Japan (Tokyo), and the UK (London). The revisions are extracted from the Institutional Brokers' Estimate System (IBES). Following Jegadeesh and Kim (2006), for the *International sample* the market return model is used to compute the abnormal returns. (Many of the factors used in the *Event-time sample* cannot be calculated quarterly for these stocks.) We use three market indexes for each country: Datastream, FTSE, and Standard and Poors's. However, because the results using each index are qualitatively similar, for brevity only the Datastream market return results are reported. All firms are listed on a major stock exchange and their common stock returns and market values are converted to US dollar terms.

Calendar portfolios using the market model are used to calculate abnormal returns in a manner similar to the U.S. calendar portfolios reported for the *Portfolio sample* estimations above, with weights proportional to market value of equity. To measure PRD for country c, the difference between the Buy and Sell portfolio returns, $RBuy(c)_t$–$RSell(c)_t$, is regressed on the country market return index $RM(c)_t$,

$$RBuy(c)_t - RSell(c)_t = \alpha + \beta RM(c)_t + u_t. \quad (6)$$

The intercept, α, is the estimate for the abnormal return drift. Three durations of 20, 60, and 120 days are examined, and the portfolio start date is day three relative to the recommendation revision date.

For the post-period, the findings reveal no significant PRD in any of the foreign countries. The conclusion from these findings is therefore qualitatively similar to the conclusion reached earlier for the US firms, namely, that in the post-period, average PRD is not significant.

For the pre-period, there is little drift except for the 20-day duration in Germany and Japan. Otherwise, none of the 16 other PRD measures is significant. These results are also qualitatively similar to the Jegadeesh and Kim (2006) findings, which in multiple estimation trials demonstrate very little PRD in their November 1993 through July 2002 sample period.

The conclusions reached from the international findings in the post-period largely agree with the conclusions reached for the results reported in this article for analysts' revisions in the United States; that little if any drift follows analysts' recommendation revisions (Table 15).

7. Conclusion

For decades, researchers have reported that post-revision return drift, or PRD, moves in the direction of analysts' recommendation revisions; this is to say, PRD is typically positive following upgrades and negative following downgrades. New evidence provided in this article shows the disappearance of significant average PRD that agrees with analysts' revisions, in the 2003–2010 period. Also, a reliable and robust causal relationship between the revisions and the PRD cross-section is rejected in a variety of tests. These findings are confirmed through a number of perspectives. While some modest PRD is found in small subsamples, these findings are also not particularly robust.

Further new evidence is provided concerning PRD persistence and its sources. Findings do not consistently show that PRD reflects enduring investor underreaction to new information from analysts' revisions. Other findings support the view that PRD may have persisted due to high transaction costs. These include the disappearance of PRD in the period of historically low transaction costs – due to supercomputers, decimalization, and algorithmic trading. Second, some PRD found in the post-period for a small sample of firms is associated with characteristics of high transaction costs. The results also do not rule out a role for persistent asset pricing model limitations. Possible sources for the PRD can also include drift from other recent events and news and possible asset pricing model limitations.

The findings add to the empirical evidence about analysts' information intermediary role in the securities market. They do not support the view that analysts' reports consistently provide the typical investor with useful new information about long-run stock price behavior, which complements recent research suggesting that analysts' reports generally provide little new information for investors in the short-run. They also suggest that it could be difficult for analysts to provide useful new information for ordinary investors in a low transaction cost environment.

Some findings are also relevant for researchers interested in market efficiency. The disappearance of PRD shows that recommendations do not provide significant profit opportunities for analysts' clients, and they do not reliably predict future prices, in agreement with theories of efficient markets. The coincidence of the PRD disappearance with lower transaction costs demonstrates how rational pricing of securities extends the reach of market efficiency in the presence of transaction costs.

