



Citation for published version:

Perotti, P & Windisch, D 2017, 'Managerial Discretion in Accruals and Informational Efficiency', *Journal of Business Finance and Accounting*, vol. 44, no. 3-4, pp. 375-416. <https://doi.org/10.1111/jbfa.12241>

DOI:

[10.1111/jbfa.12241](https://doi.org/10.1111/jbfa.12241)

Publication date:

2017

Document Version

Peer reviewed version

[Link to publication](#)

This is the peer reviewed version of the following article: Perotti, P. and Windisch, D. (2017), Managerial Discretion in Accruals and Informational Efficiency. *Journal of Business Finance & Accounting*, 44: 375–416., which has been published in final form at <https://doi.org/10.1111/jbfa.12241>. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Self-Archiving.

University of Bath

Alternative formats

If you require this document in an alternative format, please contact:
openaccess@bath.ac.uk

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Managerial Discretion in Accruals and Informational Efficiency

Pietro Perotti

University of Bath
tel: +44 1225 383 635
fax: +44 1225 386 473
p.perotti@bath.ac.uk

David Windisch

University of Graz
tel: +43 316 380 7280
fax: +43 316 380 9565
david.windisch@uni-graz.at

Accepted for publication in the Journal of Business Finance and Accounting

We thank Lucie Courteau, Joshua Coyne, Steve Crawford, Florian Eugster (discussant), Igor Goncharov (discussant), Christian Gross, Joanne Horton, Roland Koenigsgruber, Sonia Konstantinidi, Wayne Landsman, Garen Markarian, Bo Qin, Bryce Schonberger (discussant), Catherine Schrand, Andrew Stark (the editor), Steve Stubben, David Veenman, Alfred Wagenhofer, and an anonymous referee for helpful comments. We also thank participants at the 2012 AAA Annual Meeting, the 2013 AAA IAS Midyear Meeting, the 2013 EAA Annual Meeting, the 2013 WHU FAccT Center Workshop, the 2016 JBFA Capital Markets Conference, and at the workshops at University of Graz, Bocconi University, University of North Carolina at Chapel Hill, Free University of Amsterdam, Erasmus University Rotterdam, University of Bath, Free University Bozen, and University of Essex. Part of this research was conducted while Pietro Perotti and David Windisch were visiting scholars at the University of Mannheim and the University of Chicago Booth School of Business, respectively. We gratefully acknowledge financial support of the Austrian Science Fund (P 24911-G11) and the Austrian Academy of Public Accountants.

Managerial Discretion in Accruals and Informational Efficiency

Abstract

In this paper, we examine the relation between managerial discretion in accruals and informational efficiency. We measure managerial discretion in accruals by the absolute value of abnormal accruals. Assuming that efficient prices follow a random walk, we measure informational efficiency by using stock return variance ratios. We find that the absolute value of abnormal accruals is negatively associated with the price deviation from a random walk pattern, estimated in the 12-month period subsequent to the accrual reporting; hence, future informational efficiency increases with the extent to which managers exercise discretion over accruals. The results are consistent with the view that discretionary accruals, on average, convey useful information to investors and facilitate the price convergence to its fundamental value. Our findings are robust to a battery of tests, including tests to validate both our measures of informational efficiency and our measure of managerial discretion in accruals.

Keywords: managerial discretion; discretionary accruals; informational efficiency; stock return variance ratios

1. INTRODUCTION

Informational efficiency is a fundamental aspect of market quality. The extent to which prices reflect available information has been shown to affect both capital allocation and real investment decisions (Wurgler 2000; Subrahmanyam and Titman 2001; Chen et al. 2006). The accounting process, as a major source of firm-specific information, is likely to play a crucial role in the determination of informational efficiency. On a related note, more research on how accounting affects informational efficiency has been called for by Kothari (2001) in his survey on accounting-based capital market research; by Lee (2001) in his commentary;¹ and by Richardson et al. (2010) in their review of the literature on accounting anomalies.

In this paper, we examine the relation between a central feature of the accounting process, namely managerial discretion in accruals, and informational efficiency. Generally Accepted Accounting Principles (GAAP) give managers considerable discretion in determining accruals through accounting policy choices and implementation decisions. This flexibility should enable them to convey relevant private information and improve earnings as a measure of firm performance (Guay et al. 1996; Francis et al. 2005). More informative financial statements (i.e., giving more precise information about of the financial position and performance of a firm) allow investors to improve their cash flow forecasts and help them to better process new information coming to the market by providing context for subsequent events and disclosures (Drake et al. 2015, 2016). Therefore, ideally, managers' discretionary choices in accrual reporting enhance

¹ "Rather than remaining agnostic about the role of market prices, I advocate a more proactive approach. Rather than assuming market efficiency, we should study how, when, and why price becomes efficient (and why at other times it fails to do so). Rather than ignoring the current market price, we should seek to improve it." (Lee 2001, p. 251).

investors' ability to assess a firm's fundamental value and, consequently, increase informational efficiency.² However, managers can use the flexibility in accrual-based accounting not only as a tool to convey private information, but also to conceal the firm's true underlying economic performance (Holthausen and Leftwich 1983; Watts and Zimmerman 1986; Guay et al. 1996; Healy and Wahlen 1999). Because managers' accrual choices are influenced by manifold unobservable financial reporting motivations, understanding what is the prevailing effect of their use of discretion over accruals on informational efficiency is an empirical question.

In contrast to many prior works that focus on idiosyncratic samples where managers have specific incentives to exercise discretion over accruals, we focus on a general sample of firms. This allows us to examine the prevailing effect of managerial discretion exercised over accruals on informational efficiency in the whole population of firms. If the prevailing effect of managerial discretion in accruals on the informativeness of financial statements is beneficial (detrimental), we expect to observe a positive (negative) association between the extent to which managers use their discretion to manage earnings and the informational efficiency of a firm's stock price in the period after the earnings release.

We measure the extent to which managers exercise discretion over accruals by the absolute value of abnormal accruals;³ the main analysis uses the specification proposed by Kothari et al. (2005) to identify the discretionary portion of a firm's total accruals. Our tests of informational efficiency are based on the assumption that informationally efficient prices follow

² By fundamental value we refer to the present value of all expected future payoffs, discounted by the appropriate risk factor (Christensen and Feltham 2003; Penman 2013). A widely accepted definition of informational efficiency states that at any time informationally efficient prices fully reflect all available information (Fama 1970). Therefore, informationally efficient prices equal, at any time, an unbiased estimate of the fundamental value (e.g., Jensen 2005).

³ We use the term 'abnormal accruals' to refer to the empirical proxy used to estimate the discretionary portion of accruals.

a random walk.⁴ Specifically, following a standard approach in the informational efficiency literature (e.g., Campbell et al. 1997), we focus on firm-specific stock return variance ratios to investigate the deviation of prices from the random walk benchmark.

Using a large sample of U.S. firms over 20 years, we find that, after controlling for other cross-sectional determinants of informational efficiency (i.e., firm size, liquidity, trading volume, and institutional ownership), the deviation of the price pattern from a random walk process decreases as the absolute value of abnormal accruals increases; thus, informational efficiency in the period after the publication of the financial statements increases with the extent to which managers exercise discretion over accruals. In particular, a one standard deviation change in the absolute value of abnormal accruals is associated with approximately a 3% change in the measures of informational efficiency.

We run a battery of tests to validate both our measures of informational efficiency and our measure of managerial discretion in accruals. Specifically, we show that our results are not driven by sub-samples where potentially extremely slow incorporation of information into stock prices may lead to a reversed interpretation of the informational efficiency measures (see Griffin et al. 2010); furthermore, we show that the results are not attributable to cross-sectional differences in operating volatility or business model shocks, which can impair the ability of accrual expectation models to estimate the magnitude of managerial discretion in accruals (Hribar and Nichols 2007; Owens et al. 2016).

⁴ We note that our objective is not to test whether prices follow a random walk; we instead seek to explain cross-sectional differences in the extent to which prices deviate from an informationally efficient benchmark. Therefore, similar to prior literature (Boehmer and Kelley 2009), we take a 'relative informational efficiency' approach.

The results are robust to using alternative specifications that introduce additional control variables potentially related to informational efficiency (e.g., analyst coverage, growth opportunities, financial distress). Inference is also unchanged for alternative accrual expectation models, across different time periods, and sub-samples of profit vs. loss firms. The positive association between managerial discretion in accruals and informational efficiency persists over each quarter of the examined 12-month period. In the main analysis, we concentrate on annual discretionary accruals; we obtain similar results examining quarterly discretionary accruals. Controlling for the non-discretionary portion of accruals and for the perceived reliability of financial statements does not change the results.

We also examine the cross-sectional variation in our results. We find that the richness of the information environment has a mitigating effect on the strength of the association between managerial discretion in accruals and informational efficiency; this result is consistent with managers' reduced need of using accruals to convey information in richer information environments (Arya et al. 2003; Louis and Robinson 2005). Furthermore, we identify a sub-sample of restated financial statements in which the primary reason for restatement is related to accrual accounting; in this setting, a larger use of discretion in accrual reporting presumably makes accounting numbers less informative for market participants. Accordingly, we find a negative association between the absolute value of abnormal accruals and informational efficiency in this sub-sample. Our cross-sectional evidence further supports the view that our main results are due to the effect of managerial discretion in accruals on the informativeness of financial statements.

Our main empirical results indicate that, on average, discretionary accruals convey useful information to market participants, which facilitates the convergence of prices to the fundamental

value in the period after the publication of the financial statements. The observed positive association between the extent to which managers' exercise discretion over accruals and informational efficiency is an aggregate result and supports the interpretation that the prevailing effect of managerial discretion in accruals on the informativeness of financial statements is beneficial. These findings are in contrast with the general view underlying a large body of empirical literature that considers a higher magnitude of discretionary accruals as indicating poorer earnings quality,⁵ and a related stream of literature that documents that the prevailing effect of discretion in accruals on the informativeness of financial statements is detrimental. For example, some of these works find that the magnitude of abnormal accruals, and proxies of (poor) accounting quality which have been documented to be positively correlated to the magnitude of abnormal accruals, are positively associated to various aspects of mispricing (e.g., Francis et al. 2007; Callen et al. 2013; Perotti and Wagenhofer 2014). In additional analyses, we examine how our results are related to these works. However, our findings contribute to and are consistent with a stream of empirical works that find that discretionary accruals have significant predictive power with respect to future earnings and cash flows (e.g., Subramanyam 1996; Bowen et al. 2008; Badertscher et al. 2012) and with many normative and analytical works that suggest that managerial discretion in earnings is predominately informative (e.g., Sankar and Subramanyam 2001; Arya et al. 2003; Ewert and Wagenhofer 2012).

In addition to the literature on the informativeness of managerial discretion in accruals, we also contribute to the literature on informational efficiency and price formation by documenting a positive association between managerial discretion in accruals and informational

⁵ See Francis et al. (2006), Dechow et al. (2010), and Ewert and Wagenhofer (2012) for a recent overview of earnings quality research.

efficiency. Although informational efficiency is of paramount importance to regulators and market participants, the consequences of managerial discretion in accounting numbers for the informational efficiency of stock prices have received little attention in prior research. In this respect, our results also inform about potential adverse effects of reducing accrual-based discretion on informational efficiency.⁶

This work also has important practical relevance within the current trend in accounting regulation. Some of the major issues addressed by the standard setters in recent years involve accrual-based managerial discretion. For instance, FASB's notable revisions concern the accounting standards on financial instruments, employee stock options, fixed assets and goodwill impairment, and valuation of acquired intangibles (Lev et al. 2010). Current joint projects of the FASB and IASB deal with revenue recognition, financial instruments, and leases. Particularly with the proposed convergence to the more principles-based International Financial Reporting Standards (IFRS), the need for managers to apply their professional judgment over accounting numbers is expected to increase (Alexander and Jermakovicz 2006).⁷ These regulatory changes are likely to substantially influence the extent of discretion in accrual reporting.

2. MOTIVATION AND RELATED LITERATURE

The accounting literature has mainly examined two different motivations for managers to make use of the flexibility allowed by GAAP in accrual reporting. One possibility is that

⁶ Particularly in the wake of the accounting scandals of the early 2000s, policy makers increasingly advocated a reduction of accounting discretion. As emphasized by Fields et al. (2001, p. 259), it is important for regulators to "understand the advantages and disadvantages of allowing choice and determine the 'optimal' level of discretion". See Dechow and Skinner (2000) and Bushman and Landsman (2010) for critical surveys.

⁷ See, for example, the special issues, *Accounting Horizons* (March 2003) and *Abacus* (June 2006), dedicated to the principles-based vs. rules-based accounting standards debate.

discretionary accruals are used by managers as a means to communicate private information about future economic prospects to investors ('signaling view'). The second possibility is that discretionary accrual reporting is mostly contracting-motivated. Contracting motivations can be opportunistic ('opportunistic-contracting view'); for example, it has been documented that managers manipulate earnings to maximize bonus payouts (Healy 1985) or to avoid violations of debt contracts (DeFond and Jiambalvo 1994). Alternatively, it has also been suggested that contracting-motivated choices are aimed at improving the efficiency of contracts ('efficient-contracting view'); these choices can have the objective of reducing agency costs among stakeholders (Watts 1977; Watts and Zimmerman 1978, 1986; Demski et al. 1984).

According to the signaling view, discretionary accruals provide useful information to investors. A large group of normative and analytical works supports the signaling view (e.g., Holthausen and Leftwich 1983; Demski 1998; Sankar and Subramanyam 2001; Arya et al. 2003; Stocken and Verrecchia 2004; Ewert and Wagenhofer 2012), though relatively limited research examines this perspective from the empirical side (e.g., Subramanyam 1996; Louis and Robinson 2005; Bowen et al. 2008; Gunny and Zhang 2014). Subramanyam (1996) empirically finds that discretionary accruals are positively associated with contemporaneous stock returns; he explains this result by the ability of discretionary accruals to predict future profitability. Tucker and Zarowin (2006) find that firms that use abnormal accruals to smooth their earnings increase the informativeness of their current stock price with respect to future earnings; they interpret this as managers' using accruals to convey private information about future earnings. Bowen et al. (2008) document that increased accounting discretion due to poor corporate governance quality is positively associated with future cash flows and return on assets. Badertscher et al. (2012)

examine a sample of restatement firms and find that, if the restatements are not opportunistically motivated, the originally reported earnings and accruals have a higher forecasting power than the restated numbers. It is worthwhile noticing that we differ from the aforementioned studies that focus on future profitability as we concentrate on future informational efficiency; the difference is substantial, as the latter is determined by changes in investors' expectations conditional on accrual reporting throughout the period after the earnings release, while the former represents an ex post accounting realization.

The opportunistic-contracting view predicts that discretionary accruals do not convey useful information, unless investors are able to recognize the opportunistic motivation of the reporting choices (Dechow et al. 2010). In accordance with this view, an extensive body of literature uses discretionary accruals as a proxy for poor earnings quality.⁸ For example, some recent studies provide evidence consistent with the notion that accrual-based managerial discretion adversely affects the informativeness of financial statements by investigating different aspects of mispricing. Francis et al. (2007) find that a disproportionate amount of post-earnings-announcement drift (PEAD) returns is associated with stocks characterized by high information uncertainty. As one of their measures of information uncertainty, they use the absolute value of abnormal accruals. Their results imply that managerial discretion in accruals reduces the ability of market participants to interpret accounting information around earnings announcements. Callen et al. (2013) document that price delay, defined as the delay with which market information is incorporated into prices (following Hou and Moskowitz 2005), decreases with accruals quality. Because accruals quality is partly driven by managers' discretionary choices,

⁸ See, for example, Francis et al. (2006), Dechow et al. (2010), or a review of the audit literature by DeFond and Zhang (2014).

these results may imply that discretionary accruals reduce the ability of market participants to interpret market-wide information. Perotti and Wagenhofer (2014) document that the absolute value of abnormal accruals is positively associated with the absolute value of excess returns in the following year, which is used as a measure of mispricing. Their findings are in line with the view that discretionary accruals reduce the ability of market participants to estimate equity value correctly.

