The effect of reporting frequency on the timeliness of earnings: The cases of voluntary and mandatory interim reports[†]

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Abstract

We examine whether financial reporting frequency affects the speed with which accounting information is reflected in security prices. For a sample of 28,824 reporting-frequency observations from 1950 to 1973, we find little evidence of differences in timeliness between firms reporting quarterly and those reporting semiannually, even after controlling for self-selection. However, firms that voluntarily increased reporting frequency from semiannual to quarterly experienced increased timeliness, while firms whose increase was mandated by the SEC did not. We conclude that there is little evidence to support the claim that regulation forcing firms to report more frequently improves earnings timeliness.

JEL classification: D82; G38; M41; L51

Keywords: Earnings timeliness; Voluntary disclosure; Regulation; Information asymmetry; Agency costs

[†] We appreciate the comments of Bill Baber, Ray Ball, Sudipta Basu, Walt Blacconiere, Larry Brown, Rajib Doogar, Bjorn Jorgensen, Krishna Kumar, Andy Leone, Thomas Lys (the editor), Jim McKeown, Sanjog Misra, Jerry Salomon, Rachel Schwartz, Jake Thomas, Ross Watts, Jim Wahlen, Joanna Wu, Gregory Waymire, Stephen Zeff, Jerry Zimmerman, an anonymous referee, and workshop participants at the Berkeley Accounting Research Talks, Columbia's Burton Workshop, Connecticut, Emory, George Washington, Georgia State, Hebrew University, Illinois, Indiana, London Business School, Maryland, Northwestern, Ohio State, Penn State, Rochester, Rutgers, SMU, Tel Aviv, Texas A&M, and Vanderbilt. The authors thank Chasen Jones, Wendy Li, Alisa Marcus, Brad Topchik, and Elisabeth White for excellent research assistance, and Steve Wheeler at the New York Stock Exchange for providing access to NYSE archives. Financial support was provided by Columbia Business School, Goizueta Business School, London Business School, and the John M. Olin Foundation and Bradley Policy Research Center at the University of Rochester.

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1. Introduction

We examine how the frequency of interim reporting affects earnings timeliness, the speed with which accounting information is impounded into price. While previous research has shown that interim financial reports preempt some information in annual reports (McNichols and Manegold, 1983) and improve forecasts of annual earnings (Brown and Niederhoffer, 1968; Brown and Rozeff, 1979), the effect of interim reporting on the timeliness of earnings is ambiguous because increases in reporting frequency affect the information-gathering activities of intermediaries (e.g., financial analysts). Additionally, mandating more frequent reporting can influence firms' propensity to issue voluntary disclosures (Gigler and Hemmer, 1998; Einhorn, 2005), which are potentially more precise indicators of firm value.

One motivation for studying the connection between interim reporting and earnings timeliness is to improve our understanding of the capital-market effects of increased disclosure. Other researchers have investigated whether increased disclosure improves liquidity (e.g., Welker, 1995; Healy et al., 1999; Leuz and Verrecchia, 2000), reduces the cost of capital (e.g., Botosan, 1997; Sengupta, 1998; Piotroski, 2003; Botosan and Plumlee, 2002), increases analyst following (e.g., Lang and Lundholm, 1993; Healy et al., 1999; Francis et al., 2002), and reduces information asymmetry (Welker, 1995; Healy et al., 1999; Brown et al., 2005). We believe our paper is the first to directly test the effect of disclosure frequency on timeliness.[1]

A second motivation for the paper is policy-based, since understanding the effect of reporting frequency on timeliness is important in helping regulators decide whether to impose more frequent, and potentially more costly, interim reporting. In fact, regulators and other interested parties in both the United States (Elliott, 2000) and Europe (IASC, 1996; Commission, 2003) have recommended that more frequent interim reporting be required or, at minimum, encouraged. For example, Robert Litan, co-director of the AEI-Brookings Joint Center on Regulatory Studies, argues in testimony before Congress that “if, in an age of computers and the Internet, companies have the ability to publish their financial statements more frequently than every quarter, why shouldn’t public policy

[1] McNichols and Manegold (1983) offer indirect evidence of timeliness improvements due to disclosure increases.

encourage that result?" (Litan, 2002). Prevailing accounting standards in Europe require firms to report no more frequently than semiannually (IAS 34).

To provide evidence on the connection between reporting frequency and timeliness, we examine both voluntary and mandatory changes in interim reporting. By including both voluntary and mandatory changes in disclosure, we offer new evidence on the question of whether disclosure is better left to the firm (Stigler, 1964) or whether government can play a useful role in mandating disclosures and other regulation (Friend and Herman, 1964; Benston, 1973; Coffee, 1984; Easterbrook and Fischel, 1984). Recent papers suggest that, at least for certain types of disclosures, the benefits of regulating disclosure exceed the costs to shareholders when the cost-benefit trade-off is measured by equity returns (Lo, 2003; Greenstone et al., 2005). While we do not specifically evaluate this cost-benefit trade-off, by separately analyzing voluntary and mandatory increases in interim reporting, we provide evidence on whether frequency-increasing regulation affects one specific property of the association between earnings and returns, earnings timeliness.

An additional benefit of this setting is the ability to define precisely the timing of the disclosure change. As Healy and Palepu (2001) points out, other studies on voluntary increases in disclosure use either the change in AIMR ratings (Lang and Lundholm, 1993; Healy et al., 1999) or other self-constructed measures of disclosure (Miller, 2002). Botosan and Harris (2000), which studies the voluntary initiation of quarterly segment disclosures, is a notable exception.

We collect a sample of 28,824 firm-year observations of financial-statement reporting frequency from 1950 to 1973, representing the entire population of CRSP firms in non-regulated industries. As of the beginning of this period, firms were only required to file financial reports annually, although most chose to report either semiannually or quarterly. A key impetus for more frequent reporting was the New York Stock Exchange, whose listing requirements became progressively more stringent in this respect over the first half of the twentieth century. Not until 1955 did the Securities Exchange Commission (SEC) mandate semiannual reporting, and it did not require quarterly reporting until 1970.

Our initial focus is the relation between reporting frequency and how quickly earnings information is reflected in price during the current reporting period, i.e., *intraperiod timeliness*. Reporting frequency is expected to affect intraperiod timeliness directly because, as interim earnings reports become more frequent, the information in annual earnings is anticipated sooner. Following Pope and Walker (1999), we distinguish intraperiod timeliness from measures of *long-horizon timeliness* that capture how much of the period's earnings information is explained by (or explains) current economic income.

Our analysis controls for the fact that firms self-select reporting frequency. These controls are important because of the endogenous relation between disclosure frequency and the effects of disclosure (Core, 2001). We control for self-selection using an endogenous switching model—a variant of Heckman's (1979) procedure—that incorporates factors which extant literature suggests influence managerial disclosure decisions.

We find little evidence of a difference in timeliness between firms reporting quarterly and those reporting semiannually, even after controlling for self-selection. When observations are aggregated across the entire period in which quarterly reporting was optional, 1951–69, there is no significant difference in the *intraperiod* timeliness of quarterly and semiannual firms. While the first of three distinct subperiods, 1951–55, does indicate higher *intraperiod* timeliness for quarterly firms, there is no evidence of a difference in the later two subperiods (1956–62, 1963–69). Similarly, the *long-horizon* timeliness of firms reporting semiannually is statistically indistinguishable from that of firms reporting quarterly.

In contrast, we do find evidence of a significant relation between voluntary changes in reporting frequency and changes in timeliness. Firms that voluntarily increase reporting frequency have significantly greater intraperiod timeliness after the reporting change than before the change. In addition, whereas this group of firms has untimely earnings relative to a set of control firms before the reporting change, the treatment firms' intraperiod timeliness is comparable to that of the control firms after the reporting change. We also find evidence supportive of timelier loss recognition for

firms that chose to report more frequently. On the other hand, after mandated changes in reporting frequency, neither intraperiod nor long-horizon timeliness increases significantly.

Overall, the results are consistent with firms voluntarily altering their reporting frequency when doing so leads to higher earnings timeliness. Our interpretation is that cross-sectional variation in financial reporting frequency is an equilibrium response to differences in the market's demand for accounting information and that this demand is shaped by firm-specific characteristics and by the availability of lower-cost information alternatives. The evidence further suggests that regulation which forces firms to adopt more frequent financial reporting policies is unlikely to result in improvements in earnings timeliness as great as those achieved by firms freely choosing to report more frequently. Note, however, that changes in disclosure frequency can affect other important parameters in addition to timeliness (e.g., liquidity, cost of capital).

The paper proceeds as follows. In the next section, we provide a historical overview of the regulation of financial reporting frequency in the United States. Section 3 reviews the literature and develops our hypotheses. Section 4 describes the research design. Section 5 reports the results for the comprehensive sample of firms, while Section 6 discusses results for firms that increased reporting frequency. Section 7 concludes the paper.