Appendix A

A.1. Description of samples and sample modifiers

Samples	
Event-time	The *Event-Time Sample* contains all real time recommendation revisions from First Call Historical Database (FCHD) from 1997 through 2010 that have the control variables used in this study and identified from the literature (variables are defined in Appendix A.2).
Portfolio	The *Portfolio Sample* contains the Buy and the Sell portfolios. The Buy portfolio is all FCHD firms' stock in the sample period for which at least one brokerage upgraded their recommendation. Each recommended stock enters the portfolio three days after the day the recommendation is announced and remains for 60 days, except in the unlikely case when return information becomes unavailable. The Sell portfolio is constructed the same way as the Buy portfolio. When there are multiple revisions for the firm on the same day the firm is included once in the sample. For the value-weighted case the investment in each stock is proportional to the firm's market value divided by the market value on that day. For the equal investment case the initial investment is $1 in each stock, and the investment value over time changes according to the returns.
Earnings	The *Earnings sample* includes all quarterly earnings announcements from FCHD. Recommendation revisions in the trading day window (0, 2) relative to the quarterly earnings announcement date are sorted into upgrades and downgrades. If there is no recommendation issued in window (0, 2), the quarterly earnings announcement is classified as a continuation. When multiple revisions for the firm conflict the earnings announcement event is dropped.
Matched-earnings	The *Matched-earnings sample* contains each upgrade and downgrade in the *Earnings sample*, and their respective match to a similar continuation in the *Earnings sample*, where the matching is done through propensity scoring that uses 12 characteristics.
Consensus	The *Consensus sample* follows Jegadeesh, Kim, Krische, and Lee (2004). In each quarter all individual brokerage's most recent outstanding recommendations issued in the prior year, but not in the last two days of the quarter, hence in the window (-365, -2) relative to the quarter-end, are averaged to form the consensus level. This is ranked by sorting the consensus into quintiles, from 0-most negative opinion to 1-most positive opinion, with 0.25 increment between groups (see Appendix A.2). The revisions of the consensus are then measured as the current quarter level less the previous quarter level, and are sorted into quintiles with unchanged revisions in the middle group.
International	The *International sample* is obtained from recommendations for firms in the following countries (and stock exchanges); Canada (Toronto), France (NYSE Euro.), Germany (Deutsche), Italy (Borsa), Japan (Tokyo), and UK (London), uses IBES recommendations, for years 1996–2010. Most quarterly accounting data are from quarterly Compustat North America and Global files, and market returns are from Datastream Thomson Reuters. Returns and market values are in (or are converted to) US dollar terms.
Sample modifiers	
No-crisis	Revisions made in the crisis period, from September 2008 to the sample era end, are removed.
Fama, MacBeth	Uses the Fama and MacBeth (1974) method, where only the means of the quarterly estimates are reported.

A.2. Definitions of variables

Abnormal volume	Difference between period p daily turnover for firm i, $\bar{T}^i_p$, relative to the firm's month-3 daily turnover, $\bar{T}^i_{month-3}$, and the relevant market turnover (NYSE mean daily turnover for NYSE firms, Nasdaq mean daily turnover for Nasdaq firms): $ABVOL(i,p) = \left(\frac{\bar{T}^i_p}{\bar{T}^i_{month-3}}\right) - \left(\frac{\bar{T}^M_p}{\bar{T}^M_{month-3}}\right)$, where $p=-1$ is month -1; $p=0$ is the five-day announcement window centered on the revision announcement day; $p=1$ (2, 3) is month 1 (2,3); where months are 20 trading days measured relative to period 0.
BP^+	Book-to-market at the most recent quarter. Equals one if above median, zero otherwise.
$Capex^+$	Moving sum of last four quarters' capital expenditure scaled by total assets. $\frac{\sum_{i=0}^{3} Capex_{q-i}}{[(Totalassets_q + Totalassets_{q-4})/2]}$, where q is the most recent quarter. Equals one if below median, zero otherwise.
ChgCon	The change in the consensus recommendation, measured as the current quarter level less the previous quarter level, which are sorted into quintiles; unchanged recommendations are in the middle group. Values of 0, 0.25, 0.5, 0.75, and 1 are assigned to those quintiles, where 1 is most favorite.
Con	An indicator variable for the rank, hence level of the consensus, ranging from one to five, the mean of individual brokerage's most recent outstanding recommendations for the firm over trading days $(-250, -2)$, which is then ranked in the sample by sorting the consensus into quintiles, from 5=buy, to 0=sell.
Coverage	The number of recommendations issued for the firm over the prior calendar year.
DOWN	Dummy variable equal to one for downgrades and zero otherwise.
DOWNtoS	Dummy variable equal to one for downgrades to Sell and zero otherwise.
DOWNtoSS	Dummy variable equal to one for downgrades to Strong Sell and zero otherwise.
EP^+	Moving sum of earnings per share EPS for prior four quarters deflated by quarter-end price. Equals one if above median, zero otherwise.
Firm size	Logarithm of equity size at the fourth quarter-end of the last fiscal year. Equals one if below median, zero otherwise.
$Frev^+$	Rolling sum of analyst earnings forecast revisions to price ratios months $(-6, -1)$; $\sum_{i=1}^{6}\left(\frac{f_{m-i} - f_{m-1-i}}{p_{m-1-i}}\right)$, where f_m is the month m FY1 forecast and P_{m-1} is month $m-1$ stock price. Equals one if above median, zero otherwise.
HML_t	A factor in the Carhart (1997) four-factor model; HML_t is the date t return on a value-weighted portfolio of high book-to-market value stocks, minus the date t return on a value-weighted portfolio of low book-to-market value stocks.