As introduced above, the different motivations underlying the use of discretion in accrual accounting have conflicting implications for the informativeness of financial statements (i.e., the precision with which they represent the performance and the financial position of the firm).⁹ Overall, as suggested, for example, by Dye and Verrecchia (1995) and Hann et al. (2007), understanding what is the prevailing effect of managerial discretion on the informativeness of financial statements is an empirical issue. More informative financial statements help investors to improve their cash flow forecasts and, by providing context for subsequent events and disclosures, to better process new information (Drake et al. 2015, 2016). Therefore, if managerial discretion in accruals affects the informativeness of financial statements, we expect that informational efficiency varies with the extent to which managers make use of their discretion in accruals. Given the absence of consensus in the literature regarding the informative role of managerial discretion in accruals, we formulate two alternative directional hypotheses. If the prevailing effect of managerial discretion in accruals on the informativeness of financial

⁹ The efficient-contracting view does not provide a clear-cut prediction as to the effect of managerial discretion on the informativeness of financial statements. See Badertscher et al. (2012) for a discussion of the efficient-contracting view implications for accrual informativeness.

statements is beneficial, we expect that managerial discretion in accruals and informational efficiency are positively associated.

H1a. Managerial discretion in accruals and informational efficiency are positively associated.

Conversely, if the prevailing effect of managerial discretion in accruals on the informativeness of financial statements is detrimental, we expect that managerial discretion in accruals and informational efficiency are negatively associated.

H1b. Managerial discretion in accruals and informational efficiency are negatively associated.

3. RESEARCH DESIGN AND VARIABLE MEASUREMENT

Measuring the extent of discretion in accruals

To measure discretionary accruals, we use a performance-adjusted version of the modified Jones model, as proposed by Kothari et al. (2005). The model is meant to capture management's discretionary reporting decisions in accruals by splitting a firm's total accruals into normal and abnormal accruals, where the normal portion of accruals is assumed to be economically driven by the firm's underlying business activities.

Using the Fama-French 48 industries classification,¹⁰ our proxy for discretionary accruals is the prediction error (abnormal accruals) obtained from the following regression model estimated by industry-year (firm subscript i is suppressed for notational convenience):

$$TA_t = \beta_0 + \beta_1(1/AT_{t-1}) + \beta_2(\Delta SALES_t - \Delta AR_t) + \beta_3 PPE_t + \beta_4 ROA_{t-1} + \varepsilon_t \quad (1)$$

¹⁰ Using two-digit SIC code instead of the Fama-French 48 industries classification does not affect our results.

where TA is total accruals,¹¹ calculated as: change in current assets (Compustat *ACT*) minus change in cash and short-term investments (Compustat *CHE*) minus change in current liabilities (Compustat *LCT*) plus change in debt included in current liabilities (Compustat *DLC*) minus depreciation and amortization expense (Compustat *DP*); Δ SALES is change in sales (Compustat *SALE*); Δ AR is change in accounts receivables (Compustat *RECT*); PPE is gross property, plant and equipment (Compustat *PPEGT*); ROA is net income before extraordinary items (Compustat *IB*) divided by total assets (Compustat *AT*).

All variables (except lagged ROA) are deflated by beginning-of-year total assets to mitigate heteroscedasticity. As we do not impose any directional sign on management's accrual decisions, we use the absolute value of the prediction error as our firm-year specific measure of the extent to which managers exercise discretion over accruals (ABSDA).

Measuring informational efficiency

Price deviation from a random walk as a measure of informational efficiency

We measure informational efficiency by the price deviation from a random walk pattern; assuming that informationally efficient prices follow a random walk, a higher deviation from the random walk pattern implies a wider divergence from an unbiased estimate of the fundamental value and, thus, lower informational efficiency.¹²

The logic of the random walk idea as a benchmark for informationally efficient prices is summarized, for example, by Malkiel (2003): "If the flow of information is unimpeded and

¹¹ Alternatively, we calculated total accruals using the cash flow approach as proposed by Hribar and Collins (2002), and our inference is unchanged. The results are discussed in Section 7.

¹² It is also worthwhile to notice that this approach to measuring informational efficiency is consistent with the assumption that the fundamental value follows a random walk.

information is immediately reflected in stock prices, then tomorrow's price change will reflect only tomorrow's news and will be independent of the price changes today. But news is by definition unpredictable, and thus, resulting price changes must be unpredictable and random."

Prices deviate from the random walk pattern due to the process of price adjustment to new information in the convergence to an unbiased estimate of the fundamental value.¹³ Alternative explanations include illiquidity and time-varying expected returns; as described in the following sub-section, these two explanations are unlikely to play a significant role in determining our results.

The deviation of the price from the random walk pattern is a widely used measure of informational efficiency. Early contributions on testing the deviation from random walk pricing are provided by Fama (1965), Barnea (1974), and Solnik (1974). More recently, these tests have been used as measures of informational efficiency in different research fields: for example, Boehmer and Kelley (2009) (the role of institutional investors), Griffin et al. (2010) (international comparison of market efficiency), Choi et al. (2009) (in the bond market), Erdos and Ormos (2010) (in the art market), Bennett and Wei (2006) and O'Hara and Ye (2011) (the effect of market fragmentation), Boehmer et al. (2015) (in the derivatives market), Saffi and Sigurdsson (2011) (the effect of short selling constraints), Conrad et al. (2015) (the effect of high frequency trading), Kadapakkam et al. 2015 (informational efficiency of exchange traded funds). Surveys of the empirical literature on informational efficiency are contained in Charles and Darné (2009) and

¹³ A number of prior works suggest that the process of price adjustment to new information leads to non-zero return autocorrelation and, therefore, to a deviation from the random walk benchmark. See, e.g., Klibanoff et al. (1998), Daniel et al. (1998, 2001), Chordia and Swaminathan (2000), Hong et al. (2000), Adams et al. (2004), Anderson (2011), Anderson et al. (2012, 2013).

Lim and Brooks (2011); a methodological discussion of the informational efficiency measures is provided by Campbell et al. (1997).

The measures of informational efficiency

Our main measure of informational efficiency is the return variance ratio. Variance ratios reflect the deviation of the price pattern from a random walk process. The analysis is based on daily returns, as obtained from CRSP. We compute the variance ratio, $VR(n,m)$, as n/m times the ratio of the m -day return variance to the n -day return variance.¹⁴ We use continuously compounded returns. A random walk implies that the ratio of long-term to short-term variances, per unit of time, is equal to one.¹⁵ Variance ratios less than one are consistent with negative return autocorrelation; variance ratios greater than one are consistent with positive return autocorrelation; if return autocorrelations at all lags are equal to zero, variance ratios are equal to one. Because we are interested in any departure from the random walk, following prior literature (e.g., Boehmer and Kelley 2009) we examine the quantity $|VR-1|$. A smaller deviation from random walk pricing implies a smaller divergence of prices from the unbiased estimate of the fundamental value; thus a lower level of $|VR-1|$ indicates higher informational efficiency. We present results concerning $VR(1,5)$ and $VR(1,10)$.¹⁶ For ease of interpretation, we denote

¹⁴ For example, to estimate $VR(1,5)$ over a 12-month estimation period we divide the sample variance of the 5-day return (calculated over the 12-months estimation period) by the sample variance of the 1-day return (calculated over the 12-months estimation period); we then divide the quantity by 5.

¹⁵ To see the intuition, consider the simplest example of a variance ratio which relates the 2-day return variance to twice the 1-day return variance: $VR(1,2)=\text{Var}[r_t(2)]/(2*\text{Var}[r_t])$, where r_t is the 1-day continuously compounded return, and $r_t(2)=r_t+r_{t-1}$ is the 2-day return. Assume that the log of price, p_t , follows a random walk, defined as $p_t=\mu+p_{t-1}+\varepsilon_t$, where $\varepsilon_t \sim \text{i.i.d.}(0,\sigma^2)$; this implies that also returns are i.i.d. Under this assumption, the variance ratio reduces to: $VR(1,2)=(2\text{Var}[r_t]+2\text{Cov}[r_t,r_{t-1}])/(2\text{Var}[r_t])=1+\rho(1)=1$; where $\rho(1)$ is the first order autocorrelation of the 1-day return. Campbell et al. (1997) formally derive this result for any return frequency; they also derive the result using different definitions of random walk which do not assume that price increments are i.i.d.

¹⁶ We repeat our analysis with variance ratios over different time horizons in our validation section and obtain similar inferences.

$|VR(1,5)-1|$ multiplied by -1 as IE1 and $|VR(1,10)-1|$ multiplied by -1 as IE2, so that a higher level of IE1 and IE2 indicates higher informational efficiency.

As a second approach to studying the deviation from random walk pricing, we examine the autocorrelation of returns. We consider the first-order autocorrelation in 5-day and 10-day continuously compounded returns. If prices follow a random walk, the autocorrelation of returns at all frequencies should be equal to zero. Because both a positive and a negative autocorrelation of returns indicate a departure from random walk pricing, we focus on the absolute value of autocorrelation.¹⁷ The results obtained using stock return autocorrelation (untabulated) are qualitatively similar to those obtained using return variance ratios.

Following, for example, Campbell et al. (1997), in the computation of our measures of deviation from random walk pricing, we use overlapping observations to improve the power of the tests. In the main analysis, we do not consider return horizons longer than ten days to reduce the probability that the results might be affected by time-varying expectations on the returns.¹⁸ However, in additional analyses, we also provide consistent results for variance ratios using longer time horizons (e.g., $|VR(1,20)-1|$ or $|VR(1,30)-1|$).

We compute our informational efficiency measures over the 12-month period beginning three months after the end of the fiscal year. We use this time adjustment to ensure that financial statements are available to the public.

¹⁷ The deviation of the single return autocorrelations from zero is conceptually closely related to the deviation of the variance ratios from one because, as described above, if autocorrelations at all lags are equal to zero, variance ratios are equal to one. Accordingly, we find that our informational efficiency measures and the absolute value of return autocorrelations multiplied by -1 are highly positively correlated. Specifically, the Pearson correlation coefficient between IE1 (IE2) and the absolute value of the 5-day (10-day) return autocorrelation multiplied by -1 is equal to 0.449 (0.263). The correlation coefficients are different from zero at the 1% level.

¹⁸ Griffin et al. (2010) argue that focusing on variance ratios based on return-horizons from one day to five weeks reduces the likelihood that results are influenced by time-varying expected returns. Cochrane (2001), Ahn et al. (2002), Anderson (2011), and Anderson et al. (2012) suggest that time-varying expected returns only affect the autocorrelation of long horizon returns.

Relating managerial discretion in accruals and informational efficiency

In our main analysis, we examine the association between managerial discretion in accruals and informational efficiency by estimating the following regression model:

$$\begin{aligned} IE_t = & \beta_0 + \beta_1 ABSDA_{t-1} + \beta_2 SIZE_{t-1} + \beta_3 ILLIQ_{t-1} + \beta_4 TURN_{t-1} \\ & + \beta_5 NASDAQ_t + \beta_6 INST_{t-1} + \varepsilon_t \end{aligned} \quad (2)$$

where:

IE = Measures of stock price informational efficiency, computed as $|VR(n,m)-1|$ multiplied by -1; where $VR(n,m)$ is the return variance ratio, i.e. n/m times the ratio of the m -day return variance to the n -day return variance. IE1 is computed using $VR(1,5)$ and IE2 using $VR(1,10)$. Both measures are calculated over the 12-month period beginning three months after the end of the previous fiscal year.

ABSDA = Measure of the magnitude of discretionary accruals; computed as the absolute value of abnormal accruals obtained following Kothari et al. (2005).

SIZE = Log of market value of equity; market value of equity is computed as the market price of shares at the end of the fiscal year times the number of common shares outstanding.

ILLIQ = Amihud (2002) illiquidity ratio; computed as the average of daily absolute stock return per dollar trading volume. The measure is calculated over the 12-month period corresponding to the fiscal year.

TURN = Log of share turnover; where share turnover is computed as the number of shares traded divided by the number of shares outstanding. The measure is calculated over the 12-month period corresponding to the fiscal year.

NASDAQ = Dummy variable coded 1 for stocks traded on NASDAQ and 0 otherwise.

INST = Institutional ownership; computed as the average of the quarter-end percentage of common shares outstanding held by institutional investors in a fiscal year.

In addition to our proxies for informational efficiency (IE1, IE2) and for the extent of managerial discretion in accruals (ABSDA), we add a set of control variables identified by prior literature to be associated with our informational efficiency measures. SIZE is the log of market value of equity at the end of the fiscal year (Compustat $PRCC_F*CSHO$); firm size has been consistently documented to be negatively related to the price deviation from a random walk (French and Roll 1986; Keim and Stambaugh 1986; Boehmer and Kelley 2009; Griffin et al. 2010;

Kadapakkam et al. 2015); a common explanation is that larger firms are easier to value and this increases informational efficiency (Boehmer and Wu 2013).¹⁹ ILLIQ is the Amihud (2002) illiquidity ratio, computed as the annual average of daily absolute stock return per dollar trading volume; illiquidity, because of higher transaction costs, reduces the incentives for arbitrage trades and can cause deviations of prices from an unbiased estimate of the fundamental value (Griffin et al. 2010).²⁰ TURN is the log of share turnover (Compustat *CSHTR_F/CSHO*); similar to larger firms, the valuation process is easier for stocks with higher trading activity, implied by greater turnover, thus increasing informational efficiency (Boehmer and Wu 2013).²¹ NASDAQ is a dummy variable for stocks traded on NASDAQ; the variable is added to control for the potential effect of cross-market differences in trading structure on the results. INST is the average institutional ownership during the fiscal year obtained from Thomson Financial's 13F-filings database; Boehmer and Kelley (2009) document that stocks with greater institutional ownership are priced more efficiently.

We estimate the model with OLS and present firm-clustered standard errors.²² We also include year and industry fixed effects.

¹⁹ As a robustness test, we also use the log of total assets, sales, and the number of employees as alternative size proxies. All our results remain unchanged.

²⁰ On a related note, it has also been documented that liquidity may affect managers' incentives to exercise discretion over accruals. For example, Huang et al. (2016) find a positive relation between liquidity and signed discretionary accruals; they identify the effects of liquidity on takeover pressure and equity compensation as possible explanations for their findings.

²¹ Following previous literature (e.g., Boehmer and Kelley 2009), we use the lagged value of the market variables (turnover and illiquidity ratio) to avoid endogeneity issues. Using the contemporaneous values does not change the results.

²² Using two-way clustered standard errors by firm and year (Petersen 2009) does not change our inferences. As robustness check, we also estimated the model using the Fama-MacBeth (1973) two-step approach; inferences are unchanged.

4. SAMPLE AND DESCRIPTIVE STATISTICS

Our main sample is obtained from Compustat and CRSP. We examine firms covering a 20-year period, based on fiscal years, from 1988-2007; because we examine stock prices in the 12-month period beginning three months after the end of the fiscal year, we use stock price data up to 2009. To compute our primary measure of discretionary accruals, we require at least 20 observations with sufficient accounting data in CRSP/Compustat Merged for each industry-year, using the Fama-French 48 industries classification. Consistent with previous literature, we exclude financial firms.

Table 1 describes the sample selection procedure and reports the distribution of the sample firms across industries and years. After excluding firm-years with insufficient data, we are left with a sample of 10,369 firms from 39 industries with 76,873 firm-year observations. The number of observations is fairly well distributed throughout the sample period and across industry groupings.²³

[Table 1]

In an alternative specification of our model, we also require data on the number of analysts following (NAF) from I/B/E/S. Moreover, we need at least five consecutive firm-years of data to compute the standard deviation of cash flow from operations and the standard deviation of sales, our measures of a firm's underlying operating volatility. These requirements reduce the sample for our alternative specification to 53,211 firm-year observations.

²³ Excluding the only industry group representing more than 10% of the sample (Business Services, 11.95%) does not affect our results.

Table 2 reports descriptive statistics for the variables used in later analyses. Descriptive statistics for our informational efficiency and discretionary accruals measures, as well as for our other variables, are consistent with prior literature examining U.S. stocks. IE1 has mean equal to -0.236 and median equal to -0.187; IE2 has mean equal to -0.302 and median equal to -0.260. Mean and median values of ABSDA are 0.066 and 0.042, respectively.

[Table 2]

5. UNIVARIATE ANALYSIS

The Pearson (upper triangle) and Spearman (lower triangle) correlation coefficients between the variables are shown in Table 3. The univariate correlations indicate a negative relation between informational efficiency (IE1, IE2) and ABSDA.