2. Historical context

Before the Securities Act of 1933 and Securities Exchange Act of 1934 (Securities Acts), financial reporting was primarily governed by stock exchanges.[2] As early as the turn of the twentieth century, the New York Stock Exchange (NYSE), in particular, began requiring some newly listed firms to report profit and balance sheet information periodically, and, by the mid-1920s, actively encouraged interim reporting of financial information. In contrast, the American Stock Exchange (AMEX) and regional exchanges, concerned that mandating frequent reporting would unduly burden listed firms, did not take similar steps until the early 1960s (Taylor, 1963). With passage of the Securities Acts, the SEC took an active role in regulating reporting frequency for exchange-listed firms by mandating annual reporting in 1934, semiannual reporting in 1955, and

[2] See Leftwich et al. (1981) for an additional discussion of the history of interim reporting regulation.

quarterly reporting in 1970. Fig. 1 summarizes milestones in the development of financial reporting frequency requirements described in this section.

2.1. Early stock exchange regulation of reporting frequency

As early as the 1860s, the NYSE began requiring firms to report income statement and balance sheet information when initially applying for listing on the exchange (Shultz, 1936). Once listed, however, few firms chose to issue financial reports voluntarily.[3] Around 1900, NYSE listing agreements began to require annual reporting of earnings and balance sheet information, and by 1910 such reporting had become the norm.[4] Agreements for semiannual reporting followed within the next ten years (e.g., the Cluett, Peabody Company in 1914). Smaller companies and industrials desiring to list were apt to agree to conditions that the older, more established railroads and other large corporations might have been reluctant to make. Beginning in 1923, the NYSE required all newly listed companies to publish quarterly financial statements and pressured already listed companies to do the same.

In 1926, the NYSE asked all firms to amend their listing agreements to commit to quarterly reporting (NYSE, 1939). These efforts were reasonably successful. Whereas in 1926 only 25% of the 957 NYSE-listed companies were under agreements to publish quarterly (8% semiannually), by the following year, 37% had agreed to do so (15% semiannually). In October 1931, the NYSE again encouraged listed firms to report quarterly, and by the end of that year, 63% of companies were reporting quarterly and 17% were reporting semiannually. By the mid-1950s, 90% of active domestic companies on the NYSE were publishing earnings quarterly, and by November 1962, this percentage had increased to 95% (Taylor, 1963).

Unlike the NYSE, neither the AMEX nor the regional exchanges were strong proponents of interim reporting. In fact, they uniformly opposed it and repeatedly protested all related SEC

[3] Shultz (1936) and NYSE (1939) cite as an example a letter sent by the NYSE to the secretary of the Delaware, Lachawanna & Western Rail-Road Company in 1866 requesting both current and historical financial reports. The company treasurer responded that his company had "ma[d]e no Reports and publish[ed] no statements,—and [we] have not done anything of the kind for the last five years." Similar NYSE requests of other firms were likewise unsuccessful.

[4] The earliest agreement to publish financial information appears to be a listing agreement made by Kansas City (Missouri) Gas Co. on September 24, 1897, in which it promised to publish net profits at least twice a year.

proposals. This opposition appears to have been motivated by a concern that some firms, finding the regulations too burdensome, might choose to delist and trade over the counter. Additionally, a quarterly reporting regime for all listed firms would mean less differentiation between the NYSE and non-NYSE exchanges. In 1962, the AMEX and the other exchanges finally softened their stances, requiring newly listed corporations to report quarterly and requesting that already-listed companies do so (Taylor, 1963). Not all previously listed AMEX companies complied with the request.

2.2. SEC regulation of interim reporting frequency

Although the Securities Exchange Act of 1934 specifically allows the SEC to mandate both annual and quarterly financial statements for exchange-listed corporations, the SEC initially mandated only annual reports. Not until 1945 did the SEC take steps to have companies report any financial information more frequently than annually. Concerned that investors might be caught off-guard by sales reductions due to war contracts, in July 1945 the SEC began requiring firms with war business exceeding 25% of sales to file quarterly reports. In the following year, the SEC adopted a rule requiring most firms to report revenues quarterly. Although the SEC preferred that firms also report income, the SEC had no such requirement in 1946, apparently acquiescing to public criticisms that quarterly income information would be unreliable and potentially misleading due to the seasonal nature of some business.

In the early 1950s, the SEC first proposed quarterly reporting of income information, then abandoned the proposal, and in 1953 even rescinded its limited quarterly sales reporting requirements before finally mandating semiannual reporting of income in 1955. The new rule required firms to provide semiannual reports that included sales, net income (before and after taxes), and all extraordinary and special items. The SEC did not reconsider quarterly reporting until the end of the 1960s when the Wheat Commission proposed quarterly reporting. In September 1969, the SEC proposed that companies be required to file quarterly reports on a new Form 10-Q, a proposal finally adopted in October 1970 and effective for quarters ending after December 31, 1970.

3. Timeliness constructs and hypothesis development

Interim reporting can be viewed more generally as one form of disclosure. Researchers have directly investigated how disclosure affects liquidity, analyst following, and the cost of capital (Healy and Palepu, 2001),[5] but have thus far provided only indirect evidence of how disclosure affects timeliness. For example, McNichols and Manegold (1983) finds that after firms institute quarterly reporting, stock market volatility around annual earnings announcements is lower than it was before the firms increased reporting frequency. In generating the hypotheses, we also consider the effect of competing information sources on timeliness.[6]

3.1. Timeliness of earnings: Intraperiod versus long-horizon

We characterize timeliness in two distinct ways, intraperiod and long-horizon timeliness. The first concept of timeliness, *intraperiod timeliness*, captures the speed with which earnings information is impounded into price over a given period and is comparable to the construct studied by Ball and Brown (1968) and Alford et al. (1993). The second concept of timeliness, *long-horizon timeliness*, captures the extent to which current earnings are explained by, or explain, current economic income (e.g., Beaver et al., 1987; Basu, 1997; Pope and Walker, 1999; Ball et al., 2000; Bushman et al., 2004; Lundholm and Myers, 2002).[7] Long-horizon timeliness can be viewed as measuring how much of the period's earnings information is associated with contemporaneous returns.

The distinction between the two forms of timeliness is important. Intraperiod timeliness measures the speed of earnings-based price formation during a specific period (e.g., a year),

[5] Disclosure improves the liquidity of securities (Welker, 1995; Healy et al., 1999; Leuz and Verrecchia, 2000) and increases analyst following (Lang and Lundholm, 1993; Healy et al., 1999). The evidence on whether it reduces the cost of capital is inconclusive (Botosan, 1997; Sengupta, 1998; Piotroski, 2003; Botosan and Plumlee, 2002), however. While these studies find that disclosure reduces the cost of capital, Fields et al. (2001) notes that this interpretation is problematic because the studies "suffer from a lack of analysis of the costs of disclosure" (e.g., proprietary costs). If such costs are not considered, firms have an incentive to adopt the highest level of disclosure.

[6] Additionally, our paper is one of few papers providing empirical evidence on disclosure *frequency*, as opposed to the more general study of voluntary disclosure. Other papers focusing on disclosure frequency include Leftwich et al. (1981) and McNichols and Manegold (1983), both of which study aspects of interim reporting, and Van Buskirk (2004), which investigates the effects of voluntary disclosures of monthly sales information.

[7] The terminology derives from Pope and Walker's (1999, p. 54) distinction between the "*intra*-year timeliness" examined by Alford et al. (1993) and "timeliness over longer horizons."

independent of the overall explanatory power of earnings for returns within the reporting period. Long-horizon timeliness, in contrast, represents the extent to which accounting income lags economic income, standard proxies for which are the explanatory power of a returns-earnings regression or the magnitude of slope coefficients in such a regression. Long-horizon timeliness is closely linked to the concept referred to in the literature as valuation (or value) relevance.[8]

3.2. Effect of reporting-frequency choice on competing information sources

The frequency of reporting affects the incentives of competing information sources (e.g., financial analysts) to seek out and analyze information since accounting reports can either substitute for or complement the analysis performed by these intermediaries. On the one hand, financial reports issued by firms act as *substitutes*, competing with intermediaries in the release of managers' private information (Healy and Palepu, 2001). More frequent reporting reduces the information gap between the market's expectation of earnings and the expectation conditional on full information, thereby reducing the rents to activities such as forecasting. On the other hand, disclosures by firms can *complement* work done by analysts through reducing the cost of analysis (Bhushan, 1989a and 1989b; Lang and Lundholm, 1993) and enabling analysts to improve forecasts and stock recommendations.

There is also a relation between firms' interim reporting policies and their use of other voluntary disclosures, such as management forecasts. The frequency or relevance of other voluntary disclosures may be reduced by more frequent interim reporting since, independent of higher costs of disclosure, interim reporting mitigates information asymmetries between managers and investors, potentially reducing the value of other voluntary disclosures. Alternatively, the presence of more frequent interim reports may necessitate increased guidance from management and hence more frequent or relevant voluntary disclosures.