Lowest	Dummy variable equal to one if the firm is in the bottom quintile, based on *Firm size* sorts.
LTG^{+}	IBES long-term growth forecast in month -1. Equals one if below median, zero otherwise.
MM and *DGTW*	Two cumulative abnormal return measures for PRD. For the *Event-time* and *Earnings samples*, PRD for firm i is $\prod_{t=\tau}^{\tau+T}(1+r_{i,t})-\prod_{t=\tau}^{\tau+T}(1+I_{i,t})$, where T is PRD trading day duration, starting on day $t=3$, and ending 22, 62, or 122 days relative to the recommendation or earnings announcement. For Market Model returns, $MM(T)$, $I_{,t}$ is the CRSP value-weighted market index return ($R_{m,t}$). For characteristic-adjusted returns, $DGTW(T)$, $I_{,t}$ is the characteristic portfolio return, where portfolios are formed at the end of June of each year, when stocks are sorted into 125 ($5\times5\times5$) groups based on mean monthly equity value in the past 12 months, book-to-market equity value (book value is from last fiscal year-end financial report), and past 12 months' stock return. For the future 12 months, the benchmark return is the stock's characteristic portfolio return based on the prior June sort. For the *Consensus sample*, T is 1, 3, and 6 months duration, starting at month 1 relative to quarter-end month (see Daniel, Grinblatt, Titman, and Wermers, 1997).
Nasdaq	Dummy variable equal to one if the firm is listed on the Nasdaq stock exchange, and zero if the firm is listed on the NYSE or Amex.
PRD	PRD measured by abnormal returns computed using *MM* drift or *DGTW* drift.
$R_t^j-R_{ft}$	The dependent variable in the Carhart (1997) four-factor model; R_{ft} is the date t risk-free rate, and R_t^j is the date t return on portfolio j, constructed as $R_t^j=\sum_{i=1}^{n_t} x_{it}\cdot R_{it}/\sum_{i=1}^{n_t} x_{it}$, where R_{it} is the gross date t return on recommendation i, n_t is the number of recommendations in the portfolio on date t, x_{it} is the compounded daily return of recommended stock i from the close of trading on the day of the recommendation through day $t-1$.
$R_{mt}^v-R_{ft}$	A factor in the Carhart (1997) four-factor model; R_{mt}^v is the date t return on the value-weighted market index, and R_{ft} is the date t risk-free rate.
Pre-period	Dummy variable equal to one if the revision occurs before May 2003, and zero otherwise.
Reputation	Brokerage reputation, measured by the prior year's recommendation market share.
Retp^{+}	Cumulative *MM* return for months $(-6,\ -1)$. Equals one if above median, zero otherwise.
Ret2p^{+}	Cumulative *MM* return for the months $(-12,\ -7)$. Equals one if above median, zero otherwise.
SG^{+}	Sales growth in past year $\frac{(\sum_{i=q-3}^{q} Sale_i}{\sum_{i=q-7}^{q-4} Sale_i)-1}$ where q denoted the most recent quarter. Equals one if below median, zero otherwise.
Size^{+}	Logarithm of equity size at the fourth quarter-end of the last fiscal year. Equals one if below median, zero otherwise.
B_t	A factor in the Carhart (1997) four-factor model; on date t is the return on a value-weighted portfolio of small-cap stocks less the return on a value-weighted portfolio of large-cap stocks.
SUE^{+}	Standardized unexpected earnings, $\frac{(eps_q-eps_{q-4})}{\sigma_{q-(q-7)}}$ where q denotes fiscal quarter and σ denotes standard deviation over the last eight quarters. Equals one if above median, zero otherwise.
TA^{+}	Total accrual, where q is the most recent quarter, Δ is the difference between quarter q and $q-4$ $\{\Delta Cur\ A_q-\Delta Cash_q-(\Delta CurLiab._q-\Delta Cur\ LTD_q)-\Delta def\ tax_q-dep\ and\ Amor_q)\}/(TA_q+TA_{q-4})/2$. Equals one if below median, zero otherwise.
Turn^{+}	Mean daily number of shares traded relative to shares outstanding, for months $(-6,\ -1)$. Equals one if below median, zero otherwise.
UP	Dummy variable equal to one for upgrades and zero otherwise.
UPtoB	Dummy variable equal to one for upgrades to buy.
UPtoSB	Dummy variable equal to one for upgrades to strong buy.
WML_t	A factor in the Carhart (1997) four-factor model; WML_t on day t is return on a value-weighted portfolio of stocks with high recent returns, minus the return on a value-weighted portfolio of stocks with low recent returns.
Volume	Average daily trading volume over the prior calendar year.
VSC revisions	Revisions that are *jointly* in each of the three lowest deciles in decile sorts on *Volume, Firm-size,* and *Coverage* characteristics then rechecks the lowest decile drift in each of the characteristic sorts.

$^{+}$These variables follow Jegadeesh, Kim, Krische, and Lee (2004).

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