[Table 3]

Previous research shows that both informational efficiency (e.g., Boehmer and Kelley 2009; Kadapakkam et al. 2015) and the absolute value of abnormal accruals (e.g., Kothari et al. 2005; Hribar and Nichols 2007) are significantly associated with firm size; this can lead to spurious associations between IE and ABSDA in the univariate analysis. To examine the relation between discretionary accruals and informational efficiency after partialling out the effect of firm size, we take a double sorting approach. Specifically, we first rank firms into three equally weighted portfolios based on firm size; then, within each size portfolio, we rank firms into three equally weighted portfolios based on the absolute value of abnormal accruals. Table 4 presents the results:

for each firm size portfolio, firms in the portfolio with the highest level of ABSDA show the highest level of IE. The results indicate a positive association between informational efficiency and the absolute value of abnormal accruals. These results emphasize the need to control for firm size when examining the association between IE and ABSDA. We also note that the effect of firm size on IE is substantially larger than the effect of ABSDA; this is consistent with the large size effect on informational efficiency found by prior literature (e.g., Boehmer and Kelley 2009; Kadapakkam et al. 2015).

[Table 4]

This last finding is also confirmed by replicating the correlation analysis after orthogonalizing our measures of informational efficiency (IE1, IE2) and ABSDA with respect to SIZE. The results (untabulated) show that both the Pearson and Spearman correlation coefficients between IE and ABSDA are significantly positive at the 1% level.

6. MULTIPLE REGRESSION ANALYSIS

Main analysis

For our main analysis, we use a multiple regression model that controls for other cross-sectional determinants of informational efficiency. We estimate equation (2), where we relate informational efficiency to the absolute value of abnormal accruals, and to a set of variables potentially affecting the price deviation from a random walk process. The results, presented in Table 5 (Model 1), show a positive and highly significant association between both measures of

price deviation from a random walk (IE1, IE2) and ABSDA. Thus, informational efficiency increases as the absolute value of abnormal accruals increases. In terms of economic magnitude, a one standard deviation change in absolute abnormal accruals corresponds to a change of approximately 3% in our informational efficiency measures.²⁴

[Table 5]

The coefficients of the control variables have the expected sign. SIZE is positively associated with IE; i.e., larger firms have more informationally efficient prices. Furthermore, IE is negatively associated with ILLIQ (Amihud's illiquidity ratio) and positively associated with TURN (turnover by volume); hence, more liquid stocks and more traded stocks exhibit a lower price deviation from a random walk. INST is positively associated with IE, indicating that stocks with greater institutional ownership are priced more efficiently. We also find that the market structure influences IE: NASDAQ (the dummy variable for stocks listed on NASDAQ) has a negative and significant coefficient.

In an alternative specification of our main model, we consider additional control variables potentially affecting the relation between informational efficiency and the absolute value of abnormal accruals. As a further proxy for the richness of the information environment, we add the number of analysts following at the end of the fiscal year (NAF; Rajgopal and Venkatachalam 2011). Furthermore, we control for potential confounding effects on the association between

²⁴ These results indicate that, on average, managerial discretion in accruals has a beneficial effect on informational efficiency. An interesting question is how these results are affected by those firms that exercise a low level of discretion over accruals because their financial statements are highly informative without the use of discretion. We note that these settings would imply a negative association between managerial discretion in accruals and informational efficiency; therefore, it is unlikely that our results are driven by these firms.

ABSDA and IE relating to uncertainty from growth firms and distress firms by including the book-to-market ratio (BM) and Altman's Z-Score. BM can be interpreted as a measure of long-term growth opportunities that captures the extent to which current stock prices reflect future cash flows. A low value of BM indicates higher expected future cash flows, which in turn adds to the uncertainty in firm value and might affect our measures of deviation from random walk pricing. To consider financial distress as a further possible driver of uncertainty, we include Altman's Z-Score (ALTZ) in the regression model. Hribar and Nichols (2007) show that the expected value of absolute discretionary accruals is an increasing function of the variance of signed discretionary accruals, and thus of operating volatility. To avoid a potential bias in the coefficient estimate of ABSDA due to operating volatility affecting both IE and ABSDA, we follow Hribar and Nichols (2007) and add cash flow volatility and sales volatility as proxies for operating volatility to our model. Finally, as our informational efficiency measures—through the return variance—might be affected by non-trading periods, we add the number of non-trading days (NTDAYS); these are identified as the days with zero returns in CRSP (Griffin et al. 2010). The measurement of all variables in our alternative specification is defined in Appendix A.

The results of the alternative specification with additional control variables are presented in Table 5 (Model 2). The coefficient of ABSDA is positive and highly significant; hence, the positive association between informational efficiency and the absolute value of abnormal accruals is confirmed.

Finally, it is worthwhile to notice that our multiple regression results of both models provide confidence in the validity of our measure of informational efficiency. The key determinants of informational efficiency identified by prior literature display the expected sign

of linear association with informational efficiency. Specifically, we find that informational efficiency is positively associated with firm size, turnover, institutional ownership, and the number of analysts following, whereas it is negatively associated with the Amihud illiquidity ratio and the number of non-trading days.²⁵

Cross-sectional variation in the association between informational efficiency and managerial discretion in accruals

In this subsection, we examine the cross-sectional variation in the association between managerial discretion in accruals and informational efficiency. As potential drivers of the cross-sectional variation, we consider proxies for the richness of the information environment and a sub-sample of observations where managerial discretion is likely to be less informative. This cross-sectional evidence allows us to further validate our interpretation of the association between managerial discretion in accruals and informational efficiency as being determined by the effect of managerial discretion on the informativeness of financial statements.

The role of the information environment. Previous literature suggests that managers of firms in richer information environments have less need to use discretion in accounting numbers to communicate their private information (Arya et al. 2003; Louis and Robinson 2005). To test whether the information environment of a firm affects our findings on the association between informational efficiency and discretionary accruals, we use three proxies for the richness of the

²⁵ We further investigate the association between our informational efficiency measures and the key determinants of informational efficiency mentioned above using a portfolio approach (untabulated). We build quintile portfolios based on each variable and compare the mean of our informational efficiency measures in the portfolios. We find that the mean of our informational efficiency measures monotonically increases with firm size, turnover, institutional ownership, and the number of analysts following, whereas it monotonically decreases with the Amihud illiquidity ratio and the number of non-trading days.

information environment: firm size (SIZE), the number of analysts following (NAF; Louis and Robinson 2005), and institutional ownership (INST; Boehmer and Kelley 2009). A higher value of the three variables represents a richer information environment. The results (see Table 6) show a negative coefficient for the interaction term between ABSDA and all the information environment proxies, consistent with the interpretation that discretionary accruals of firms with a richer information environment contain less private information and therefore have a less positive effect on the informational efficiency of stock prices.²⁶

[Table 6]

Accrual-related restatements. We use a sample of restated financial statements identified from Audit Analytics' Non-Reliance Restatements database where the primary reason for restatement is related to accrual accounting.²⁷ Since restatement data in Audit Analytics is available starting from 2000 only, this reduces our sample to 29,161 observations in the period from 2000 to 2007. For this period, we identify 1,639 accrual-related restatements.²⁸ To examine the effect of restatements on the association between IE and ABSDA, we include a dummy variable for restatements (REST) into our main model and interact REST with ABSDA²⁹ and all control variables. The results (see last columns of Table 6) indicate that the interaction term

²⁶ We note that the significance of the association is at the 1% (5%) level for SIZE, at the 1% (5%) level for INST for IE1 (IE2), and at the 5% (insignificant) level for NAF. We also repeated this analysis using our alternative specification (i.e., Model 2 in Table 5) and all results remain significant except the interaction term ABSDA*NAF, which is still negative but not significant at conventional levels.

²⁷ We examine restatements filed between 2000-2011. Restatements are classified as accrual-related if Audit Analytics' item RES_ACC_RES_FKEY_LIST is 1, 6, 7, 12, or 14, where 1 is "depreciation, depletion or amortization errors", 6 is "revenue recognition issues", 7 is "expense (payroll, SGA, other) recording issues", 12 is "liabilities, payables, reserves, and accrual estimate failures", and 14 is "accounts/loans receivable, investments, & cash issues".

²⁸ We also repeated the analysis considering only observations where financial statements are restated after the period used to estimate informational efficiency. The results (untabulated) are qualitatively unchanged.

²⁹ ABSDA is calculated, consistent with the main analysis, using data from the originally reported financial statements.

between ABSDA and REST is negative and significant at the 1% (5%) level for IE1 (IE2). In addition, the coefficient of ABSDA for restatement firms ($\beta_1 + \beta_3$) is negative and significant at the 5% level.³⁰ These results suggest that when accruals are misstated the positive association between our measure of managerial discretion in accruals and informational efficiency not only decreases in magnitude, but becomes negative; thus, in this sub-sample, a larger use of managerial discretion in accruals adversely affects information efficiency.

7. VALIDITY TESTS

Validity of the measures of informational efficiency

We use variance ratios as our main measures to capture informational efficiency. Despite the fact that variance ratios are well-established and widely used in the finance literature (see recent research by O'Hara and Ye 2011; Saffi and Sigurdsson 2011; Boehmer et al. 2015; Conrad et al. 2015; Kadapakkam et al. 2015), a study by Griffin et al. (2010) questions the construct validity of variance ratios based on their counter-intuitive empirical findings for an international setting. Although their results are potentially specific to their setting (Kadapakkam et al. 2015), Griffin et al. (2010) also discuss conceptual limitations of informational efficiency measures that can lead to misleading inferences in our setting. In particular, they show that variance ratios are potentially unsuitable as a measure of informational efficiency if the incorporation of information into stock prices is extremely slow; therefore, alternative explanations for our results may exist.³¹

³⁰ Using our alternative specification with additional control variables (i.e., Model 2 in Table 5) yields similar results.

³¹ We thank an anonymous reviewer for highlighting this point.

To address this issue, we conduct further robustness tests to ensure that our results are not due to extremely slow information incorporation. First, we repeat our main analysis on several sub-samples in which an extremely slow incorporation of information is unlikely. The sub-samples are formed based on firm-specific characteristics that prior literature has related to high (relative) informational efficiency. These characteristics reflect two fundamental building blocks of informational efficiency — transaction and information costs (Griffin et al. 2010). Second, we compute additional variance ratios relating to different time horizons. In particular, extending the base period of the variance ratios should increase confidence that our results are not driven by an extremely slow incorporation of information. Third, we repeat our analysis using an alternative measure of informational efficiency following Hasbrouck (1993), which is obtained from a structural model of prices and trades using intra-day data.

Sub-samples where slow incorporation of information is unlikely

We expect that extremely slow information incorporation into stock prices is unlikely for sub-samples of stocks with large firm size, high liquidity, high trading volume, high institutional ownership, a large number of analysts following, and the possibility to trade stock options. Stocks of large firms and stocks with higher trading volume may be easier to value, thereby incorporating information faster (Boehmer and Wu 2013). High liquidity has been found to stimulate arbitrage trading and thus to increase efficiency (Chordia et al. 2008). Furthermore, sophisticated market participants, such as institutional investors and analysts, are expected to facilitate information incorporation into prices (Boehmer and Kelley 2009). In addition, prior literature finds that options trading facilitates informational efficiency (Watt et al. 1992; Truong

2012). Specifically, Truong (2012) finds that options trading increases the extent to which stock prices reflect future earnings due to private information flowing from the derivative markets to the market for the underlying security.

To empirically test whether our positive association also holds when we exclude stocks with potentially extremely slow information incorporation, we use sub-samples of firm-year observations with (1) more than median market capitalization (our measure of firm size), (2) less than median Amihud illiquidity ratio (our main measure of liquidity), (3) less than median non-trading days (our alternative measure of liquidity), (4) more than median turnover (our measure of trading volume), (5) more than median institutional ownership, (6) more than two sell-side analysts following, (7) options trading available.³² The results in Table 7 show that our inferences hold in all sub-samples; in particular, the coefficient on ABSDA is significantly positive at the 1% level in each of the sub-samples.

[Table 7]

Variance ratios at different time horizons

In addition to our main variance ratio measures that relate 5-day (10-day) return variances to 5 (10) times the 1-day return variance, we compute additional variance ratios by increasing the horizon of the base period, i.e., $VR(2,5)$, $VR(2,10)$, $VR(5,10)$, and the horizon of the returns used at the denominator, i.e., $VR(1,20)$ and $VR(1,30)$. By increasing the horizon of the base period, n ,

³² We obtain data on options from Option Metrics; because data is only available starting from 1996, there is a substantial decrease in sample size. It is interesting to notice that a dummy variable for optioned firms (OPT) is highly positively correlated with our informational efficiency measures. The Pearson correlation coefficient between OPT and IE1 (IE2) is equal to 0.293 (0.265) and significantly different from zero at the 1% level. Because options trading has been found to be positively associated with informational efficiency, this result brings further support to the interpretation of IE1 and IE2 as measures of informational efficiency.

the likelihood that only a small portion of the information is incorporated into prices in the base period decreases. Furthermore, increasing the horizon of the returns used at the denominator, m , allows us to examine the effect of extending the number of lags used to form the variance ratios. Panel A in Table 8 reports the results for variance ratios at different horizons. Our findings hold for variance ratios at different horizons. This provides further confidence in the validity of the informational efficiency measures in our context.

[Table 8]

A structural model of prices and trades to estimate informational efficiency

We also consider a transaction-based measure of informational efficiency, Hasbrouck's (1993) pricing error. This measure of informational efficiency has been used by prior research in different fields (e.g., Kumar et al. 1998; Boehmer and Kelley 2009; Boehmer and Wu 2013; Boehmer et al. 2015; Gozluklu et al. 2015) and does not suffer from the conceptual limitations of the informational efficiency measures discussed in Griffin et al. (2010).

The measure is calculated by estimating a structural model of prices and trades using intra-day data obtained from TAQ. Because of computational limits associated with calculating the measure, we focus on one randomly selected month per fiscal year for the first eight years with available data.³³ The estimation procedures are described in Appendix B.

³³ TAQ data are available to us only starting from 1996; therefore, we consider fiscal years from 1995 to 2002. Furthermore, we restrict the analysis to firms with fiscal year-end in December. For each fiscal year, we randomly select one month in the estimation period used for IE1 and IE2. We divide the 12-month estimation period into four quarters and we select the month in different quarters in groups of four years. Specifically, the selected months are November 1996, August 1997, June 1998, January 2000, November 2001, March 2002, September 2002, and April 2003.

This approach to examining informational efficiency relies on a model where the log of transaction price is decomposed into an efficient price component (which is a random walk) and a pricing error. The measure of informational efficiency is based on the inverse of the magnitude of the pricing error. The variance of the pricing error can be obtained by estimating a VAR model involving the change in price, and trade characteristics. Following prior literature (e.g., Boehmer and Wu 2013), we focus on the ratio of the standard deviation of the pricing error to the standard deviation of the log of price, which can be interpreted as the proportion of deviations from the efficient price in the total variability of the observable transaction price process. We define the measure of informational efficiency, denoted as IE3, as negative one multiplied by the ratio of the standard deviation of the pricing error to the standard deviation of the log of price; therefore, a high level of IE3 implies higher informational efficiency.

IE3 in our sample has a mean equal to -0.069 and a standard deviation of 0.093; these figures are comparable to those reported by prior literature for U.S. markets (e.g., Boehmer and Kelley 2009; Boehmer and Wu 2013). The Spearman (Pearson) correlation between IE3 and our informational efficiency measures is equal to 0.313 (0.260) for IE1 and to 0.283 (0.248) for IE2, respectively; all correlation coefficients are significantly different from zero at the 1% level. We interpret the substantial positive correlation between IE3 and our measure of informational efficiency as a further validation of IE1 and IE2 as informational efficiency measures.

We replicate our main analysis using IE3 as dependent variable. The results are reported in Panel B of Table 8. The coefficient of ABSDA is positive and highly significant, confirming the results obtained with our main measures of informational efficiency. The results for IE1 and IE2 for the sample used to estimate IE3 (see last two columns of Table 8, Panel B) suggest that the

results for IE3 are not due to an exceptionally strong association between informational efficiency and managerial discretion in accruals in the restricted sample.