Lastly, the interaction among changes in reporting frequency, the information provided by intermediaries, and firms' other voluntary disclosures could differ depending on whether a change

[8] Lo and Lys (2001, p. 5) describe the "relation between accounting information and the evolution of prices over time… [as] the central theme of the valuation relevance approach."

in reporting frequency is voluntarily undertaken by management or due to government mandate. For example, Gigler and Hemmer (1998, 2001) predict that requiring more frequent interim reports may induce firms to reduce voluntary disclosures by increasing the overall cost of disclosure (e.g., costs of production and dissemination, legal costs, proprietary costs, or agency costs) or by reducing the value of each additional voluntary disclosure. They suggest that, because voluntary disclosures are arguably more precise indicators of firm value than mandatory reports, such regulation could cause the price-informativeness of earnings to decline. Similarly, information intermediaries may view mandatory increases in reporting frequency differently from voluntary increases. Overall, the uncertain effect of interim reporting on competing information sources makes the connection between reporting frequency and timeliness unclear.

3.3. Earnings timeliness across different interim reporting frequencies

The question of how interim reporting frequency affects timeliness is related to previous studies about whether more frequent interim reporting allows more accurate and timely predictions of annual earnings. Evidence in Green and Segall (1967), who contend that interim reports are not designed to help predict annual earnings, casts doubt on the ability of interim reports to improve earnings forecasts. In contrast, Brown and Niederhoffer (1968) finds that including interim-quarter earnings in prediction models improves forecasts of annual earnings. In addition, evidence in McNichols and Manegold (1983) suggests that interim reports reduce the informativeness of annual reports.

While one effect of increased reporting frequency is to provide elements of annual information more quickly, it is also possible that interim reporting releases additional information beyond what can be learned from annual numbers. For example, a decline in earnings in a single quarter might be due to a one-time exogenous shock, whereas a steady decline in quarterly earnings could suggest longer-term concerns. Information in the trend or seasonal pattern of quarterly earnings is lost when earnings are aggregated into one annual number. The long-horizon timeliness metrics, which

measure the extent to which accounting income lags economic income, are designed to capture the effect of this information.[9]

Both intraperiod and long-horizon timeliness are potentially affected by competing information sources because it is unclear how the interaction among these sources affects total information in the market. As discussed previously, the competing sources of information may be complements or substitutes to interim reporting, as well as to one another. Hence, the predicted effect of interim reporting on timeliness is unclear.

Ultimately, whether reporting more frequently affects the intraperiod and long-horizon timeliness of earnings is an empirical question, around which we formulate our first (null) hypotheses comparing quarterly and semiannual reporting:

> **H1A:** There is no difference in the **intraperiod** timeliness of annual earnings for firms reporting quarterly and firms reporting semiannually.
>
> **H1B:** There is no difference in the **long-horizon** timeliness of annual earnings for firms reporting quarterly and firms reporting semiannually.

3.4. Timeliness surrounding voluntary and mandatory increases in interim reporting frequency

While H1A and H1B focus on the relation between the level of reporting frequency and earnings timeliness, a potentially more powerful approach is to examine changes in timeliness around changes in frequency. Although focusing on firms that increase their frequency reduces the sample size, doing so allows us to isolate how factors associated with the decision to report more frequently affect earnings timeliness. Furthermore, examining reporting changes better controls for self-selection since it allows us to examine the same firm both pre- and post-switch, and also to match treatment firms with control firms. Finally, our full sample spans a twenty-year period over which a variety of factors change, so focusing on switching firms mitigates the impact of changes over time.

When examining the relation between timeliness and changes in reporting frequency, it is important to distinguish between situations in which management voluntarily increases reporting frequency and situations in which management is forced to increase frequency. A managerial choice

[9] We thank the editor and referee for pointing out this issue.

to increase reporting frequency is likely to occur when the old reporting policy is viewed as suboptimal. Motives for such a change include reducing information asymmetries or improving monitoring (Leftwich et al., 1981). Alternatively, management might decide that earnings information is not reaching the market in a timely manner. This suggests that a voluntary increase in reporting frequency improves both the intraperiod and long-horizon timeliness of earnings. Since annual earnings are an aggregation of interim-period earnings, increasing reporting frequency assists in estimating annual earnings and thus implies an increase in intraperiod timeliness. Long-horizon timeliness is expected to improve because of the improved predictability of current and future earnings.

The effect of a mandatory increase in reporting frequency can differ from a voluntary increase because firms are forced to alter a reporting strategy they had presumably deemed optimal. As Gigler and Hemmer (1998) suggests, a mandated increase in interim reporting is likely to result in firms' reducing voluntary disclosures, since these disclosures are now less valuable. Moreover, such voluntary disclosures are arguably more precise indicators of firm value due to the discretion allowed for their timing and substance. Based on this hypothesized decrease in voluntary disclosures, the model in Gigler and Hemmer (1998) implies that a mandated increase in disclosure may actually reduce earnings timeliness. The effect, however, could be partially offset by either additional analysis by information intermediaries or additional management guidance to increase the precision of mandatory reports (e.g., the explanation of earnings patterns otherwise obscured in a lower-frequency reporting regime).

Given the potentially differential effects on timeliness of discretionary and compulsory increases in reporting frequency, we develop separate hypotheses for each type of increase. Stated in null form, our second and third hypotheses are as follows:

> **H2:** The intraperiod (long-horizon) timeliness of annual earnings is unchanged after a **voluntary** increase in interim reporting frequency.
>
> **H3:** The intraperiod (long-horizon) timeliness of annual earnings is unchanged after a **mandatory** increase in interim reporting frequency.

Note the complementary nature of our two sets of hypotheses—H1A/H1B and H2/H3. While our focus with each set of hypotheses is on assessing the relation between reporting frequency and timeliness, H1A and H1B capture, all else equal, the average relation over time between reporting frequency and earnings timeliness, whereas H2 and H3 investigate the short-term effect of a change in frequency on timeliness. The last two hypotheses not only provide an additional means of controlling for the effect of self-selection on timeliness, they also allow us to draw inferences about the potentially differential benefits of voluntary and mandated reporting choices.

4. Specification of tests

4.1. Intraperiod and long-horizon timeliness

4.1.1. Intraperiod timeliness metric

Similar to Ball and Brown (1968) and Alford et al. (1993), we derive our initial intraperiod measure of earnings timeliness using a hedge portfolio, formed at the beginning of a given year based on complete foreknowledge of year-end annual earnings. This *perfect foresight of earnings* hedge portfolio constitutes a long (short) position in firms in the top (bottom) 27% of scaled earnings changes, $(EPS_t - EPS_{t-1})/P_{t-1}$, where EPS_t is primary earnings per share before extraordinary items for year *t*, and P_{t-1} represents lagged price.[10]

To test for intraperiod timeliness, we examine how quickly hedge portfolio returns are earned over a 12-month window ending at fiscal-year end. We compute the earnings-based hedge portfolio return at the end of each month *m* ($EHPRet_m$, $m=1,12$) as a percentage of the 12-month hedge portfolio return ($EHPRet_{12}$) and graph the computed data points. The timeliness of annual earnings is given by the area under the graph (see Fig. 2, for example). The larger the area, the more quickly annual earnings information is reflected in returns during the year. To test for a difference in the areas of two graphs, we use a permutation test described in McNichols (1984) and the appendix.

[10] We use a 27% cutoff, as opposed to the 40% cutoff of Alford et al. (1993), because Lys and Sabino (1992) shows that a 27% cutoff maximizes test power. Results are qualitatively similar using a 40% cutoff.

Our second measure of intraperiod timeliness is derived by calculating an individual intraperiod timeliness statistic for each firm (IPT). A firm's IPT measure is calculated as the sum of the firm's buy-and-hold return from month 1 through *m* (BH_m) divided by the buy-and-hold return from month 1 through 12 (BH_{12}), for each of month *m* from 1 to 11, plus 0.5:[11]

$$IPT = \frac{1}{2}\sum_{m=1}^{12}\left(BH_{m-1} + BH_m\right)/BH_{12} = \sum_{m=1}^{11}\left(BH_m/BH_{12}\right) + 0.5. \quad (1)$$

This measure is designed to capture the speed, or timeliness, with which all of the information related to that firm (proxied by returns) is impounded into price. More timely firms should have larger individual IPTs. In contrast to our first intraperiod timeliness measure, the individual IPT measure does not directly use information about the individual firms' earnings. Instead, earnings information will indirectly affect the monthly and cumulative buy-and-hold returns. To test for intraperiod timeliness, we examine the average individual IPTs for various groups of firms after controlling for self-selection.