Validity of the measure of managerial discretion in accruals

The effect of operating volatility and unusual events on the estimation of discretionary accruals

To measure the extent to which managers exercise discretion over accruals, we rely on a widely used model based on Jones (1991) as modified by Kothari et al. (2005). However, Jones-type models have come under much scrutiny as to misspecification problems with respect to the firms' underlying accrual generating process, particularly in the presence of exceptional business circumstances (e.g., Bernard and Skinner 1996; Owens et al. 2016). As a result, these models potentially misclassify non-discretionary accruals as discretionary, which manifests in implausibly large magnitudes of discretionary accruals (Ball 2013; Owens et al. 2016). Therefore, a major concern is that our results are not attributable to managerial discretion in accruals, but rather to underlying economic events correlated with the misclassification of discretionary accruals and our dependent variable of interest (i.e., informational efficiency).

To mitigate potential misclassification issues, prior empirical studies include controls for firm performance and operating volatility, in particular when using unsigned measures of discretionary accruals. We control for firm performance by including (lagged) return on assets directly into the discretionary accruals estimation model (Kothari et al. 2005); following Hribar and Nichols (2007), we include the standard deviation of cash flows and the standard deviation of sales in our extended model to control for operating volatility. However, accruals arising from

unusual business circumstances, such as business model shocks, can still introduce severe biases into both unsigned and signed discretionary accruals (Owens et al. 2016).

To mitigate concerns that unusual business circumstances drive our results, we identify and exclude firm-year observations that experienced a shock to their business model (about 18% of our sample) following Owens et al. (2016).³⁴ Specifically, we exclude firm-year observations that have (1) major acquisitions, (2) large discontinued operations, (3) four-digit SIC industry changes, (4) large restructuring charges, and (5) large special items. The results in Table 9 show that our findings are not only robust to operating volatility, but also to potential misspecification problems in the discretionary accruals model arising from business model shocks.

[Table 9]

Alternative calculation of total accruals

We also repeat our main analysis calculating total accruals using the cash flow approach as proposed by Hribar and Collins (2002). Specifically, we compute total accruals from the cash flow statement as net income before extraordinary items and discontinued operations (Compustat *IBC*) minus cash flow from operations before extraordinary items and discontinued operations (Compustat *OANCF-XIDOC*). The coefficient of *ABSDA* is 0.080 (t-value 10.25) using *IE1* and 0.089 (t-value 9.73) using *IE2*. Thus, our inference regarding the association between managerial discretion in accruals and informational efficiency is unchanged.

³⁴ According to Owens et al. (2016), these shocks can affect accruals over multiple years. Therefore, we repeat our analysis excluding all firm-year observations that have at least one of the indicators in the current or in the prior year. Our results remain unchanged.

Alternative models to estimate discretionary accruals

Following Kothari et al. (2005), in the main analysis, we control for a potential misspecification of prior accrual models for firms with extreme performance by including the lagged return on assets (ROA_{t-1}). Alternatively, we use cash flow from operations and book-to-market ratio to control for firm performance and growth opportunities (Larcker et al. 2007) instead of lagged ROA. Additionally, we use various alternative models used in previous literature to estimate discretionary accruals (i.e., Jones 1991; Dechow et al. 1995; Xie 2001; Ball and Shivakumar 2006). Our results are robust with respect to different accrual models.

8. SENSITIVITY ANALYSIS

Time sub-samples. To examine the stability of our results over time, we split the sample in two periods of ten years (1988-1997 and 1998-2007) and four periods of five years (1988-1992, 1993-1997, 1998-2002, 2003-2007). The coefficient of ABSDA is positive and significant at the 1% level in all sub-periods, although the magnitude of the coefficient is higher in earlier periods.³⁵

Profit vs. loss firms. We repeat our main analysis on profit firms and loss firms separately.³⁶ The association between informational efficiency and managerial discretion in accruals is weaker for loss firms, but the coefficient of ABSDA (0.057, t-value 4.29, using IE1 and 0.063, t-value 4.02, using IE2) is still positive and significant at the 1% level.³⁷ One potential explanation for the lower

³⁵ When using IE1, the coefficient of ABSDA is 0.140 (t-value 10.24) in 1988-1997; 0.065 (t-value 5.57) in 1998-2007. When using IE2, the coefficient of ABSDA is 0.149 (t-value 9.63) in 1988-1997; 0.080 (t-value 5.51) in 1998-2007.

³⁶ A firm is considered a loss firm if net income before extraordinary items is less than zero. Loss firms represent 32.47% of our sample.

³⁷ For firms with positive earnings the coefficient of ABSDA is 0.130 (t-value 10.27) for IE1 and 0.146 (t-value 9.89) for IE2.

coefficient is that managers of loss firms engage in big bath accounting using their discretion over accruals to create reserves for future periods (e.g., Healy 1985).

Positive vs. negative discretionary accruals. Different signs of discretionary accruals may reflect different underlying financial reporting motivations, and thus, have potentially different implications for the information value of discretionary accruals. However, segmenting the analysis by income-increasing and income-decreasing abnormal accruals does not change our inferences regarding the association between informational efficiency and the extent of discretionary accruals. The coefficient for ABSDA in the positive discretionary accruals sample is 0.111 (0.123) using IE1 (IE2) with a t-value of 9.28 (8.83), whereas the coefficient for ABSDA in the negative discretionary accruals sample using IE1 (IE2) is 0.079 (0.085) with a t-value of 5.91 (5.34). These findings suggest that both income-increasing and income-decreasing discretionary accruals convey useful information to the market.

Discretionary vs. non-discretionary accruals. As a further sensitivity test, we examine the association between informational efficiency and the non-discretionary portion of total accruals. We follow the design used in the main analysis and add the absolute value of normal (non-discretionary) accruals (ABSNDNA) to the model. The results show that the coefficient of ABSNDNA is positive and significantly different from zero. The magnitude and the significance of the coefficient of ABSDA are essentially unchanged. Furthermore, prior literature (e.g., Francis et al. 2004, 2005) documents that discretionary accruals identified using Jones-type models are potentially affected by “innate factors”, i.e. variables that are not related to discretionary choices. Therefore, we also replicate our analysis using the residuals of a regression relating ABSDA to the innate factors used by Francis et al. (2004) as measure of managerial discretion in accruals.

The innate factors are firm size, operating cycle, capital intensity, intangible intensity, a dummy variable for the absence of intangibles, standard deviation of cash flow from operations, standard deviation of sales and number of negative earnings; the last three variables are calculated using the last five years. Inference on the association between ABSDA and IE is unchanged.

Informational efficiency and managerial discretion in accruals: intra-year variation. In the main analysis we concentrate on informational efficiency in the 12-month period beginning three months after the end of the fiscal year. Here, we divide this period into quarters and examine the association between IE and ABSDA separately for each quarter. We find a positive association between IE and ABSDA in all quarters.³⁸ The magnitude of the positive ABSDA coefficient is highest in the second quarter, i.e. between the seventh and the ninth month after the end of the fiscal year. In the third and in the fourth quarter, the positive association is weaker but still highly significant. These findings suggest a decrease in the informativeness of discretionary accruals over time. The high significance of the ABSDA coefficient over the whole year also indicates that the association between informational efficiency and discretionary accruals goes beyond the period most affected by the post-earnings announcement drift. Specifically, most studies document that the drift is concentrated between the first quarter and the end of the second quarter after earnings announcements (see, for a survey, Richardson et al. 2010).

Excluding information days. To further examine the timing of the effects of discretionary choices in accrual reporting on price discovery we replicate the analysis excluding the three days around earnings announcements (identified using Compustat *RDQ*). Our findings remain

³⁸ When using IE1, the coefficient of ABSDA is 0.091 (t-value 8.10) in the first quarter; 0.100 (t-value 9.06) in the second quarter; 0.058 (t-value 5.02) in the third quarter; 0.071 (t-value 5.48) in the fourth quarter. When using IE2, the coefficient of ABSDA is 0.092 (t-value 5.86) in the first quarter; 0.109 (t-value 7.99) in the second quarter; 0.058 (t-value 4.04) in the third quarter; 0.065 (t-value 2.32) in the fourth quarter.

unchanged; this suggests that our main results are not driven by the time period around which the market response to accounting information is strongest.

Informational efficiency and managerial discretion in quarterly accruals. In addition to our main analysis using annual data, we investigate the relation between managerial discretion in quarterly accruals (ABSDAQ) and informational efficiency.³⁹ Using our main model in equation (2), we relate ABSDAQ to informational efficiency in the period between the corresponding quarterly earnings announcement and the following quarterly earnings announcement. In the model, we add dummy variables for the quarters. The dates of the quarterly earnings announcements are obtained from Compustat (*RDQ*); we remove observations where the quarterly announcement for the fourth quarter was issued more than 90 days after quarter end or more than 60 days after quarter end for the first three quarters. Consistent with the analysis using annual data, the results show that the coefficient on ABSDAQ is positive and significantly different from zero with a t-value of 2.73 (2.38) for IE1 (IE2). The association is weaker than in the main analysis, suggesting that quarterly discretionary accruals carry less information than annual discretionary accruals.

The role of the perceived reliability of financial statements. The price deviation from a random walk pattern can also be affected by the extent to which investors rely on and use the information in accounting numbers. Therefore, a systematic relation between ABSDA and the perceived reliability of financial statements could influence our results. We control for the reliability of financial statements as perceived by investors using the absolute value of the three-day abnormal return around the annual earnings announcement and the ratio of the three-day abnormal return

³⁹ We measure quarterly discretionary accruals (ABSDAQ) following Collins et al. (2016).

to the earnings surprise as an indicator for reliability.⁴⁰ Adding any of the two variables to the main model, inference regarding the ABSDA coefficient is unchanged. The coefficient of the absolute value of abnormal returns is positive and significant, whereas the coefficient of the ratio of the absolute abnormal return to the earnings surprise is insignificantly different from zero.

Further alternative control variables. As an alternative measure of liquidity we use the annual average of the daily percentage bid-ask spread, which is measured as the difference between the closing ask and bid price divided by the midquote. As a further alternative measure of liquidity, we use the estimator of the bid-ask spread developed by Corwin and Schultz (2012), which is based on daily high and low prices. We use leverage as an alternative control variable for financial distress since highly leveraged firms are presumably more likely to go bankrupt (Rajgopal and Venkatachalam 2011).⁴¹ We also use two alternative controls for firms' growth options, Tobin's Q and sales growth, and exclude firms with an Altman Z-Score below 1.81 to ensure that growth or distress firms do not drive our results. The results obtained using these alternative specifications are qualitatively the same as in the main analysis.

Market-adjusted returns. Following a wide body of prior literature (e.g., Campbell et al. 1997) we use raw returns to calculate variance ratios in the main analysis. We also repeat the analysis using market-adjusted returns, which are defined as the raw return minus the value weighted return in CRSP. Inference regarding the association between ABSDA and informational

⁴⁰ The abnormal return is defined as the difference between the actual return and the value-weighted return on the stocks in the same capitalization decile (as provided by CRSP). We focus on the period from day -1 to day +1 around an earnings announcement. The earnings surprise is defined as earnings per share minus the median consensus in analysts' forecasts, divided by the stock price. We also replicated the analysis using raw returns and the results are virtually unchanged.

⁴¹ As additional control variables we consider: the log of the stock price at the end of the fiscal year; cash flow from operations, both signed and in absolute value; the standard deviation of monthly returns in the period used to calculate the informational efficiency measures and in the prior 12 months; the standard deviation of annual returns calculated using returns in the last five years; IE1 and IE2 in the previous year. The results are unchanged.

efficiency is unchanged. This suggests that our results are not driven by the relation between the market return and individual stock returns.

Penny stocks. Penny stocks (with a price lower than one dollar) have often been documented as being related to extreme illiquidity and pricing anomalies. Accordingly, we also replicate the analysis excluding penny stocks; untabulated findings are qualitatively analogous.

General managerial discretion and discretionary accruals. For an alternative proxy of managerial discretion, we consider a widely used industry discretion index (MDSCORE) developed by Hambrick and Abrahamson (1995). This index measures the effect of executives on the organizational outcome within an industry. It is based on ratings of the overall managerial discretion in 17 industries; the ratings are given by a panel of securities analysts specialized in these industries and by academic experts. Using industry determinants of discretion theoretically proposed by Hambrick and Finkelstein (1987), Hambrick and Abrahamson (1995) extend the 17-industry index by 53 additional industries, resulting in a final index encompassing 70 four-digit-SIC code industries.⁴² The index uses a seven-point scale, where higher levels of MDSCORE indicate greater managerial discretion. As the index is only available for 70 four-digit-SIC code industries, our sample is limited to 36,498 observations from these industries. Using a model with the same set of control variables as in our main analysis, the coefficient of MDSCORE is positive and highly significant. This finding is consistent with our main results: the extent of managerial discretion is positively associated with informational efficiency.⁴³

⁴² The extended index is presented in Finkelstein, Hambrick and Cannella (2009).

⁴³ We also replicated the main analysis including MDSCORE as additional control variable. The inference regarding the association between managerial discretion in accruals and informational efficiency is qualitatively unchanged.

9. ADDITIONAL ANALYSES

In this section, we discuss how our results are related to prior accounting literature dealing with various aspects of informational efficiency and accrual-based managerial discretion. In particular, we empirically evaluate how our results relate to recent work by Callen et al. (2013) that examines the association between accruals quality and price delay, a measure of information efficiency developed by Hou and Moskowitz (2005) that focuses on the speed of adjustment to market-wide information. Furthermore, we investigate how idiosyncratic volatility is related to our results. Finally, we discuss the relation between our results and the findings of prior research on discretionary accruals and the post-earnings announcement drift, the absolute value of excess returns, and the accrual anomaly.

Price delay

Hou and Moskowitz (2005) develop a firm-specific measure of price delay that reflects the annual average delay with which weekly stock returns reflect market-wide news of the past four weeks. Callen et al. (2013) employ this measure to examine whether accounting quality explains some of the cross-sectional variation in price delay. Their findings suggest that poor accounting quality is positively related to price delay. Although our measure of managerial discretion in accruals (ABSDA) is conceptionally different from their main measure of accounting quality, i.e., accrual quality (AQ), measured as the inverse of the standard deviation of the residuals from the Dechow and Dichev (2002) model, prior literature has documented a considerable positive correlation between the two measures suggesting that they have a common component.

To evaluate how our results relate to the results in Callen et al. (2013), we replicate their main analysis using ABSDA instead of AQ.⁴⁴ ABSDA is significantly positively associated with the price delay measure at the 5% level with a coefficient of 0.023 (t-value 2.03); this indicates that stock price delay increases in the magnitude of discretionary accruals. However, we further follow their suggestion to include additional controls (i.e., firm size, $\sigma(\text{CFO})$, $\sigma(\text{Sales})$, the length of the operating cycle, and the Amihud's illiquidity ratio) to address concerns that the accruals-based measures mainly capture firm's innate operating characteristics and to appropriately control for the effect of liquidity on the price discovery process. Our results for ABSDA in this specification now turn insignificant with a coefficient of 0.005 (t-value 0.43), while AQ is still significantly positively associated with price delay.⁴⁵ This suggests that AQ and ABSDA are related to price delay in a substantially different way. Furthermore, it is noteworthy that the coefficient on ABSDA is significantly negative when we add firm-fixed effects (-0.018, t-value -2.02).

In addition to the differences in the accrual measures, our main measures of informational efficiency, i.e. variance ratios, differ substantially from Hou and Moskowitz's (2005) price delay measures that are based on lower frequency week-to-week return patterns and deal with one specific type of information, namely market-wide information.

⁴⁴ The results from our replication using AQ are comparable to the results presented in Table 4 of Callen et al. (2013). The coefficient on AQ for the regression model in column (1) of Table 4 is 0.830 (t-value 7.97) and 0.213 (t-value 5.06) for the model in column (2). Differences between our replication results and the original results in Callen et al. (2013) are potentially attributable to the fact that data on one control variable, the breadth of mutual fund ownership, is not available to us.

⁴⁵ AQ in our replication is significantly positively associated with price delay at the 1% level with a coefficient of 0.170 (t-value 3.38).