4.1.2. Long-horizon timeliness metrics

Long-horizon timeliness metrics take the following forms: the explanatory power (R^2) of a reverse regression of annual earnings on returns (hereafter "reverse regression"), and the estimated slope coefficients on positive and negative returns in a reverse regression.[12] Following Basu (1997), Ball et al. (2000), and Bushman et al. (2002), we estimate the following reverse regression:

$$EARN_{it} = \beta_{f0} + \beta_{f1} \times NEG_{it} + \beta_{f2} \times RET_{it} + \beta_{f3} \times NEG_{it} \times RET_{it} + \eta_{it}, \quad (2)$$

where $EARN$ is annual earnings before extraordinary items, divided by beginning-of-year market value of equity; RET is the stock return for the 12-month period ending at fiscal year-end; and NEG is a dummy variable equal to one if $RET < 0$ and zero otherwise. Long-horizon timeliness is increasing in the regression R^2, which measures the extent to which current-period earnings contain the news reflected in contemporaneous stock returns, and in β_{f2} and β_{f3}, which capture the speed of good-news and incremental-bad-news incorporation, respectively. Because cross-sample

[11] This formula represents the sum of the areas of twelve trapezoids (one for each month).

[12] We also measure long-horizon timeliness as the R^2 from a standard regression of returns on earnings levels and changes (see Bushman et al., 2002). Untabulated results of these tests are qualitatively similar.

comparisons of R^2 are frequently suspect (e.g., when there are cross-sample differences in either heteroskedasticity (Chang, 1999) or the dependent variable's coefficient of variation (Brown et al., 1999)),[13] we base our analyses of long-horizon timeliness on the slope-coefficient measures.

4.2. Controlling for endogenous self-selection using a model of reporting-frequency choice

4.2.1. Endogeneity and self-selection concerns

By construction, the previous tests examine timeliness under each separate reporting regime without conditioning on the reporting-frequency decision. The choice of reporting frequency, however, is nonrandom because firms select reporting frequency based on a variety of factors. For example, firms with high information asymmetry might report more frequently in an attempt to reduce the asymmetry, as might firms with high agency costs. Conversely, firms with high proprietary costs are expected to report less frequently.

Econometric tests that fail to account for endogeneity and self-selection can be flawed, resulting in potentially biased coefficient and standard-error estimates.[14] This problem arises because factors influencing cross-sectional variation in reporting frequency are likely also to be relevant in determining earnings timeliness. If, as we hypothesize, interim reporting frequency influences earnings timeliness, then managers are likely to base reporting frequency decisions, in part, on the expected effect of that decision on timeliness and factors that influence timeliness. Firms with high information asymmetry, for example, may choose to report more frequently because their news is conveyed slowly. The decision to report more frequently is thus influenced by the untimeliness of the firm's earnings, while, at the same time, management expects the policy change to influence future earnings timeliness.

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[13] Gu (2004, p. 5) argues that R^2 s are incomparable across samples "[u]nless one is sure both that *the underlying population is held constant and that the samples are drawn randomly from the same population.*" If these conditions fail to hold, he contends, even R^2 comparisons involving samples with no differences in scale are flawed.

[14] The econometric issues raised in the context of our study parallel (a) those in labor economics studies in which individuals choose professions based on the expected wealth produced by that choice and (b) those in strategic management studies in which alternative strategies are chosen based on their expected effects on firm performance. See Hamilton and Nickerson (2003) for a full discussion of these issues. Maddala (1991) reviews the use of self-selection models in accounting research.

4.2.2. Controlling for endogenous self-selection

To mitigate potential bias due to self-selection, we estimate selectivity-corrected earnings timeliness regressions for each reporting-frequency regime and each type of frequency-increasing firm (i.e., voluntary and mandatory) using an ordered probit and probit model, respectively. This approach incorporates a variant of Heckman's (1979) two-stage procedure, an endogenous switching model (Maddala, 1983), and is patterned after the method Main and Reilly (1993) use to examine the wage effects of unionization as a function of manufacturing plant size.

The estimation procedure varies slightly depending on whether we are comparing timeliness across reporting regimes (hereafter the "full sample"), as in Section 3.3, or changes in timeliness due to voluntary and mandatory increases in reporting frequency (hereafter the "switching sample"), as in Section 3.4. In the former case, the first stage involves estimating an ordered probit model in which the dependent variable takes on a value of 0 if the firm reports annually, 1 if semiannually, and 2 if quarterly. In the latter comparison, the dependent variable is 0 if a firm voluntarily switches from semiannual to quarterly reporting and 1 if the firm does so mandatorily.

Specifically, the two first-stage regressions take the following forms:

$$FREQ = \chi_0 + \chi_1 \times Z + \nu_1 \tag{3}$$

$$MAND = \phi_0 + \phi_1 \times Z + \nu_2, \tag{4}$$

where the ordinal variable $FREQ$ indicates reporting frequency, $MAND$ is a dummy variable equal to 0 if the reporting-frequency increase was mandatory, and Z is a vector of covariates representing factors hypothesized to explain reporting frequency (described in more detail in Section 4.2.3).

In the second stage, we specify k selection-corrected earnings timeliness equations. In the full sample analysis, k = 3, which corresponds to one equation for each reporting-frequency regime (annual, semiannual, and quarterly). In the switching sample analysis, k = 2, which corresponds to one equation each for voluntary and mandatory switchers. In addition to the independent variables in the standard ordinary least squares (OLS) framework (see equation (2)), each selection-corrected equation includes a regressor, the inverse Mill's ratio (IMR), constructed using results of the first-stage regression. This additional variable, *IMR*, represents the probability of firms' choosing a

particular reporting frequency (full sample) or the probability of a change in reporting frequency being nondiscretionary (switching sample). Thus, in the second stage of the procedure we use OLS to separately estimate the following augmented IPT and reverse regressions:

$$IPT_{it} = \alpha_{f0} + \alpha_{f1} \times IMR_{it} + \varepsilon_{it} \quad (5)$$

$$EARN_{it} = \beta_{f0} + \beta_{f1} \times NEG_{it} + \beta_{f2} \times RET_{it} + \beta_{f3} \times NEG_{it} \times RET_{it} + \beta_{f4} \times IMR_{it} + \eta_{it} \quad (6)$$

where variables are as previously defined. For the full sample, *f* = annual, semiannual, or quarterly; and for the switching sample, *f* = voluntary or mandatory.

4.2.3. Factors determining reporting-frequency choice

A firm's choice of reporting frequency depends on several factors, noted as the vector of covariates, *Z*, in equations (3) and (4). Firms trade off the benefits of more frequent disclosure (e.g., reductions in the cost of capital or litigation risk) with the associated costs (e.g., report production and dissemination or proprietary costs). We predict firms for which information problems are most severe to mitigate information asymmetry by reporting more frequently. In addition, agency costs create a demand for monitoring, and financial reporting is one means of monitoring (Jensen and Meckling, 1976). Furthermore, proprietary costs are higher for firms in concentrated industries, which are generally less competitive and therefore more likely to protect economic rents by reporting less frequently (Harris, 1998). Finally, as a firm's operating cycle increases, errors in accrual estimation grow (Dechow and Dichev, 2002) and shortening the reporting interval exacerbates these estimation errors, resulting in noisier financial reports. Based on this reasoning, firms with longer operating cycles will issue interim reports less frequently. Confounding this explanation, however, is the potentially greater demand for accounting information due to the lower transparency of firms with a longer operating cycle. The model of reporting frequency choice is therefore a function of the factors influencing the benefits and costs of disclosure; hence,

$$ReportingFrequency = f\left(\begin{array}{l} Information\ Asymmetry, Agency\ Costs, Proprietary\ Costs, \\ Informativeness\ of\ Shorter\ Measurement\ Intervals, Performance \end{array}\right)$$

Proxies for the above correspond to the vector-Z covariates in first-stage regression equations (3) and (4).

To proxy for information asymmetry we use a measure of stock return volatility—the standard deviation of firms' monthly market-model residuals (e.g., Bhagat et al., 1985)—and a surrogate for the firm's investment opportunity set, assets in place (e.g., Smith and Watts, 1992)—the ratio of the book value of assets to firm value. Following Leftwich et al. (1981), we proxy for agency costs and the benefits of monitoring using the ratio of total liabilities to firm value. We measure proprietary costs as the four-firm concentration ratio and operating cycle as

$$\frac{(AR_t + AR_{t-1})/2}{Sales_t/365} + \frac{(Inventory_t + Inventory_{t-1})/2}{COGS_t/365}.$$

In addition to the above proxies, we include a proxy for firm performance, measured by lagged return on assets. We also include an indicator variable for exchange listing (1 if listed on AMEX and 0 if on NYSE) because it is an alternative form of monitoring, and we separately run regressions for AMEX and NYSE firms. Lastly, we include the logarithm of the market value of common equity to control for firm size.

5. Reporting frequency choice and timeliness: Sample and results

5.1. Sample selection and data sources

To collect the sample, we identify all NYSE and AMEX firms appearing on the monthly CRSP tapes in any year from 1950 to 1973. We rely on the NYSE and AMEX (to the exclusion of regional exchanges) because they account for the overwhelming majority of listed firms during this period, and the databases that we use for price information (CRSP) and accounting information (Compustat) have limited coverage of regional exchanges. We eliminate industries that the SEC typically excludes from certain disclosure requirements (e.g., utilities; financial service, insurance, and real estate firms; and railroad and other transportation companies). The total number of firms on CRSP from 1950 to 1973 is 4,164, of which 462 are in excluded industries, leaving 3,702 firms for which to collect annual reporting frequency. Our primary source for the frequency of financial statement publication is the index to the annual edition of *Moody's Industrial News Reports* (published semiweekly). The final sample includes 28,824 firm-year observations, which include all

firm-years for which required frequency data are available and the firm is listed on CRSP for the entire year.

Table 1 contains reporting frequency distributions for the 1950–73 period, grouped by three-year subperiods. We report the frequency distribution by industry and exchange separately since the reporting requirements of the NYSE and AMEX differ. Observations for AMEX firms begin in the 1962–64 period because CRSP did not report AMEX data until July 1962.

A few patterns are apparent from Table 1. First, even in the early 1950s, the majority of NYSE firms reports quarterly, with industry-group frequencies ranging from 59% to 92% in the 1950–52 period.[15] Second, the number of firms reporting quarterly increases monotonically over time due, in part, to the frequency-increasing regulation imposed by the SEC in 1955 and 1970. Indeed, by the early 1970s, approximately 98% (94%) of all NYSE (AMEX) firms were reporting quarterly. Third, on average, NYSE firms report more frequently than AMEX firms, consistent with the NYSE's stronger historical emphasis on frequent reporting. Finally, firms in industries with seasonal sales patterns tend to disclose less frequently than others. For example, in the 1950–52 period, only 59% of NYSE firms involved in either wholesale or retail trade (SIC 50–59) reported quarterly, compared to 92% of firms in heavy manufacturing.

5.2. Descriptive statistics

Table 2 reports descriptive statistics by reporting frequency for the periods 1951–55, 1956–62, and 1963–69. To be included in the table and subsequent analysis, a firm must have current and lagged total assets greater than $100,000 (in 1962 dollars) and must have complete monthly return data for each year. Assets are adjusted for inflation using the Gross National Product Implicit Price Deflator. The table includes statistics on firm size and other factors expected to be associated with disclosure policy.

Firm size—as measured by total assets, market value of equity (MVE), and size decile—is positively associated with reporting frequency. During each subperiod, firms reporting more frequently tend to be larger, on average, and the relation appears to strengthen over time. During the

[15] Firms reporting three times a year (2.1% of sample) are grouped with those reporting quarterly.

1951–55 reporting period, mean (median) total assets of firms reporting quarterly was $253.6 ($85.0) million versus $170.7 ($74.9) million for firms reporting semiannually. By the 1963–69 period, the mean (median) total assets for firms reporting quarterly was $263.9 ($55.3) million, while that of firms reporting semiannually fell to $69.0 ($16.3) million.

The univariate correlations between reporting frequency and each of our information asymmetry proxies—assets in place and the volatility of market-model residuals—imply that the marginal benefits of reporting more frequently are lower for firms with less severe information problems. Our proxy for agency costs, leverage, is generally lower for more frequent reporters, and our proxy for proprietary costs, the four-firm concentration ratio, bears no consistent relation to reporting frequency. Additionally, firms reporting quarterly have longer operating cycles than other firms, consistent with the hypothesis that the demand for accounting information is higher for such firms.

Table 2 also includes measures of firm performance and risk. Firms reporting quarterly are more profitable than firms reporting less frequently in terms of return on assets (lagged ROA) and, in two of the three subperiods, have had superior stock market performance over the prior year (lagged 12-month market-adjusted stock returns). Our first measure of risk, book-to-market, is negatively related to reporting frequency in all time periods, suggesting that firms reporting more frequently are less risky. For our other two measures of risk, return volatility and return volatility scaled by the average market return volatility, there is no consistent pattern across reporting frequencies.

5.3. Choice of reporting frequency: first stage to control for potential self-selection bias

As outlined in Section 4.2, we incorporate a model of reporting frequency choice in our timeliness tests to control for self-selection effects. Overall, the results (untabulated) of the ordered probit confirm the hypotheses described in Section 4.2 that firms with more asymmetrically informed investors, higher agency costs, longer operating cycles, and better performance tend to report more frequently, as do firms listed on the NYSE. Evidence on the relation between industry concentration and reporting frequency is mixed.

5.4. Timeliness of annual earnings across different reporting frequencies

We examine intraperiod and long-horizon timeliness across the sample firms, partitioned into semiannual and quarterly reporting frequencies. Partitioning gives us a sample of 1,049 firms reporting semiannually and 11,785 reporting quarterly over 1951–69. The sample includes all firms for which we have collected reporting frequency and for which monthly return and annual earnings are available on CRSP and Compustat, respectively.[16]

Our first measure of timeliness is the intraperiod timeliness metric from Ball and Brown (1968) and Alford et al. (1993), described in Section 4.1.1. Fig. 2 includes graphs of intraperiod timeliness for firms reporting semiannually and quarterly, over the entire period 1951–1969.[17] In this figure, and all subsequent ones, the shaded region represents timeliness for firms reporting semiannually, and the area under the dashed line corresponds to the timeliness of firms reporting quarterly. Larger regions under the graph suggest greater levels of intraperiod timeliness.

In Fig. 2, the area under the timeliness graph for firms reporting quarterly (6.21) is larger than that for firms reporting semiannually (5.82). However, based on permutation-test statistics described in the appendix, the difference is not statistically significant (73rd percentile of sampling distribution). So, while graphically it appears that earnings information is impounded into price sooner for firms reporting quarterly, we are unable to reject the null of no difference (H1A).

In Fig. 3 and Table 3, we report the results of comparing both intraperiod and long-horizon timeliness across reporting-frequency regimes. In addition to the intraperiod timeliness graphs, we also measure intraperiod timeliness by calculating individual IPT values for each firm (see Section 4.1.1) and examine the following long-horizon timeliness metrics: (i) the good- and incremental-bad-news slope coefficients from the estimate of the reverse earnings-returns regressions (equation 6), and (ii) the R^2 from the same regression. All regressions are corrected for the endogenous selection of reporting frequency using the procedure described in Section 4.2.

[16] Later in the paper, we isolate 180 firms that increased reporting frequency from semiannually to quarterly. Of the 180 firms, 78 are included in the timeliness tests here because both CRSP and Compustat data are available. Excluding these firms leaves results qualitatively unchanged.

[17] To save space, we omit timeliness plots for firms reporting annually. The plots and related inferences are similar to those based on the comparison of semiannual and quarterly reporting.

Fig. 3 (Panels A, B, and C) and Table 3 (Panel A) display the results of timeliness graphs and statistics for firms partitioned into the subperiods 1951–55, 1956–62, and 1963–69. We partition into these subperiods because the reporting regime changed in 1955 (from annual to semiannual), and because AMEX firms are not included in the CRSP database until 1962. The first two graphs in Fig. 3 (Panel A:1951–55; Panel B:1956–62) suggest that earnings timeliness is greater under quarterly reporting than semiannual reporting, although the differences are statistically significant only in the first subperiod (95th percentile). In the most recent subperiod (Panel C: 1963–69), timeliness does not differ (50th percentile).

Results of the individual IPT regressions, reported in Table 3, Panel A, are consistent with the timeliness graphs. In particular, in the first subperiod (1951–55), firms reporting quarterly display significantly greater intraperiod timeliness than firms reporting semiannually (6.10 versus 4.71; $t = 3.39$). Note also that, in the 1951–55 period, the estimated IMR coefficient in the semiannual-reporter IPT regression is significant ($t = 2.03$) and thus, in this case, we reject the null of no self-selection bias. In other words, failing to include in these IPT regressions a control for characteristics that influenced firms' reporting-frequency choice (i.e., the IMR variable) results in a biased estimate of the sample-mean IPT and could alter inferences. Indeed, if the self-selection correction is excluded, there is no statistically significant difference in the average IPT of firms reporting semiannually and those reporting quarterly in the 1951–55 period. In the other two subperiods, however, the estimated IMR coefficients are not significantly different from zero in the IPT regressions and inferences regarding the effect of reporting frequency level on intraperiod timeliness are invariant to controlling for self-selection.

One potential explanation for the continual decline in the difference between the intraperiod timeliness of firms reporting semiannually and those reporting quarterly is that, as the 1970 mandate for quarterly reporting neared, firms that benefited most from increased reporting frequency were already reporting quarterly. An alternative explanation is that, over time, the analyst community and other competing sources of information played more prominent roles in timely price formation, thus causing financial reporting frequency to have less of an effect on earnings timeliness.