Idiosyncratic volatility

Idiosyncratic stock return volatility has been proposed as a measure of informational efficiency. Hence, our analysis is related to prior research investigating the relation between idiosyncratic return volatility and discretionary accruals; the findings of these studies are mixed. Rajgopal and Venkatachalam (2011) and Chen et al. (2012) find that idiosyncratic return volatility is positively associated with the absolute value of abnormal accruals; conversely, Hutton et al. (2009) document a negative association. Relatedly, Li et al. (2014) discuss how the conflicting evidence can be reconciled. Yet, the interpretation of idiosyncratic volatility as a measure of price efficiency is controversial.⁴⁶

The deviation of prices from a random walk pattern is different from idiosyncratic volatility. Chae et al. (2013) present a formal comparison of idiosyncratic volatility and variance ratios. However, we also examine the relation between idiosyncratic volatility, discretionary accruals and the price deviation from a random walk pattern, our main measure of informational efficiency in our sample. Following the standard approach in previous literature (Ang et al. 2006; Rajgopal and Venkatachalam 2011), we measure idiosyncratic volatility as the standard deviation of residuals of the Fama-French three-factor model, calculated using daily returns. We relate idiosyncratic volatility (IVOL) to ABSDA and to the cross-sectional determinants of informational efficiency. We find that IVOL is positively and highly significantly associated with ABSDA, i.e.

⁴⁶ One group of works argues that greater idiosyncratic volatility implies greater price informativeness (Morck et al. 2000; Durnev et al. 2003; Jin and Myers 2006). A second stream of studies contends that greater idiosyncratic volatility indicates a poorer information environment (West 1988; Krishnaswami and Subramaniam 1999; Brown and Kapadia 2007; Dasgupta et al. 2010); consistent with this view, it has been suggested that idiosyncratic volatility reflects noise trading (Roll 1988; Kelly 2014) or limits to arbitrage (Pontiff 1996, Wurgler and Zhuravskaya 2002, and Mashruwala et al. 2006). Lee and Liu (2011) try to reconcile the different views on idiosyncratic volatility and price informativeness; they develop a model showing that idiosyncratic volatility has either a U-shaped or negative relation with price informativeness; using six widely used price informativeness measures, they also document a U-shaped relation between idiosyncratic volatility and price informativeness.

idiosyncratic volatility increases with the extent to which managers exercise discretion over accruals.

To further investigate the relation between idiosyncratic volatility and a price deviation from a random walk pattern, we examine the correlation between IVOL and IE for different quartiles of IE obtained by sorting firms in each year separately. Consistent with Lee and Liu (2011), we find that IE exhibits a U-shaped relation with IVOL. More specifically, in the lower three quartiles of IE, the correlation between IE and IVOL is negative; in the highest quartile of IE the correlation between IE and IVOL is positive.

Post-earnings-announcement drift

Francis et al. (2007) find that a disproportionate amount of post-earnings-announcement drift (PEAD) returns is associated with stocks characterized by high information uncertainty. In sensitivity tests, they use the absolute value of abnormal accruals as measure of information uncertainty. Their results imply that a specific form of inefficiency (the PEAD) is positively associated with the absolute value of abnormal accruals.⁴⁷ We argue that our approach to measuring informational efficiency is different from that adopted by Francis et al. (2007). First, we focus on a 12-month period after the earnings announcement while most prior literature documents that the drift is concentrated in the first six months. As described in Section 8, we observe a significantly positive association between ABSDA and IE for each of the quarters of the period used to estimate informational efficiency. Second, the PEAD only captures one specific

⁴⁷ Shivakumar (2007), in his discussion of Francis et al. (2007), suggests a possible explanation of the results that is unrelated to information uncertainty. He notices that the proxies used to measure information uncertainty are positively related to the volatility of earnings; a higher volatility of earnings leads to a higher likelihood that a firm experiences extreme earnings surprises and is classified in the extreme quantiles used to implement the PEAD trading strategy.

form of inefficiency (i.e., positive autocorrelation in returns), whereas our measure of informational efficiency captures any deviation from a random walk pattern.

Absolute value of excess returns

Perotti and Wagenhofer (2014) use the absolute value of excess returns, calculated as the deviation from the Fama-French (1993) three factor model augmented with momentum (Carhart 1997), as a measure of mispricing. Perotti and Wagenhofer (2014) find that the absolute value of abnormal accruals is positively associated with future absolute value of excess returns; their findings suggests that a specific aspect of mispricing, namely the deviation of stock returns from the expectations deriving from a widely used asset pricing model, increases as managerial discretion in accruals increases. We note that their measure captures a different return pattern than that examined by our measures; specifically, the existence of non-zero absolute excess returns does not necessarily imply a deviation from the random walk benchmark. We also control in our main model for the absolute value of excess returns, calculated following Perotti and Wagenhofer (2014) in the period used to estimate informational efficiency; the results are qualitatively unchanged.

The discretionary accrual anomaly

The accrual anomaly—the tendency of stocks of firms in the bottom tail of the accrual distribution to outperform stocks of firms in the top tail of the accrual distribution—is one of the most pervasive market anomalies based on financial accounting information. The anomaly has also been found for discretionary accruals (Xie 2001). Our results suggest that the discretionary

accrual anomaly is distinct from the association between the absolute value of abnormal accruals and the deviation of the price from a random walk. Specifically, the anomaly has been documented in the tails of the discretionary accrual distribution; this implies that stock prices of firms with discretionary accruals in the tails of the distribution are less informationally efficient than stock prices of the other firms. Hence, the discretionary accrual anomaly should bias against finding our results, which instead indicate a positive association between the absolute value of abnormal accruals and informational efficiency. We also repeat our analysis excluding the observations in the extreme deciles based on signed abnormal accruals; we follow this approach because most literature documents the anomaly for the extreme deciles of the distribution. The results are qualitatively analogous to the main findings.

10. CONCLUSIONS

Informational efficiency is a fundamental aspect of market quality and of the capital allocation and investment decision process. Financial reporting may play a crucial role in determining the extent to which prices reflect available information. Relatedly, calls for more research on the accounting determinants of informational efficiency have been raised by, among others, Kothari (2001), Lee (2001), and Richardson et al. (2010). This paper examines how an important aspect of the accounting process, namely the amount of discretion exercised by managers in accrual reporting, affects informational efficiency.

A longstanding debate among academics, regulators, and practitioners is centered on the informativeness of managerial discretion in accounting earnings—which is mainly determined by the accrual component. One side of the debate argues that discretionary accruals communicate

useful information to market participants; the other side of the debate contends that investors are more often than not misled by accrual-based discretion in financial reporting. Understanding what is the prevailing effect of managerial discretion in accruals on the informativeness of financial statements, and therefore on informational efficiency, is an empirical question.

We measure the magnitude of managerial discretion in accruals by the absolute value of abnormal accruals. Assuming that efficient prices follow a random walk, we measure informational efficiency by using stock return variance ratios. Our analysis considers a large sample of non-financial U.S. firms over 20 years. We find that the absolute value of abnormal accruals is negatively associated with the price deviation from a random walk pattern. Hence, informational efficiency increases with managerial discretion in accruals. These results are consistent with the view that discretionary accruals, on average, do convey useful information to investors.

Our findings have implications for the interpretation and regulation of managerial discretion in accrual reporting. In particular, our results indicate that reducing accrual-based discretion may have adverse effects on the informational efficiency of stock prices, which should be taken into consideration when assessing the impact of changes in regulation of financial reporting. The analysis is related to the major issues addressed by the FASB in recent years (e.g., financial instruments, employee stock options, fixed assets and goodwill impairment and valuation of acquired intangibles); it is also closely linked to the current debate on rules-based vs. principles-based accounting—the latter model (which characterizes the international financial reporting standards) relying to a greater extent on managerial discretion.

APPENDIX A: VARIABLES DEFINITION

| <i>Variable</i> | <i>Definition</i> |
|------------------------|--|
| ABSDA | Measure of the magnitude of discretionary accruals. ABSDA is the absolute value of abnormal accruals obtained from a Jones (1991) accruals model as modified by Dechow et al. (1995) and Kothari et al. (2005). |
| ALTZ | Altman's Z-Score is computed as $Z = 1.2*WC/AT + 1.4*RE/AT + 3.3*NIBE + 0.6*MVE/TL + SALE/AT$, where WC is working capital (Compustat <i>WCAP</i>); RE is retained earnings (Compustat <i>RE</i>); NIBE is net income before extraordinary items (Compustat <i>IB</i>); MVE is the market value of equity (Compustat <i>PRCC_F*CSHO</i>); TL is total liabilities (Compustat <i>LT</i>); SALE is sales (Compustat <i>SALE</i>), and AT is total assets (Compustat <i>AT</i>). |
| BM | Book-to-market ratio, computed as the book value of equity (Compustat <i>CEQ</i>) divided by the market value of equity at the end of the fiscal year (Compustat <i>PRCC_F*CSHO</i>). |
| IE1,2 | Measures of stock price informational efficiency, computed as $ VR(n,m)-1 $ multiplied by -1; where $VR(n,m)$ is the return variance ratio, i.e. n/m times the ratio of the m -day return variance to the n -day return variance. IE1 is computed using $VR(1,5)$ and IE2 using $VR(1,10)$. Both measures are calculated over the 12-month period beginning three months after the end of the previous fiscal year. See Section 3. |
| ILLIQ | Amihud (2002) illiquidity ratio; computed as the average of daily absolute stock return per dollar trading volume both obtained from CRSP. The measure is calculated over the 12-month period corresponding to the fiscal year. |
| IVOL | Measure of idiosyncratic volatility; computed as the in-sample standard deviation of the residuals of the Fama-French three-factor model. The measure is calculated over the 12-month period beginning three months after the end of the previous fiscal year. |
| INST | Average quarterly institutional ownership in the fiscal year. Quarterly institutional ownership is computed as the number of shares held by institutional investors at quarter end obtained from Thomson Financial's 13F-filings database divided by the number of shares outstanding. |
| NAF | Log of (1 + number of analysts following in I/B/E/S) at the end of the fiscal year. |
| NASDAQ | Dummy variable coded 1 for stocks traded on NASDAQ and 0 otherwise. |
| NTDAYS | Number of non-trading days, computed as the number of days with zero returns in CRSP. The measure is calculated over the 12-month period beginning three months after the end of the previous fiscal year. |
| SIZE | Log of market value of equity (Compustat <i>PRCC_F*CSHO</i>) at the end of the fiscal year. |
| $\sigma(\text{CFO})$ | Rolling standard deviation of cash flow from operations, calculated from fiscal year t-4 to fiscal year t. Cash flow from operations is computed as net income before extraordinary items (Compustat <i>IB</i>) minus total accruals. Total accruals is obtained as: change in current assets (Compustat <i>ACT</i>) minus change in cash and short-term investments (Compustat <i>CHE</i>) minus change in current liabilities (Compustat <i>LCT</i>) plus change in debt included in current liabilities (Compustat <i>DLC</i>) minus depreciation and amortization expense (Compustat <i>DP</i>). |
| $\sigma(\text{SALES})$ | Rolling standard deviation of sales (Compustat <i>SALE</i>), calculated from fiscal year t-4 to fiscal year t. |
| TURN | Log of share turnover; where share turnover is computed as the number of shares traded during the fiscal year divided by the number of shares outstanding (Compustat <i>CSHTR_F/CSHO</i>). |

**APPENDIX B: ESTIMATION OF A TRANSACTION-BASED INFORMATIONAL EFFICIENCY
MEASURE (PRICING ERROR, FOLLOWING HASBROUCK 1993)**

The measure of informational efficiency relies on a model where the log of transaction price, p_t , is decomposed in m_t+s_t . m_t is the efficient price corresponding to the expected value of the future payoffs—given all available information—and it is a random walk, with $m_t=m_{t-1}+w_t$; s_t is the deviation of the price from the fundamental value, denoted as pricing error.⁴⁸ The measure of informational efficiency is based on the inverse of the magnitude of the pricing error. We focus on the ratio of the standard deviation of the pricing error to the standard deviation of the log of price (Boehmer and Wu 2013), which can be interpreted as the proportion of deviations from the efficient price in the total variability of the observable transaction price process.

To obtain an estimate of the standard deviation of the pricing error, more assumptions on the evolution of prices and trades are required. Specifically, the variation in price and a set of trade characteristics are assumed to follow a VAR with five lags as follows:

$$\begin{cases} r_t = a_1 r_{t-1} + a_2 r_{t-2} + \dots + b_1 x_{t-1} + b_2 x_{t-2} + \dots + v_{1,t} \\ x_t = c_1 r_{t-1} + c_2 r_{t-2} + \dots + d_1 x_{t-1} + d_2 x_{t-2} + \dots + v_{2,t} \end{cases}$$

where r_t is the difference in (log) prices p_t and x_t is a column vector of trade-related variables: the sign of the trade (+1 if buyer initiated; -1 if seller initiated), signed trading volume (in number of shares), and the signed square root of trading volume to model concavity between prices and trades. To infer trade direction we use the tick test (Finucane, 2000). The price of a trade is

⁴⁸ We apply the filters to TAQ data suggested by prior literature using this measure (e.g., Boehmer and Kelley 2009; Boehmer and Wu 2013). We exclude overnight returns. Furthermore, we require that TAQ's CORR field is equal to zero, and the COND field is either blank or equal to *, B, E, J, or K. Trades with non-positive prices or sizes are eliminated. A trade with a price greater than 150% or less than 50% of the price of the previous trade is also excluded. Following Boehmer and Kelley (2009), we require that the stock has at least 200 transactions in the month used as estimation period.

compared to the price of the previous trade with a different price; if the price is higher (lower) than the previous trade with a different price, the trade is classified as buyer (seller) initiated.

The VMA representation of the above VAR is obtained as:

$$\begin{cases} r_t = a_0^* v_{1,t} + a_1^* v_{1,t-1} + a_2^* v_{1,t-2} \dots + b_0^* v_{2,t} + b_1^* v_{2,t-1} + b_2^* v_{2,t-2} + \dots \\ x_t = c_0^* v_{1,t} + c_1^* v_{1,t-1} + c_2^* v_{1,t-2} \dots + d_0^* v_{2,t} + d_1^* v_{2,t-1} + d_2^* v_{2,t-2} + \dots \end{cases}$$

The variance of the efficient price is exactly identified in the model whereas the variance of the pricing error is not. Following prior literature, to identify the variance of the pricing error we use the Beveridge and Nelson (1981) restriction. The pricing error can be written as:

$$s_t = \alpha_0 v_{1,t} + \alpha_1 v_{1,t-1} + \dots + \beta_0 v_{2,t} + \beta_1 v_{2,t-1} + \dots$$

The variance the pricing error can be derived as:

$$\sigma_s^2 = \sum_{j=0}^{\infty} [\alpha_j \ \beta_j] cov(v) [\alpha_j \ \beta_j]'$$

where $\alpha_j = -\sum_{k=j+1}^{\infty} a_k^*$; $\beta_j = -\sum_{k=j+1}^{\infty} b_k^*$.

We define the measure of informational efficiency, denoted as IE3, as negative one multiplied by the ratio of the standard deviation of the pricing error to the standard deviation of the log of price; therefore, a higher level of IE3 implies higher informational efficiency.