Table 3, Panel B, reports results of reverse-regression tests (equation (6)) comparing the long-horizon timeliness of firms reporting semiannually and quarterly. Nine of the twelve estimated good-news (β_{f2}) and incremental bad-news (β_{f3}) slope coefficients are significantly positive, while the remaining three are insignificant. In the 1951–55 period, the good-news slope coefficient, β_{f2}, is 0.17 for the firms reporting semiannually, significantly greater than the 0.05 coefficient estimate for the firms reporting quarterly (t = 4.62). The difference for β_{f3} is 0.29, which is significant at the 5% level. Similar to the intraperiod timeliness results, none of the coefficients (β_{f2} and β_{f3}) for the 1956–62 and 1963–69 periods are significant. In addition, although we do not conduct formal tests of cross-sample differences in reverse-regression R^2s, no consistent pattern emerges that would suggest such a difference. Based on the results above, we are unable to reject the null of no difference in long-horizon timeliness for any of the subperiods.

Overall, there is little evidence to reject the null hypothesis of no relation between intraperiod timeliness and reporting frequency (H1A). While Fig. 3 indicates that, in the earliest period (1951–55), intraperiod timeliness is higher for firms reporting quarterly than for those reporting semiannually, that relationship does not hold for either of the later periods. Similarly, the results for long-horizon timeliness (H1B) do not clearly suggest that one reporting frequency regime is timelier than the other. The next section discusses limitations of the above comparisons.

5.5. Limitations of timeliness comparisons across different reporting frequencies

Even with the controls for self-selection, the above comparison of earnings timeliness suffers from limitations. First, given the uncertain relation between reporting frequency and competing information sources discussed in the hypothesis development section (Section 3.2), either the increased size and sophistication of the analyst community or firms' evolving voluntary disclosure policies could be influencing our findings. Second, all firms in the above analysis are aggregated over time, so firms voluntarily reporting quarterly in the early 1960s are aggregated with firms mandatorily reporting quarterly in the late 1960s. Finally, the analysis spans a twenty-year period, over which a variety of factors may change.

One method of mitigating the above limitations is to focus on specific firms that have changed their reporting frequency over time. In our sample, few firms *decrease* their reporting frequency, other than in a year of bankruptcy, and those decreases are almost always transitory. However, a larger number of firms *increase* their reporting frequency, some voluntarily and others in response to regulation. The next section investigates these firms to assess the effect of reporting frequency on timeliness, which also allows us to separately examine the effects of changes in timeliness surrounding voluntary and mandatory increases.

6. Effects of increasing reporting frequency on timeliness

This section considers how changes in reporting frequency affect earnings timeliness. By focusing on firms changing their reporting frequency, we can compare these firms before and after the switch to isolate the effect of the reporting change on timeliness, thus using firms as their own controls. We identify two samples of firms: one sample that *voluntarily* increased reporting frequency and a second sample that increased reporting frequency around the time regulators imposed a *mandatory* change. Each sample is also compared to control firms.

6.1. Voluntary and mandatory increasers

Firms that increased reporting frequency were identified using the following criteria. First, to ensure that the firms were publicly traded both before and after the switch, only firms having CRSP data for the four-year period surrounding the switch (from two years prior through one year after) are included.[18] Next, to avoid including firms with transitory increases in reporting frequency, we require that firms reported semiannually for at least the two years immediately preceding the switch and that the increase in frequency was sustained for at least two years. This criterion excludes, for example, firms that had been reporting quarterly, reported semiannually for one year, and then resumed quarterly reporting. In total, there are 180 firms with a sustained change in reporting frequency from semiannual to quarterly.

[18] We do not require Compustat data for switching firms because we hand-collect the necessary financial statement data.

Table 4 reports the distribution of the switching firms by switch year, where the switch year is the first year of the higher reporting frequency. Because the SEC mandated quarterly reporting in 1970, we classify firms that switched prior to 1967 as voluntary increasers and all others as mandatory increasers.[19] We include firms that switched in the three years before 1970 both because SEC discussions and proposals had already taken place and because, during the 1960s, the AMEX was exerting pressure on its firms to report quarterly. Of the 180 switching firms, we classify 98 as voluntary and 82 as mandatory. Most voluntary increasers are evenly distributed over the period 1952–64, but in 1965 there was a substantial increase in firms due to CRSP's 1962 initiation of AMEX coverage.

We address the problem of endogenous self-selection both econometrically and by using multiple control samples. First, our sample firms act as their own controls since we compare their timeliness (and other characteristics) before the switch to after the switch. Secondly, we identify control samples of firms that did not change their reporting frequency. Finally, as described in Section 4.2.2, we use an endogenous switching model to control for self-selection.

6.2. Control samples and descriptive statistics

In addition to using switching firms as their own controls, we compare them to control samples matched on both size and industry. For both voluntary and mandatory switchers, we construct a matched sample of firms that were reporting quarterly before and after the treatment firms' increase in reporting frequency (hereafter "control sample 1"). Additionally, for the voluntary increasers, we create a control sample of firms that were reporting semiannually both before and after the treatment firms' increase in reporting frequency (hereafter "control sample 2"). To form the control samples, we identify firms with the appropriate frequency characteristics in the surrounding four-year period and match on year, size, and industry (two-digit SIC code if available, otherwise one-

[19] Our sample of mandatory increasers includes only firms that chose to continue to be listed by bearing the additional cost of quarterly reporting. For evidence that small firms may delist instead of paying the additional costs of disclosure, see Bushee and Leuz (2005), which investigates SEC imposition of the 1934 Act reporting requirements on OTCBB firms in 1999–2000 and finds that approximately 76% of firms listed on OTCBB choose to delist in lieu of providing the additional disclosures required under the 1934 Act.

digit). After matching on year and SIC code, we choose the firm closest in size to each of our primary sample firms (based on beginning-of-year market value of equity).

Table 5, Panel A, reports descriptive statistics for the voluntary increasers and control sample 1 for the year prior to the switch and compares them to the control group in the year prior to the switch, and to themselves in the year after the switch. Overall, the voluntary increasers more closely resemble firms already reporting quarterly (control sample 1) than those continuing to report semiannually (control sample 2, untabulated). Following the increase in frequency, there is an improvement in performance (increases in mean and median ROA are significant at the 15% and 10% levels, respectively) and a reduction in risk (decrease in average scaled return volatility is significant at the 15% level).

Table 5, Panel B, reports similar descriptive statistics for the 82 mandatory increasers and the control sample. This analysis offers evidence on how firms that wait until forced to increase disclosure differ from firms that have already chosen to report quarterly. On average, the mandatory increasers display greater information asymmetry than the control firms: the standard deviation of market-model residuals is marginally higher (significant at the 15% level for the mean). Using firms as their own controls, we see little change in the mandatory increasers' characteristics after the change in frequency.

6.3. Timeliness of annual earnings for firms increasing frequency

In this section, we compare the intraperiod and long-horizon timeliness of the 98 voluntary and 82 mandatory increasers to those of control samples. To enhance readability, we include only comparisons to firms in control sample 1 in the tables and figures.

Fig. 4 displays timeliness graphs in the pre- and post-frequency-increase period for voluntary increasers and for firms in control sample 1. Prior to the increase in reporting frequency, voluntary increasers' intraperiod timeliness (VolPre) is lower than that of control firms (CtrPre), but timeliness improves significantly after the increase in frequency (VolPost). Before the increase to quarterly reporting, the area under the timeliness curve for voluntary increasers is 2.29, which is smaller than the area for the control firms, 4.67 (88th percentile). After the increase in reporting

frequency, the area under the voluntary-increaser curve rises to 5.87, a difference of 3.58 (97th percentile). In contrast, neither control sample exhibits a significant increase in intraperiod timeliness over the same period, suggesting that the increased timeliness is related to the discretionary nature of the increase in reporting frequency. The findings do not suggest, however, that all firms would receive similar benefits from voluntarily increasing reporting frequency, because the decision to report more frequently and any resulting changes in timeliness are determined by firm-specific characteristics of a nonrandomly selected group of firms.

Table 6, Panel A1, reports the results of tests for changes in intraperiod timeliness surrounding a voluntary increase in reporting frequency. Results for the individual IPT regressions (line 3) support the timeliness graphs in Fig. 4 and suggest that firms voluntarily increasing their reporting frequency experience a significant increase in intraperiod timeliness. After controlling for self-selection, average intraperiod timeliness in the pre-switch period was 5.36, while in the post-switch period it was 6.38 (difference significant at 10% level). On the other hand, control firms exhibit an insignificant change in intraperiod timeliness.

Fig. 5 contains timeliness graphs for firms that increased reporting frequency due to changes in SEC reporting regulations, analogous to the plots in Fig. 4 for voluntary increasers. For mandatory increasers, the pre-switch area under the curve is 7.17, whereas the post-switch area is 7.91, a statistically insignificant difference (66th percentile). There is also no significant difference in the pre- and post-switch areas for the control sample, with the area under the curve increasing from 7.04 to 8.99 (77th percentile). Results for the IPT regressions (Table 6, Panel A2) support the graphical results in Fig. 5. In the pre-switch period, the estimated IPT coefficient is 6.35, statistically indistinguishable from the estimate of 6.87 in the post-switch period. These findings suggest that firms forced to increase reporting frequency experienced no improvement in intraperiod earnings timeliness.

Table 6, Panel B, reports statistics for the long-horizon timeliness tests for both the voluntary and the mandatory increasers, and their respective control samples. For the voluntary increasers, reported in Panel B1, there is no significant change in the timeliness of good-news recognition, but

these firms do exhibit timelier recognition of bad news after the switch. For the associated control sample, the estimated coefficients do not change significantly from the pre- to post-switch period. For the mandatory increasers, as reported in Panel B2, there is no significant change in long-horizon timeliness. For the mandatory control firms, there is a significant decrease in the good-news slope coefficient (–0.12; t = 3.13) . Overall, there is no evidence of a change in the long-horizon timeliness of mandatory increasers, while the evidence is mixed for the voluntary increasers.

Collectively, results suggest that firms choosing to report more frequently—voluntary increasers—have significant increases in intraperiod timeliness. In contrast, firms forced to report more frequently—mandatory increasers—experience insignificant increases in intraperiod timeliness. The findings are consistent with such firms' opting to disclose more frequently because they anticipate that the benefits of doing so (e.g., increasing the speed with which earnings information is impounded into price) outweigh the costs. There is no evidence of a significant change in the long-horizon timeliness of mandatory increasers and mixed evidence for voluntary increasers. While the results are consistent with the Gigler and Hemmer (1998) claim that mandatory disclosures substitute for voluntary disclosures, they are also consistent with hypotheses that mandatory disclosures crowd out information generated by information intermediaries or that additional mandatory disclosures lack information content. In general, forcing firms to report more frequently does not necessarily result in increased timeliness.

7. Conclusion

This paper uses the setting of interim reporting frequency to study how disclosure frequency affects the timeliness of earnings. Using 28,824 reporting-frequency observations for 1950–73, we examine the effect of reporting frequency on the speed with which earnings information is reflected in price during the current reporting period (i.e., intraperiod timeliness). We also investigate whether reporting frequency affects the extent to which annual earnings information is explained by (or explains) contemporaneous returns (i.e., long-horizon timeliness). We find little evidence of a difference in either intraperiod or long-horizon timeliness between firms reporting quarterly and those reporting semiannually, even after controlling for self-selection.

We also identify firms that voluntarily increased reporting frequency from semiannual to quarterly and firms that did so in response to reporting requirements imposed by the SEC in 1970. After increasing reporting frequency, voluntary increasers display significant improvements in intraperiod timeliness, while mandatory increasers do not. The increase in reporting frequency has no statistically significant effect on long-horizon timeliness for mandatory increasers. Results indicate that, after the switch, voluntary increasers tend to recognize bad news more quickly, but experience no change in the timeliness of good-news recognition.

Thus, consistent with Gigler and Hemmer (1998), increases in reporting frequency do not necessarily lead to increased earnings timeliness, especially when such changes are nondiscretionary. Although we document that discretionary and nondiscretionary increases in reporting frequency differentially affect timeliness, we do not examine explanations for the disparity, such as information intermediaries' reacting differently to voluntary and mandatory changes or differences in the two firm-types' substitution between interim reports and other disclosures. Future research can seek to differentiate between these and other explanations.

Our interpretation is that cross-sectional variation in reporting frequency is an equilibrium response to differences in the market's demand for accounting information and that this demand is shaped by firm characteristics and the availability of lower-cost information alternatives. We conclude that firms forced to adopt more frequent financial reporting policies are unlikely to improve their earnings timeliness as much as firms freely choosing to report more frequently.

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Appendix: Description of certain test statistics

Test of differences in area under curves (i.e., intraperiod timeliness). To test for differences in the areas of two graphs, we use a procedure from McNichols (1984). Under the null hypothesis, no timing differences should be observed between the hedge portfolio returns of high- and low-frequency reporters. Thus, under the null hypothesis, return pairs are assumed to have an equal probability of occurring in any given month. There are 12! (4.8×10^8) possible permutations of return pairs (for both the high- and low-frequency samples) for a 12-month test period. To approximate the sampling distribution of the test statistic under the null hypothesis that order is random, returns for the long and short hedge positions for each sample-month are randomly assigned to a month in the test period. For example, the actual returns for the long and short hedge positions in both samples for month 6 might be assigned to month 11 (i.e., all four sets of returns from month 6 would be assigned to month 11). The difference between the long and short hedge positions for each sample is computed for each month; then the maximum value of the cumulative returns in the test period is used to scale abnormal returns, resulting in the percentage return measure.

As in McNichols (1984), a test statistic, $D(t)$, is computed that represents the cumulative difference between the areas under the return curves for each sample at month *t*. This yields twelve $D(t)$s (one for each month), from which the maximum value, D^*, is selected. These steps are iterated 1,000 times, yielding a sampling distribution for D^*. The sampling distribution of D^* is then used to indicate the likelihood of observing the sample statistic $\hat{D}^*$ under the null hypothesis that there is no difference in the timing or order of the abnormal return pairs.

Fig. 1. Milestones in the development of financial reporting frequency requirements.

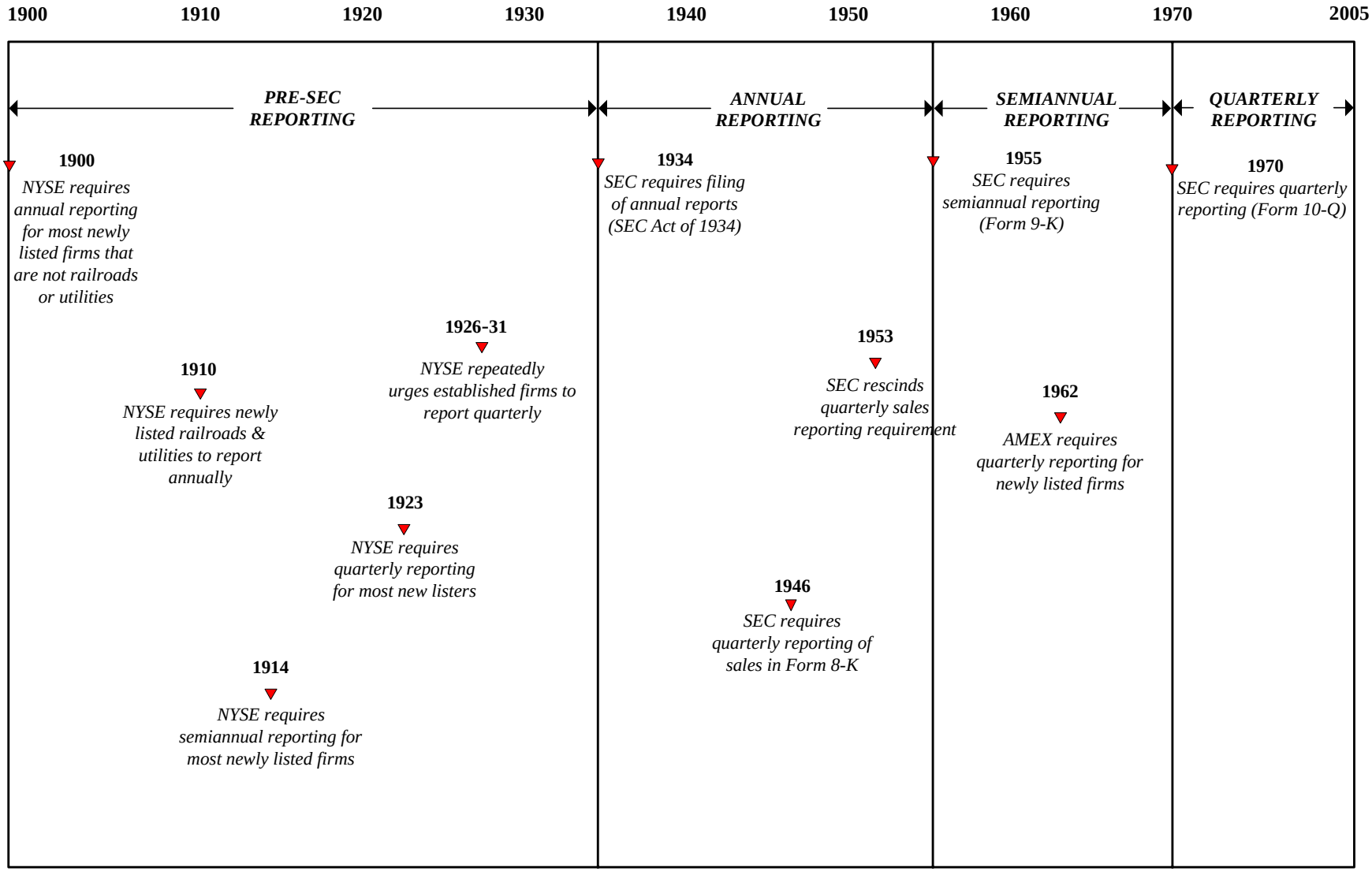


Fig. 2. Timeliness of annual earnings by reporting frequency. Plots reflect percentage of 12-month cumulative returns earned by earnings-based hedge portfolio as of the end of each month during 12-month period after beginning of event-year; that is, for each month m (m = 1,12), the plotted percentage is $y_m = \frac{EHPRet_m}{EHPRet_{12}} \times 100$. The earnings-based hedge portfolio comprises a long (short) position in the top (bottom) 27% of firms ranked annually on the change in annual earnings per share scaled by price. Semiannual and quarterly observations are separately pooled across all years, resulting in one hedge portfolio per reporting frequency. Area under graph is $IPT = \frac{1}{2}\sum_{m=1}^{12}(BH_{m-1} + BH_m)/BH_{12} = \sum_{m=1}^{11}(BH_m/BH_{12}) + 0.5$. See appendix for test statistic details.