REFERENCES

- Adams, G., McQueen, G. R., Wood, R., 2004. The Effects of Inflation News on High Frequency Stock Returns. *Journal of Business* 77, 547-574.
- Ahn, D. H., Boudoukh, J., Richardson, M. P., Whitelaw, R. F., 2002. Partial Adjustment or Stale Prices? Implications from Stock Index and Futures Return Autocorrelations. *Review of Financial Studies* 15, 655-689.
- Alexander, D. J. A., Jermakowicz, E. K., 2006. A True and Fair View of the Principles/Rules Debate. *Abacus* 42, 132-164.
- Amihud, Y., 2002. Illiquidity and Stock Returns: Cross-Section and Time Series Effects. *Journal of Financial Markets* 5, 31-56.
- Anderson, R. M., 2011. Time-varying Risk Premia. *Journal of Mathematical Economics* 47, 253-259.
- Anderson, R. M., Eom, K. S., Hahn, S. B., Park, J. H., 2012. Sources of Stock Return Autocorrelation. *Working paper*, University of California at Berkeley.
- Anderson, R. M., Eom, K. S., Hahn, S. B., Park, J. H., 2013. Autocorrelation and Partial Price Adjustment. *Journal of Empirical Finance* 24, 78-93.
- Ang, A., Hodrick, R. J., Xing, Y., Zhang, X., 2006. The Cross-Section of Volatility and Expected Returns. *Journal of Finance* 61, 259-299.
- Arya, A., Glover, J. C., Sunder, S., 2003. Are Unmanaged Earnings Always Better for Shareholders? *Accounting Horizons* 17, 111-116.
- Ball, R., 2013. Accounting Informs Investors and Earnings Management is Rife: Two Questionable Beliefs. *Accounting Horizons* 27, 847-853.
- Ball, R., Shivakumar, L., 2006. The Role of Accruals in Asymmetrically Timely Gain and Loss Recognition. *Journal of Accounting Research* 44, 207-242.
- Badertscher, B. A., Collins, D. W., Lys, T. Z., 2012. Discretionary Accounting Choices and the Predictive Ability of Accruals with Respect to Future Cash Flows. *Journal of Accounting and Economics* 53, 330-352.
- Barnea, A., 1974. Performance Evaluation of New York Stock Exchange Specialists. *Journal of Financial and Quantitative Analysis* 9, 511-535.
- Bennett, P., Wei, L., 2006. Market Structure, Fragmentation, and Market Quality. *Journal of Financial Markets* 9, 49-78.

- Bernard, V., Skinner, D., 1996. What Motivates Managers's Choice of Discretionary Accruals? *Journal of Accounting and Economics* 22, 313-325.
- Beveridge, S., Nelson, C., 1981. A New Approach to the Decomposition of Economic Time Series Into Permanent and Transitory Components with Particular Attention to the Measurement of the Business Cycle. *Journal of Monetary Economics* 7, 151-174.
- Boehmer, E., Chava, S., Tookes, H. E., 2015. Related Securities and Equity Market Quality: The Cases of CDS. *Journal of Financial and Quantitative Analysis* 50, 509-541.
- Boehmer, E., Kelley, E. K., 2009. Institutional Investors and the Informational Efficiency of Prices. *Review of Financial Studies* 22, 3563-3594.
- Boehmer, E., Wu, J. J., 2013. Short Selling and the Price Discovery Process. *Review of Financial Studies* 26, 287-322.
- Bowen, R. M., Rajgopal. S., Venkatachalam, M., 2008. Accounting Discretion, Corporate Governance, and Firm Performance. *Contemporary Accounting Research* 25, 351-405.
- Brown, G., Kapadia, N., 2007. Firm-Specific Risk and Equity Market Development. *Journal of Financial Economics* 84, 358-388.
- Bushman, R. M., Landsman, W. R., 2010. The Pros and Cons of Regulating Corporate Reporting: A Critical Review of the Arguments. *Accounting and Business Research* 40, 259-273.
- Callen, J. L., Khan, M., Lu, H., 2013. Accounting Quality, Stock Price Delay and Future Stock Returns. *Contemporary Accounting Research* 30, 269-295.
- Campbell, J. Y., Lo, A. W., MacKinlay, A. C., 1997. *The Econometrics of Financial Markets*. Princeton University Press.
- Carhart, M., 1997. On Persistence in Mutual Fund Performance. *Journal of Finance* 52, 57-82.
- Chae J., Lee, D. W., Wang, S. F., 2013. Takeover Vulnerability and the Behavior of Short-Term Stock Returns. *Journal of Corporate Finance* 22, 66-82.
- Charles, A. G., Darné, O., 2009. Variance-Ratio Tests of Random Walk: An Overview. *Journal of Economic Surveys* 23, 503-527.
- Chen, C., Huang, A., Jha, R., 2012. Idiosyncratic Return Volatility and the Information Quality Underlying Managerial Discretion. *Journal of Financial and Quantitative Analysis* 47, 873-899.
- Chen, Q., Goldstein, I., Jiang, W., 2006. Price Informativeness and Investment Sensitivity to Stock Price. *Review of Financial Studies* 20, 619-650.

- Choi, D., Getmansky, M., Tookes, H., 2009. Convertible Bond Arbitrage, Liquidity Externalities, and Stock Prices. *Journal of Financial Economics* 91, 227-251.
- Chordia, T., Roll, R., Subrahmanyam, A., 2008. Liquidity and Market Efficiency. *Journal of Financial Economics* 87, 249-268.
- Chordia, T., Swaminathan, B., 2000. Trading Volume and Cross-Autocorrelations in Stock Returns. *Journal of Finance* 55, 913-935.
- Christensen, P. O., Feltham, G.A., 2003. *Economics of Accounting*. Kluwer Academic Publishers.
- Cochrane, J. H., 2001. *Asset Pricing*. Princeton University Press.
- Collins, D. W., Pungaliya, R. S., Vih, A. M., 2016. The effects of firm growth and model specification choices on tests of earnings management in quarterly settings. *The Accounting Review*, forthcoming.
- Conrad, J., Wahal, S., Xiang, J., 2015. High-Frequency Quoting, Trading, and the Efficiency of Prices. *Journal of Financial Economics* 116, 271-291.
- Corwin, S. A., Schultz, P., 2012. A Simple Way to Estimate Bid-Ask Spreads from Daily High and Low Prices. *Journal of Finance* 67, 719-760.
- Daniel, K., Hirshleifer, D., Subrahmanyam, A., 1998. Investor Psychology and Security Market Under- and Overreactions. *Journal of Finance* 53, 1839-1885.
- Daniel, K., Hirshleifer, D., Subrahmanyam, A., 2001. Overconfidence, Arbitrage, and Equilibrium Asset Pricing. *Journal of Finance* 56, 921-965.
- Dasgupta, S., Gan, J., Gao, N., 2010. Transparency, Price Informativeness, Stock Return Synchronicity, and the Informativeness of Stock Prices: Theory and Evidence. *Journal of Financial and Quantitative Analysis* 45, 1189-1220.
- Dechow, P. M., Sloan, R. G., Sweeney, A. P., 1995. Detecting Earnings Management. *The Accounting Review* 70, 193-225.
- Dechow, P. M., Skinner, D., 2000. Earnings Management: Reconciling the Views of Accounting Academics, Practitioners, and Regulators. *Accounting Horizons* 14, 235-250.
- Dechow, P. M., Dichev, I. D., 2002. The Quality of Accruals and Estimation Errors. *The Accounting Review* 77, 35-59.
- Dechow, P. M., Ge, W., Schrand, C. M., 2010. Understanding Earnings Quality: A Review of the Proxies, Their Determinants and Their Consequences. *Journal of Accounting and Economics* 50, 344-401.

- DeFond, M. L., Jiambalvo, J., 1994. Debt Covenant Violation and the Manipulation of Accruals. *Journal of Accounting and Economics* 17, 145-176.
- DeFond, M., Zhang, J., 2014. A Review of Archival Auditing Research. *Journal of Accounting and Economics* 58, 275-326.
- Demski, J. S., Patell, J. M., Wolfson, M. A., 1984. Decentralized Choice of Monitoring Systems. *The Accounting Review* 59, 16-34.
- Demski, J. S., 1998. Performance Measure Manipulation. *Contemporary Accounting Research* 15, 261-285.
- Drake, M. S., Roulstone, D. T., Thornock, J. R., 2016. The Usefulness of Historical Financial Reports. *Journal of Accounting and Economics* 61, 448-464.
- Drake, M. S., Roulstone, D. T., Thornock, J. R., 2015. The Determinants and Consequences of Information Acquisition via EDGAR. *Contemporary Accounting Research* 32, 1128-1161.
- Durnev, A., Morck, R., Yeung, B., Zarowin, P., 2003. Does Greater Firm-specific Return Variation Mean More or Less Informed Stock Pricing? *Journal of Accounting Research* 41, 797-836.
- Dye, R. A., Verrecchia, R. E., 1995. Discretion vs. Uniformity: Choices among GAAP. *The Accounting Review* 70, 389-415.
- Erdos, P., Ormos, M., 2010. Random Walk Theory and the Weak-Form Efficiency of the US Art Auction Prices. *Journal of Banking and Finance* 34, 1062-1076.
- Ewert, R., Wagenhofer, A., 2012. Earnings Management, Conservatism, and Earnings Quality. *Foundations and Trends in Accounting* 6, 65-186.
- Fama, E. F., 1965. The Behavior of Stock-Market Prices. *Journal of Business* 38, 34-105.
- Fama, E. F., 1970. Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance* 25, 383-417.
- Fama, E. F., French, K. R. (1993). Common Risk Factors in the Returns on Stocks and Bonds. *Journal of Financial Economics* 33, 3-56.
- Fields, T. D., Lys, T. Z., Vincent, L., 2001. Empirical Research on Accounting Choice. *Journal of Accounting and Economics* 31, 255-307.
- Finucane, T. J., 2000. A Direct Test of Methods for Inferring Trade Direction from Intra-Day Data. *Journal of Financial and Quantitative Analysis* 35, 553-576.
- Finkelstein, S., Hambrick, D. C., Cannella, A. A., 2009. Strategic Leadership: Theory and Research on Executives, Top Management Teams, and Boards. Oxford University Press.

- Francis, J., Lafond, R., Olsson, P., Schipper, K., 2004. Cost of Equity and Earnings Attributes. *The Accounting Review* 79, 967-1010.
- Francis, J., Lafond, R., Olsson, P., Schipper, K., 2005. The Market Pricing of Accruals Quality. *Journal of Accounting and Economics* 39, 295-327.
- Francis, J., Lafond, R., Olsson, P., Schipper, K., 2007. Information Uncertainty and Post-Earnings-Announcement-Drift. *Journal of Business Finance & Accounting* 34, 403-433.
- Francis, J., Olsson, P., Schipper, K. 2006. Earnings Quality. *Foundations and Trends in Accounting* 1, 259-340.
- French, K. R., Roll, R., 1986. Stock Return Variances: The Arrival of Information and the Reaction of Traders. *Journal of Financial Economics* 17, 5-26.
- Gozluklu, A. E., Perotti, P., Rindi, B., Fredella, R., 2015. Lot Size Constraints and Market Quality. Evidence from the Borsa Italiana. *Financial Management* 44, 905-945.
- Griffin, J. M., Kelley, P. J., Nardari, F., 2010. Do Market Efficiency Measures Yield Correct Inferences? A Comparison of Developed and Emerging Markets. *Review of Financial Studies* 23, 3225-3277.
- Guay, W., Kothari, S. P., Watts, R., 1996. A Market-based Evaluation of Discretionary Accruals Models. *Journal of Accounting Research* 43, 83-105.
- Gunny, K., Zhang, T. C., 2014. Do Managers Use Meeting Analyst Forecasts to Signal Private Information? Evidence From Patent Citations. *Journal of Business Finance & Accounting* 41, 950-973.
- Hambrick, D. C., Abrahamson, E., 1995. Assessing Managerial Discretion Across Industries: A Multi-Method Approach. *Academy of Management Journal* 38, 1427-1441.
- Hambrick, D. C., Finkelstein, S., 1987. Managerial Discretion: A Bridge between Polar Views on Organizations. *Research in Organizational Behavior* 9, 369-406.
- Huang, K., Lao, B., McPhee, G., 2016. Does Stock Liquidity Affect Accrual-based Earnings Management? *Working paper*, Florida International University.
- Hann, R. N., Lu, Y. Y., Subramanyam, K. R., 2007. Uniformity versus Flexibility: Evidence from Pricing of the Pension Obligation. *The Accounting Review* 82, 107-137.
- Hasbrouck, J., 1993. Assessing the Quality of a Security Market: A New Approach to Transaction-Cost Measurement. *Review of Financial Studies* 6, 191-212.
- Healy, P. M., 1985. The Effect of Bonus Schemes on Accounting Decisions. *Journal of Accounting and Economics* 7, 85-107. Healy, P. M., Wahlen, J. M., 1999. A Review of the Earnings Management Literature and Its Implications for Standard Setting. *Accounting Horizons* 13, 365-383.

- Holthausen, R. W., Leftwich, R. W., 1983. The Economic Consequences of Accounting Choice Implications of Costly Contracting and Monitoring. *Journal of Accounting and Economics* 5, 77-117.
- Hong, H., Lim, T., Stein, J. C., 2000. Bad News Travels Slowly: Size, Analyst Coverage, and the Profitability of Momentum Strategies. *Journal of Finance* 55, 265-295.
- Hou, K., Moskowitz, T. J., 2005. Market Frictions, Price Delay, and the Cross-Section of Expected Returns. *Review of Financial Studies* 18, 981-1020.
- Hribar, P., Collins, D. W., 2002. Errors in Estimating Accruals: Implications for Empirical Research. *Journal of Accounting Research* 40, 105-134.
- Hribar, P., Nichols, D. C., 2007. The Use of Unsigned Earnings Quality Measures in Tests of Earnings Management. *Journal of Accounting Research* 45, 1017-1053.
- Hutton, A. P., Marcus, A. J., Tehranian, H., 2009. Opaque Financial Reports, R2, and Crash Risk. *Journal of Financial Economics* 94, 67-86.
- Jensen, M. C., 2005. Agency Costs of Overvalued Equity. *Financial Management* 34, 5-19.
- Jin, L., Myers, S. C., 2006. R2 around the World: New Theory and New Tests. *Journal of Financial Economics* 79, 257-292.
- Jones, J. J., 1991. Earnings Management during Import Relief Investigations. *Journal of Accounting Research* 29, 193-228.
- Kadapakkam, P.-R., Krause, T., Tse, Y., 2015. Exchange Traded Funds, Size-Based Portfolios, and Market Efficiency. *Review of Quantitative Finance and Accounting* 45, 89-110.
- Keim, D. B., Stambaugh R. F., 1986. Predicting Returns in the Stock and Bond Markets. *Journal of Financial Economics* 17, 357-390.
- Kelly, P. J., 2014. Information Efficiency and Firm-Specific Return Variation. *Quarterly Journal of Finance* 4.
- Klibanoff, P., Lamont, O., Wizman, T. A., 1998. Investor Reaction to Salient News in Closed-End Country Funds. *Journal of Finance* 53, 673-699.
- Kothari, S. P., 2001. Capital Markets Research in Accounting. *Journal of Accounting and Economics* 31, 105-231.
- Kothari, S. P., Leone, A. J., Wasley, C. E., 2005. Performance Matched Discretionary Accrual Measures. *Journal of Accounting and Economics* 39, 163-197.
- Krishnaswami, S., Subramaniam, V., 1999. Information Asymmetry, Valuation, and the Corporate Spin-Off Decision. *Journal of Financial Economics* 53, 73-112.

- Kumar, S., Sarin, A., Kumar, R., 1998. The Impact of Options Trading on the Market Quality of the Underlying Security: An Empirical Analysis. *Journal of Finance* 53, 717-732.
- Larker, D. F., Richardson, S. A., Tuna, I., 2007. Corporate Governance, Accounting Outcomes, and Organizational Performance. *The Accounting Review* 82, 963-1008.
- Lee, C. M. C., 2001. Market Efficiency and Accounting Research: A Discussion of 'Capital Market Research in Accounting' by S.P. Kothari. *Journal of Accounting and Economics* 31, 233-253.
- Lee, D. W., Liu, M. H., 2011. Does More Information in Stock Price Lead to Greater or Smaller Idiosyncratic Return Volatility? *Journal of Banking and Finance* 35, 1563-1580.
- Lev, B., Li, S., Sougiannis, T., 2010. The Usefulness of Accounting Estimates for Predicting Cash Flows and Earnings. *Review of Accounting Studies* 15, 779-807.
- Li, B., Rajgopal, S., Venkatachalam, M., 2014. R² and Idiosyncratic Risk are not Interchangeable. *The Accounting Review* 89, 2261-2295.
- Lim, K.-P., Brooks, R., 2011. The Evolution of Stock Market Efficiency Over Time: A Survey of the Empirical Literature. *Journal of Economic Surveys* 25, 69-108.
- Louis, H., Robinson, D., 2005. Do Managers Credibly Use Accruals to Signal Private Information? Evidence from the Pricing of Discretionary Accruals around Stock Splits. *Journal of Accounting and Economics* 39, 361-380.
- Malkiel, B. G., 2003. The Efficient Market Hypothesis and Its Critics. *Journal of Economic Perspectives* 17, 59-82.
- Mashruwala, C., Rajgopal, S., Shevlin, T., 2006. Why Is the Accrual Anomaly Not Arbitraged Away? The Role of Idiosyncratic Risk and Transaction Costs. *Journal of Accounting and Economics* 42, 3-33.
- Morck, R., Yeung, B., Yu, W., 2000. The Information Content of Stock Markets: Why Do Emerging Markets Have Synchronous Stock Price Movements? *Journal of Financial Economics* 58, 215-260.
- O'Hara, M., Ye, M., 2011. Is Market Fragmentation Harming Market Quality? *Journal of Financial Economics* 100, 459-474.
- Owens, E., Wu, J. S., Zimmerman, J., 2016. Business Model Shocks and Abnormal Accrual Models. *The Accounting Review*, Forthcoming.
- Penman, S., 2013. Financial Statements Analysis and Security Evaluation. McGraw-Hill.
- Perotti, P., Wagenhofer, A., 2014. Earnings Quality Measures and Excess Returns. *Journal of Business Finance & Accounting* 41, 545-571.

- Petersen, M. A., 2009. Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches. *Review of Financial Studies* 22, 435-480.
- Pontiff, J., 1996. Costly Arbitrage: Evidence from Closed-End Funds. *Quarterly Journal of Economics* 111, 1135-1152.
- Rajgopal, S., Venkatachalam, M., 2011. Financial Reporting Quality and Idiosyncratic Return Volatility. *Journal of Accounting and Economics* 51, 1-20.
- Richardson, S., Tuna, I., Wysocki, P., 2010. Accounting Anomalies and Fundamental Analysis: A Review of Recent Research Advances. *Journal of Accounting and Economics* 50, 410-454.
- Roll, R., 1988. R^2 . *Journal of Finance* 43, 541-566.
- Saffi, P. A. C., Sigurdsson, K., 2011. Price Efficiency and Short Selling. *Review of Financial Studies* 24, 821-852.
- Sankar, M. R., Subramanyam, K. R., 2001. Reporting Discretion and Private Information Communication through Earnings. *Journal of Accounting Research* 39, 365-386.
- Shivakumar, L., 2007. Discussion of Information Uncertainty and Post-Earnings-Announcement-Drift. *Journal of Business Finance & Accounting* 34, 434-438.
- Solnik, B. H., 1974. Why Not Diversify Internationally Rather Than Domestically? *Financial Analysts Journal* 30, 48-54.
- Stocken, P. C., Verrecchia, R. E., 2004. Financial Reporting System Choice and Disclosure Management. *The Accounting Review* 79, 1181-1203.
- Subrahmanyam, A., Titman, S., 2001. Feedback From Stock Prices to Cash Flows. *Journal of Finance* 56, 2389-2413.
- Subramanyam, K. R., 1996. The Pricing of Discretionary Accruals. *Journal of Accounting and Economics* 22, 249-281.
- Truong, C., 2012. Options Trading and the Extent that Stock Prices Lead Future Earnings Information. *Journal of Business Finance & Accounting* 39, 960-996.
- Tucker, J. W., Zarowin, P. A., 2006. Does Income Smoothing Improve Earnings Informativeness? *The Accounting Review* 81, 251-270.
- Watt, W. H., Yadav, P. K., Draper, P., 1992. The Impact of Option Listing on Underlying Stock Returns: The UK Evidence. *Journal of Business Finance & Accounting* 19, 485-504.
- Watts, R. L., 1977. Corporate Financial Statements, a Product of the Market and Political Processes. *Australian Journal of Management* 2, 53-78.

Watts, R. L., Zimmerman, J. L., 1978. Towards a Positive Theory of the Determination of Accounting Standards. *The Accounting Review* 53, 112-134.

Watts, R. L., Zimmerman, J. L., 1986. Positive Accounting Theory. Prentice-Hall.

West, K. D., 1988. Dividend Innovations and Stock Price Volatility. *Econometrica* 56, 37-61.

Wurgler, J., 2000. Financial Markets and the Allocation of Capital. *Journal of Financial Economics* 58, 187-214.

Wurgler, J., Zhuravskaya, E., 2002. Does Arbitrage Flatten Demand Curves for Stocks? *Journal of Business* 75, 583-608.

Xie, H., 2001. The Mispricing of Abnormal Accruals. *The Accounting Review* 76, 357-373.

Table 1: Sample composition

| Panel A: Sample selection procedures | | | | | |
|--|------------|-------|--------------------------------|------------|------------|
| | | | | | Firm-years |
| All non-financial firm fiscal years 1988-2007 in CRSP/Compustat Merged | | | | | 105,974 |
| - insufficient stock return data to compute variance ratios | | | | | -12,894 |
| - missing or insufficient data to compute abnormal accruals | | | | | -13,744 |
| - insufficient data to compute control variables | | | | | -2,452 |
| Final sample | | | | | 76,873 |
| Panel B: Industry distribution | | | | | |
| Industry | Firm-years | Pct.% | Industry | Firm-years | Pct.% |
| Agriculture | 119 | 0.15 | Automobiles and Trucks | 1,216 | 1.58 |
| Food Products | 1,468 | 1.91 | Aircraft | 394 | 0.51 |
| Beer & Liquor | 183 | 0.24 | Precious Metals | 747 | 0.97 |
| Recreation | 780 | 1.01 | Non-Metallic/Ind. Metal Mining | 491 | 0.64 |
| Entertainment | 1,179 | 1.53 | Petroleum and Natural Gas | 3,820 | 4.97 |
| Printing and Publishing | 765 | 1.00 | Utilities | 3,110 | 4.05 |
| Consumer Goods | 1,526 | 1.99 | Communication | 2,893 | 3.76 |
| Apparel | 1,260 | 1.64 | Personal Services | 860 | 1.12 |
| Healthcare | 1,540 | 2.00 | Business Services | 9,189 | 11.95 |
| Medical Equipment | 3,014 | 3.92 | Computers | 3,752 | 4.88 |
| Pharmaceutical Products | 4,959 | 6.45 | Electronic Equipment | 5,506 | 7.16 |
| Chemicals | 1,738 | 2.26 | Measuring and Control Eq. | 2,082 | 2.71 |
| Rubber and Plastic Products | 853 | 1.11 | Business Supplies | 1,261 | 1.64 |
| Textiles | 444 | 0.58 | Shipping Containers | 34 | 0.04 |
| Construction Materials | 1,670 | 2.17 | Transportation | 2,238 | 2.91 |
| Construction | 590 | 0.77 | Wholesale | 3,290 | 4.28 |
| Steel Works Etc | 1,342 | 1.75 | Retail | 4,466 | 5.81 |
| Fabricated Products | 297 | 0.39 | Restaurants, Hotels, Motels | 1,603 | 2.09 |
| Machinery | 3,059 | 3.98 | Other | 1,666 | 2.17 |
| Electrical Equipment | 1,469 | 1.91 | | | |
| Panel C: Fiscal year distribution | | | | | |
| Year | Firm-years | Pct.% | Year | Firm-years | Pct.% |
| 1988 | 3,404 | 4.43 | 1998 | 4,513 | 5.87 |
| 1989 | 3,406 | 4.43 | 1999 | 4,236 | 5.51 |
| 1990 | 3,426 | 4.46 | 2000 | 4,104 | 5.34 |
| 1991 | 3,439 | 4.47 | 2001 | 4,098 | 5.33 |
| 1992 | 3,623 | 4.71 | 2002 | 3,784 | 4.92 |
| 1993 | 3,926 | 5.11 | 2003 | 3,747 | 4.87 |
| 1994 | 4,193 | 5.45 | 2004 | 3,544 | 4.61 |
| 1995 | 4,429 | 5.76 | 2005 | 3,479 | 4.53 |
| 1996 | 4,505 | 5.86 | 2006 | 3,268 | 4.25 |
| 1997 | 4,612 | 6.00 | 2007 | 3,137 | 4.08 |

Table 2: Descriptive statistics

| Variable | Mean | Median | Q1 | Q3 | SD | N |
|------------------------|--------|--------|--------|--------|--------|--------|
| IE1 | -0.236 | -0.187 | -0.344 | -0.087 | 0.188 | 76,873 |
| IE2 | -0.302 | -0.260 | -0.439 | -0.126 | 0.217 | 76,873 |
| ABSDA | 0.066 | 0.042 | 0.018 | 0.086 | 0.073 | 76,873 |
| SIZE | 5.240 | 5.090 | 3.626 | 6.721 | 2.206 | 76,873 |
| ILLIQ \times 100,000 | 0.843 | 0.010 | 0.001 | 0.155 | 9.017 | 76,873 |
| TURN | 13.452 | 13.556 | 12.788 | 14.267 | 1.230 | 76,873 |
| NASDAQ | 0.576 | 1.000 | 0.000 | 1.000 | 0.494 | 76,873 |
| INST | 0.373 | 0.334 | 0.117 | 0.601 | 0.280 | 76,873 |
| NAF | 1.005 | 0.693 | 0.000 | 1.946 | 1.082 | 53,211 |
| BM | 0.600 | 0.515 | 0.295 | 0.817 | 4.120 | 53,211 |
| σ (CFO) | 0.126 | 0.071 | 0.040 | 0.127 | 0.591 | 53,211 |
| σ (SALES) | 0.330 | 0.189 | 0.099 | 0.349 | 3.565 | 53,211 |
| NTDAYS | 37.066 | 26.000 | 7.000 | 58.000 | 37.892 | 53,211 |
| ALTZ | 4.774 | 3.105 | 1.723 | 5.099 | 14.884 | 53,211 |

Notes: The sample for our main analysis consists of 76,873 firm-year observations from 1988-2007. Descriptive statistics for variables used in additional analyses are based on smaller sample sizes due to limited data availability for some of the variables. The variables are defined in the Appendix.

Table 3: Correlation matrix

| | IE1 | IE2 | ABSDA | SIZE | ILLIQ | TURN | NASDAQ | INST | NAF | BM | $\sigma(\text{CFO})$ | $\sigma(\text{SALES})$ | NTDAYS | ALTZ |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------------------|------------------------|---------|---------|
| IE1 | 1 | 0.910* | -0.042* | 0.439* | -0.148* | 0.263* | -0.247* | 0.353* | 0.311* | -0.030* | -0.002 | -0.007 | -0.427* | 0.030* |
| IE2 | 0.855* | 1 | -0.037* | 0.402* | -0.137* | 0.243* | -0.228* | 0.327* | 0.287* | -0.030* | -0.003 | -0.007 | -0.394* | 0.024* |
| ABSDA | -0.055* | -0.051* | 1 | -0.220* | 0.023* | 0.089* | 0.167* | -0.206* | -0.114* | -0.011 | 0.095* | 0.038* | 0.125* | 0.003 |
| SIZE | 0.423* | 0.396* | -0.242* | 1 | -0.141* | 0.150* | -0.412* | 0.669* | 0.566* | -0.044* | -0.062* | -0.028* | -0.613* | 0.042* |
| ILLIQ | -0.509* | -0.476* | 0.200* | -0.887* | 1 | -0.100* | 0.046* | -0.098* | -0.090* | 0.015* | 0.006 | 0.003 | 0.184* | -0.023* |
| TURN | 0.266* | 0.247* | 0.080* | 0.250* | -0.455* | 1 | 0.189* | 0.322* | 0.371* | -0.032* | 0.034* | 0.011 | -0.408* | 0.067* |
| NASDAQ | -0.217* | -0.213* | 0.179* | -0.409* | 0.350* | 0.208* | 1 | -0.268* | -0.179* | 0.013* | 0.057* | 0.016* | 0.107* | 0.075* |
| INST | 0.332* | 0.312* | -0.200* | 0.710* | -0.711* | 0.371* | -0.276* | 1 | 0.576* | -0.022* | -0.073* | -0.027* | -0.533* | -0.005 |
| NAF | 0.282* | 0.265* | -0.080* | 0.550* | -0.575* | 0.405* | -0.154* | 0.580* | 1 | -0.026* | -0.045* | -0.017* | -0.363* | 0.037* |
| BM | -0.205* | -0.183* | -0.054* | -0.372* | 0.378* | -0.297* | -0.004 | -0.159* | -0.248* | 1 | -0.122* | -0.002 | 0.038* | 0.020* |
| $\sigma(\text{CFO})$ | -0.061* | -0.057* | 0.378* | -0.383* | 0.301* | 0.191* | 0.328* | -0.294* | -0.117* | -0.124* | 1 | 0.626* | 0.014* | 0.001 |
| $\sigma(\text{SALES})$ | -0.040* | -0.037* | 0.273* | -0.284* | 0.216* | 0.146* | 0.210* | -0.172* | -0.030* | -0.039* | 0.496* | 1 | 0.011 | 0.000 |
| NTDAYS | -0.403* | -0.378* | 0.134* | -0.656* | 0.712* | -0.475* | 0.097* | -0.596* | -0.381* | 0.322* | 0.129* | 0.096* | 1 | -0.044* |
| ALTZ | 0.060* | 0.051* | 0.039* | 0.133* | -0.149* | 0.163* | 0.142* | 0.148* | 0.267* | -0.234* | 0.017* | 0.118* | -0.156* | 1 |

Notes: The sample for our main analysis consists of 76,873 firm-year observations from 1988-2007. Correlation results for NAF, BM, $\sigma(\text{CFO})$, $\sigma(\text{SALES})$, NTDAYS and ALTZ are based on a smaller sample size of 53,211 firm-year observations due to limited data availability. The Pearson correlation coefficients are reported in the upper triangle; the Spearman correlation coefficients are reported in the lower triangle. All the variables are defined in the Appendix. * indicates statistical significance at the 1% level.

Table 4: Discretionary accruals and informational efficiency – double sorting by firm size and discretionary accruals

| <u>Number of firms in each SIZE/ABSDA portfolio:</u> | | | | | <u>Average ABSDA in each SIZE/ABSDA portfolio:</u> | | | | |
|--|---------------------|--------|--------|--------|--|---------------------|-------|-------|--|
| SIZE (small to large) | ABSDA (low to high) | | | | SIZE (small to large) | ABSDA (low to high) | | | |
| | 1 | 2 | 3 | | | 1 | 2 | 3 | |
| 1 | 6,303 | 7,865 | 11,457 | 25,625 | 1 | 0.012 | 0.045 | 0.151 | |
| 2 | 8,048 | 8,666 | 8,910 | 25,624 | 2 | 0.012 | 0.044 | 0.143 | |
| 3 | 11,274 | 9,093 | 5,257 | 25,624 | 3 | 0.012 | 0.042 | 0.127 | |
| Total | 25,625 | 25,624 | 25,624 | 76,873 | | | | | |

| <u>Average IE1 in each SIZE/ABSDA portfolio:</u> | | | | <u>Average IE2 in each SIZE/ABSDA portfolio:</u> | | | |
|--|---------------------|--------|--------|--|---------------------|--------|--------|
| SIZE (small to large) | ABSDA (low to high) | | | SIZE (small to large) | ABSDA (low to high) | | |
| | 1 | 2 | 3 | | 1 | 2 | 3 |
| 1 | -0.360 | -0.357 | -0.343 | 1 | -0.436 | -0.433 | -0.417 |
| 2 | -0.214 | -0.208 | -0.197 | 2 | -0.278 | -0.271 | -0.260 |
| 3 | -0.152 | -0.151 | -0.142 | 3 | -0.214 | -0.212 | -0.200 |

Notes: Firms are sorted by size (SIZE) and by the absolute value of abnormal accruals (ABSDA). For each portfolio the table reports the number of firms, the average level of ABSDA, and of the informational efficiency measures (IE). All the variables are defined in the Appendix.

Table 5: Discretionary accruals and informational efficiency – multiple regression analysis

| Model 1 | | | | | Model 2 | | | | |
|-------------------------|-----------------------|--|------------------------|--|-----------------------|--|------------------------|--|--|
| | IE1: VR(1,5)-1 *(-1) | | IE2: VR(1,10)-1 *(-1) | | IE1: VR(1,5)-1 *(-1) | | IE2: VR(1,10)-1 *(-1) | | |
| ABSDA | 0.098*** | | 0.108*** | | 0.100*** | | 0.106*** | | |
| | [10.40] | | [9.81] | | [7.96] | | [7.21] | | |
| SIZE | 0.027*** | | 0.028*** | | 0.015*** | | 0.015*** | | |
| | [37.70] | | [34.24] | | [17.12] | | [14.39] | | |
| ILLIQ | -0.001*** | | -0.002*** | | -0.002*** | | -0.002*** | | |
| | [-3.23] | | [-3.20] | | [-4.35] | | [-4.23] | | |
| TURN | 0.031*** | | 0.034*** | | 0.026*** | | 0.027*** | | |
| | [29.55] | | [29.63] | | [19.88] | | [19.67] | | |
| NASDAQ | -0.068*** | | -0.073*** | | -0.081*** | | -0.086*** | | |
| | [-27.70] | | [-26.69] | | [-27.61] | | [-26.73] | | |
| INST | 0.008** | | 0.014*** | | 0.013** | | 0.022*** | | |
| | [2.00] | | [2.93] | | [2.54] | | [3.53] | | |
| NAF | - | | - | | 0.003** | | 0.003** | | |
| | - | | - | | [2.19] | | [2.03] | | |
| BM | - | | - | | -0.000 | | -0.000** | | |
| | - | | - | | [-0.97] | | [-2.38] | | |
| $\sigma(\text{CFO})$ | - | | - | | 0.007*** | | 0.007*** | | |
| | - | | - | | [3.09] | | [2.89] | | |
| $\sigma(\text{SALES})$ | - | | - | | -0.001** | | -0.001** | | |
| | - | | - | | [-2.26] | | [-2.23] | | |
| NTDAYS | - | | - | | -0.001*** | | -0.001*** | | |
| | - | | - | | [-13.36] | | [-14.56] | | |
| ALTZ | - | | - | | 0.000*** | | 0.000** | | |
| | - | | - | | [3.07] | | [2.25] | | |
| Observations | 76,873 | | 76,873 | | 53,211 | | 53,211 | | |
| Adjusted R ² | 0.287 | | 0.243 | | 0.313 | | 0.266 | | |

Notes: All the variables are defined in the Appendix. Industry and year fixed effects are included in all models. Reported t-values are calculated using clustered standard errors, clustered by firm. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 6: Cross-sectional variation in the association between managerial discretion in accruals and informational efficiency

| $IE_t = \beta_0 + \beta_1 ABSDA_{t-1} + \beta_2 CHAR + \beta_3 ABSDA_{t-1} * CHAR + CONTROLS + CONTROLS * CHAR + \varepsilon_t$ | | | | | | | | |
|---|--|----------------------------|-----------------------------|----------------------------|----------------------------|--------------------------|-----------------------------|----------------------------|
| | CHAR: SIZE _{t-1} | | CHAR: INST _{t-1} | | CHAR: NAF _{t-1} | | CHAR: REST _{t-1} | |
| | IE1 | IE2 | IE1 | IE2 | IE1 | IE2 | IE1 | IE2 |
| ABSDA | 0.172*** [6.26] | 0.170*** [5.41] | 0.135*** [9.30] | 0.139*** [8.28] | 0.117*** [8.91] | 0.122*** [8.05] | 0.078*** [5.63] | 0.090*** [5.19] |
| CHAR | 0.086*** [18.73] | 0.089*** [17.48] | 0.497*** [13.27] | 0.556*** [13.15] | 0.119*** [9.98] | 0.127*** [9.50] | -0.051 [-1.00] | -0.077 [-1.23] |
| ABSDA*CHAR | -0.018*** [-3.50] | -0.014** [-2.45] | -0.115*** [-3.58] | -0.083** [-2.17] | -0.018** [-2.10] | -0.010 [-0.99] | -0.219*** [-3.60] | -0.185** [-2.27] |
| | + MAIN CONTROLS + MAIN CONTROLS * CHAR | | | | | | | |
| Observations | 76,873 | 76,873 | 76,873 | 76,873 | 76,873 | 76,873 | 29,161 | 29,161 |
| Adjusted R ² | 0.320 | 0.271 | 0.310 | 0.264 | 0.304 | 0.259 | 0.195 | 0.151 |

Notes: Characteristics (CHAR) potentially affecting the cross-sectional variation in the association between managerial discretion in accruals and informational efficiency are interacted with the control variables and with ABSDA. REST is a dummy variable which takes value one for firm year observations corresponding to accrual-related restatements (see Section 6). All the other variables are defined in the Appendix. Industry and year fixed effects are included in all models. Reported t-values are calculated using clustered standard errors, clustered by firm. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7: Validity of the informational efficiency measure - Results for portfolios with low transaction/information costs

| $IE_t = \beta_0 + \beta_1 ABSDA_{t-1} + \beta_2 SIZE_{t-1} + \beta_3 ILLIQ_{t-1} + \beta_4 TURN_{t-1} + \beta_5 NASDAQ_t + \beta_6 INST_{t-1} + \varepsilon_t$ | | | | | | | | | | | | | | |
|--|------------|------------|-----------------|------------|--------------------------------|------------|---------------|------------|------------------------------|------------|----------------------------------|------------|----------------|------------|
| | Large-Cap | | Low Illiquidity | | Low Number of Non-Trading Days | | High Turnover | | High Institutional Ownership | | More than Two Analysts Following | | Traded Options | |
| | <u>IE1</u> | <u>IE2</u> | <u>IE1</u> | <u>IE2</u> | <u>IE1</u> | <u>IE2</u> | <u>IE1</u> | <u>IE2</u> | <u>IE1</u> | <u>IE2</u> | <u>IE1</u> | <u>IE2</u> | <u>IE1</u> | <u>IE2</u> |
| ABSDA | 0.078*** | 0.101*** | 0.057*** | 0.073*** | 0.065*** | 0.078*** | 0.060*** | 0.075*** | 0.078*** | 0.102*** | 0.074*** | 0.097*** | 0.058*** | 0.089*** |
| | [6.29] | [6.53] | [5.44] | [5.47] | [6.08] | [5.77] | [5.86] | [6.04] | [5.86] | [6.33] | [5.78] | [6.13] | [4.32] | [5.02] |
| SIZE | 0.015*** | 0.013*** | 0.005*** | 0.002*** | 0.010*** | 0.008*** | 0.024*** | 0.024*** | 0.019*** | 0.018*** | 0.015*** | 0.013*** | 0.006*** | 0.005*** |
| | [19.83] | [14.32] | [8.45] | [3.17] | [15.99] | [9.64] | [24.51] | [21.24] | [24.15] | [19.55] | [19.07] | [13.24] | [9.72] | [5.31] |
| ILLIQ | -0.011* | -0.013** | -1.654*** | -2.069*** | -0.125*** | -0.133*** | -0.010*** | -0.011*** | -0.012*** | -0.013*** | -0.003 | -0.003 | -0.029** | -0.035** |
| | [-1.78] | [-2.08] | [-12.98] | [-12.89] | [-9.80] | [-9.73] | [-3.25] | [-3.20] | [-3.40] | [-3.40] | [-1.13] | [-1.18] | [-2.20] | [-2.11] |
| TURN | 0.020*** | 0.022*** | 0.012*** | 0.014*** | 0.016*** | 0.018*** | 0.036*** | 0.038*** | 0.026*** | 0.029*** | 0.024*** | 0.027*** | 0.014*** | 0.017*** |
| | [17.54] | [17.41] | [11.63] | [10.52] | [14.99] | [14.43] | [23.06] | [20.44] | [18.84] | [19.02] | [17.63] | [16.35] | [11.47] | [10.78] |
| NASDAQ | -0.033*** | -0.042*** | -0.009*** | -0.018*** | -0.024*** | -0.035*** | -0.031*** | -0.038*** | -0.047*** | -0.055*** | -0.033*** | -0.044*** | -0.005** | -0.012*** |
| | [-11.38] | [-12.57] | [-3.77] | [-5.95] | [-9.73] | [-12.13] | [-13.17] | [-13.34] | [-16.16] | [-16.91] | [-11.93] | [-13.40] | [-2.35] | [-4.10] |
| INST | 0.009** | 0.008 | -0.014*** | -0.016*** | -0.013*** | -0.013*** | 0.016*** | 0.023*** | 0.041*** | 0.049*** | 0.007 | 0.006 | -0.009** | -0.019*** |
| | [1.99] | [1.47] | [-3.88] | [-3.38] | [-3.36] | [-2.63] | [3.63] | [4.32] | [6.07] | [6.03] | [1.38] | [0.90] | [-2.19] | [-3.30] |
| Observations | 38,432 | 38,432 | 38,437 | 38,437 | 37,292 | 37,292 | 38,435 | 38,435 | 38,434 | 38,434 | 29,358 | 29,358 | 18,893 | 18,893 |
| Adjusted R ² | 0.112 | 0.078 | 0.062 | 0.041 | 0.130 | 0.089 | 0.246 | 0.201 | 0.193 | 0.144 | 0.118 | 0.082 | 0.044 | 0.029 |

Notes: This table reports the results using sub-samples with low transaction and information costs. We examine firm-year observations with: (1) more than median market capitalization ('Large cap'); (2) less than median Amihud illiquidity ratio ('Low Illiquidity'); (3) less than median non-trading days ('Low Number of Non-Trading Days'), (4) more than median turnover ('High Turnover'); (5) more than median institutional ownership ('High Institutional Ownership'); (6) more than two sell-side analysts following ('More than Two Analysts Following'); (7) options trading available in the calendar year corresponding to the fiscal year-end ('Traded Options'). All the other variables are defined in the Appendix. Industry and year fixed effects are included in all models. Reported t-values are calculated using clustered standard errors, clustered by firm. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8: Validity of the informational efficiency measure - Variance ratios at different time horizons and results using Hasbrouck's (1993) pricing error

| $IE_t = \beta_0 + \beta_1 ABSDA_{t-1} + \beta_2 SIZE_{t-1} + \beta_3 ILLIQ_{t-1} + \beta_4 TURN_{t-1} + \beta_5 NASDAQ_t + \beta_6 INST_{t-1} + \varepsilon_t$ | | | | | | | | |
|--|--|---------------------------|---------------------------|---------------------------|---------------------------|--|---------------------------|---------------------------|
| | Panel A: Variance ratios at different time horizons | | | | | Panel B: Hasbrouck's (1993) pricing error | | |
| | VR(2,5)-1 *(-1) | VR(2,10)-1 *(-1) | VR(5,10)-1 *(-1) | VR(1,20)-1 *(-1) | VR(1,30)-1 *(-1) | IE3 | IE1 | IE2 |
| ABSDA | 0.058*** [9.30] | 0.073*** [8.45] | 0.029*** [5.83] | 0.109*** [8.95] | 0.112*** [8.65] | 0.030*** [2.88] | 0.079*** [4.48] | 0.080*** [3.55] |
| SIZE | 0.014*** [30.92] | 0.017*** [26.85] | 0.006*** [17.42] | 0.026*** [30.43] | 0.024*** [27.29] | 0.016*** [26.77] | 0.014*** [13.52] | 0.014*** [10.88] |
| ILLIQ | -0.001*** [-3.34] | -0.001*** [-3.34] | -0.001*** [-3.48] | -0.002*** [-3.25] | -0.002*** [-3.21] | -0.011*** [-6.48] | -0.029*** [-4.60] | -0.033*** [-4.61] |
| TURN | 0.018*** [25.94] | 0.022*** [25.51] | 0.008*** [19.07] | 0.033*** [28.39] | 0.032*** [26.87] | 0.011*** [13.15] | 0.018*** [11.67] | 0.020*** [10.68] |
| NASDAQ | -0.040*** [-25.04] | -0.049*** [-23.40] | -0.018*** [-16.58] | -0.075*** [-26.15] | -0.071*** [-24.68] | -0.030*** [-12.69] | -0.022*** [-5.71] | -0.033*** [-6.69] |
| INST | 0.010*** [3.60] | 0.016*** [4.19] | 0.009*** [4.27] | 0.026*** [4.78] | 0.032*** [5.67] | 0.027*** [7.15] | 0.005 [0.68] | -0.003 [-0.38] |
| Observations | 76,873 | 76,873 | 76,873 | 76,838 | 76,815 | 12,050 | 12,050 | 12,050 |
| Adjusted R ² | 0.226 | 0.180 | 0.082 | 0.193 | 0.158 | 0.337 | 0.123 | 0.090 |

Notes: Panel A presents the results using informational efficiency measures calculated based on variance ratios at different time horizons. Panel B reports the results using an alternative measure of informational efficiency, Hasbrouck's (1993) pricing error, denoted as IE3 (see Section 7). All the other variables are defined in the Appendix. Industry and year fixed effects are included in all models. Reported t-values are calculated using clustered standard errors, clustered by firm. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 9: Validity of the managerial discretion measure – Results excluding unusual business circumstances

| Model 1: $IE_t = \beta_0 + \beta_1 ABSDA_{t-1} + \beta_2 SIZE_{t-1} + \beta_3 ILLIQ_{t-1} + \beta_4 TURN_{t-1} + \beta_5 NASDAQ_t + \beta_6 INST_{t-1} + \varepsilon_t$ | | | | |
|--|-----------------------|------------------------|-----------------------|------------------------|
| Model 2: $IE_t = \beta_0 + \beta_1 ABSDA_{t-1} + \beta_2 SIZE_{t-1} + \beta_3 ILLIQ_{t-1} + \beta_4 TURN_{t-1} + \beta_5 NASDAQ_t + \beta_6 INST_{t-1} + \beta_7 NAF_{t-1} + \beta_8 BM_{t-1} + \beta_9 \sigma(CFO)_{t-1} + \beta_{10} \sigma(SALES)_{t-1} + \beta_{11} NTDAYS_t + \beta_{12} ALTZ_{t-1} + \varepsilon_t$ | | | | |
| | Model 1 | | Model 2 | |
| | IE1: VR(1,5)-1 *(-1) | IE2: VR(1,10)-1 *(-1) | IE1: VR(1,5)-1 *(-1) | IE2: VR(1,10)-1 *(-1) |
| ABSDA | 0.114*** | 0.124*** | 0.106*** | 0.104*** |
| | [10.23] | [9.54] | [7.10] | [6.06] |
| SIZE | 0.026*** | 0.027*** | 0.015*** | 0.015*** |
| | [35.53] | [31.86] | [15.95] | [13.29] |
| ILLIQ | -0.002*** | -0.003*** | -0.002*** | -0.002*** |
| | [-4.71] | [-4.68] | [-3.48] | [-3.44] |
| TURN | 0.031*** | 0.033*** | 0.025*** | 0.027*** |
| | [27.08] | [26.93] | [18.05] | [17.72] |
| NASDAQ | -0.072*** | -0.077*** | -0.085*** | -0.090*** |
| | [-27.30] | [-26.26] | [-26.94] | [-25.94] |
| INST | 0.011** | 0.018*** | 0.018*** | 0.026*** |
| | [2.42] | [3.26] | [3.12] | [3.91] |
| NAF | - | - | 0.002 | 0.002 |
| | - | - | [1.48] | [1.31] |
| BM | - | - | -0.001 | -0.000 |
| | - | - | [-0.69] | [-0.43] |
| $\sigma(CFO)$ | - | - | 0.004*** | 0.005** |
| | - | - | [2.59] | [2.51] |
| $\sigma(SALES)$ | - | - | 0.002* | 0.002* |
| | - | - | [1.69] | [1.82] |
| NTDAYS | - | - | -0.001*** | -0.001*** |
| | - | - | [-13.06] | [-14.00] |
| ALTZ | - | - | 0.000*** | 0.000*** |
| | - | - | [4.50] | [3.63] |
| Observations | 62,863 | 62,863 | 44,298 | 44,298 |
| Adjusted R ² | 0.294 | 0.248 | 0.317 | 0.267 |

Notes: This table reports the results excluding firm-year observations that are potentially affected by unusual business circumstances. Unusual business circumstances are identified as firm-year observations that have (1) major acquisitions (Compustat *SALE* footnote is "AB"), (2) large discontinued operations (absolute value of discontinued operations (Compustat *DO*) divided by sales (Compustat *SALE*) > 5%), (3) four-digit SIC industry changes, (4) large restructuring charges (absolute value of restructuring charges (Compustat *RCP*) divided by sales > 5%), and (5) large special items (absolute value of special items (Compustat *SPI*) divided by sales (Compustat *SALE*) > 5%). All the other variables are defined in the Appendix. Industry and year fixed effects are included in all models. Reported t-values are calculated using clustered standard errors, clustered by firm. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.