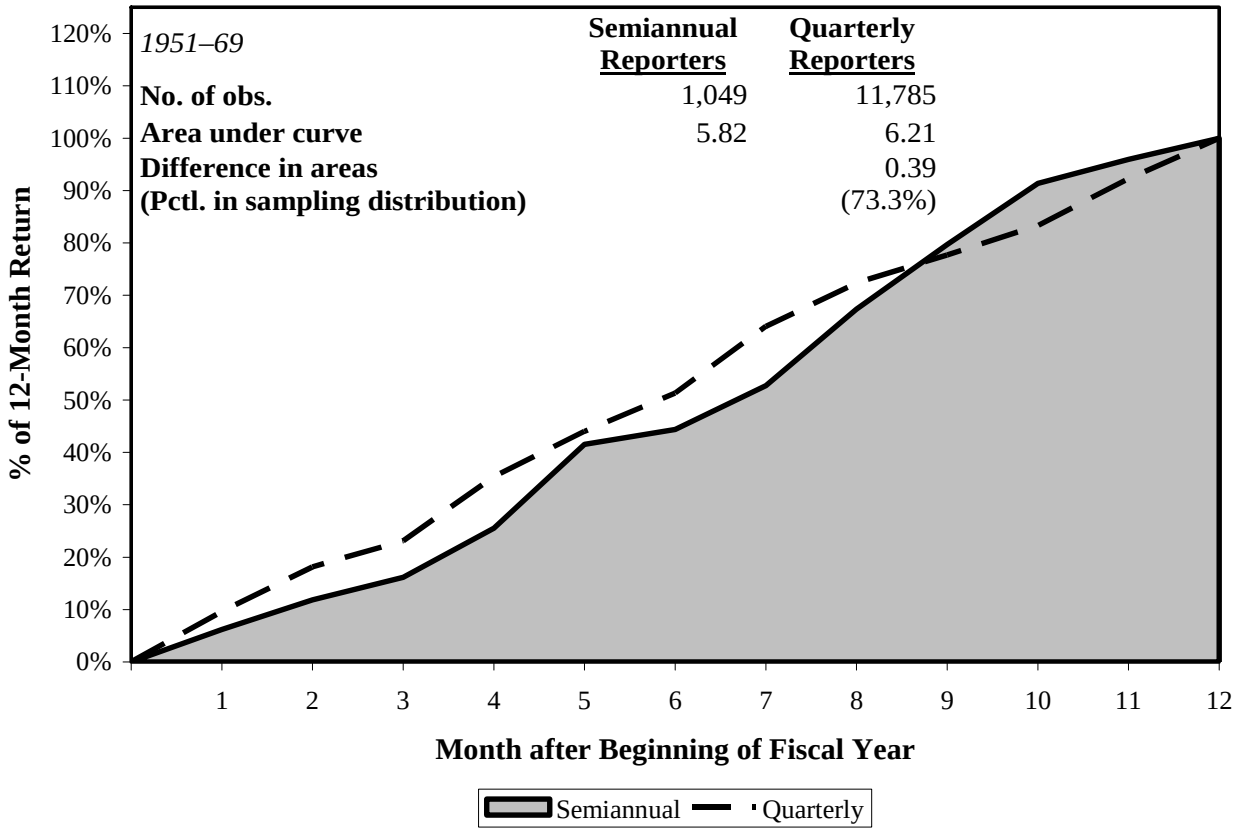
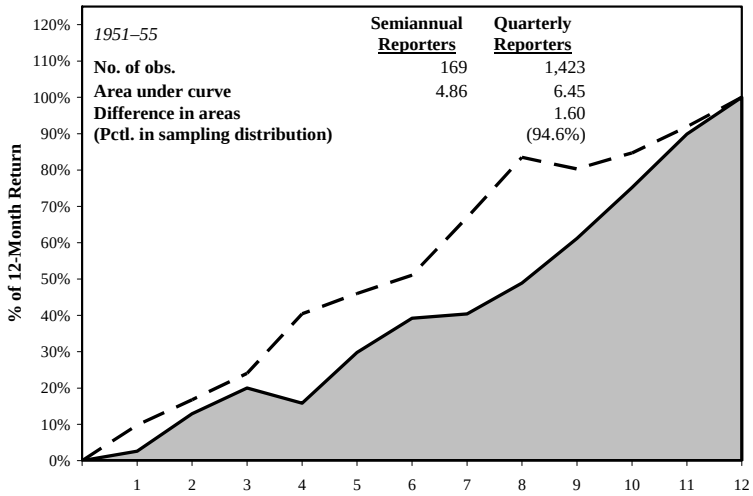
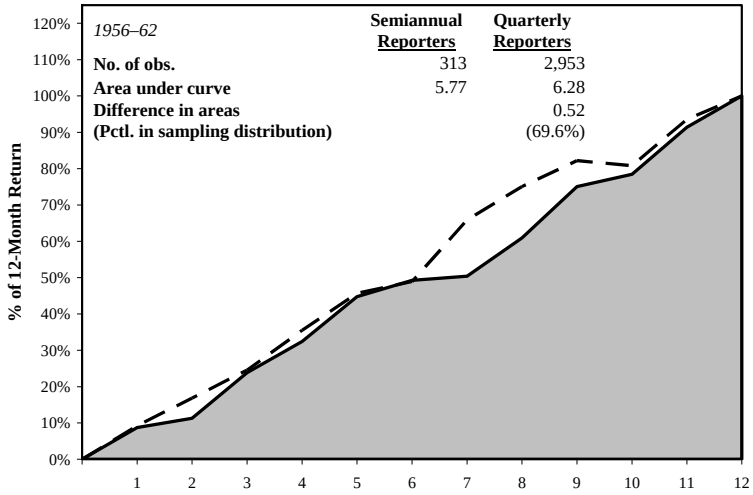


Fig. 3. Timeliness of annual earnings for firms reporting semiannually and quarterly across time. See Fig. 2 for description of methodology.

Panel A: 1951–55



Panel B: 1956–62



Panel C: 1963–69

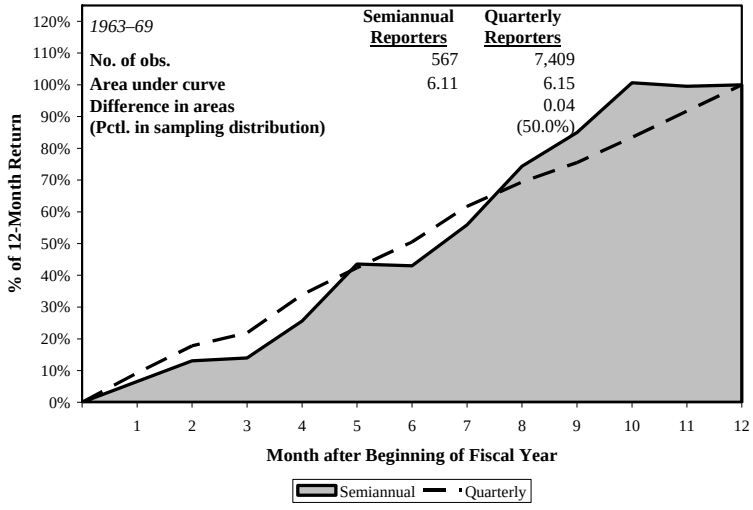


Fig. 4. Earnings timeliness surrounding voluntary increases in interim reporting (1952–66). Plots reflect percentage of 12-month cumulative earnings-based hedge portfolio return ($EHPRet_{12}$) earned as of end of each month during 12-month period after beginning of event-year; that is, $y_m = \frac{EHPRet_m}{EHPRet_{12}} \times 100$, m = 1,12. Hedge portfolio comprises long (short) position in top (bottom) 27% of firms ranked on change in annual earnings per share scaled by price. Plots are shown for switching firms in the year of the voluntary increase in reporting frequency (VolPost) and in the preceding year (VolPre). In addition, two plots are shown for matched control sample (matched on industry and size) of firms that maintained the same reporting frequency (quarterly) around the switch period. Area under graph is $IPT = \frac{1}{2}\sum_{m=1}^{12}\left(BH_{m-1} + BH_m\right)/BH_{12} = \sum_{m=1}^{11}\left(BH_m/BH_{12}\right) + 0.5$. See appendix for test statistic details.

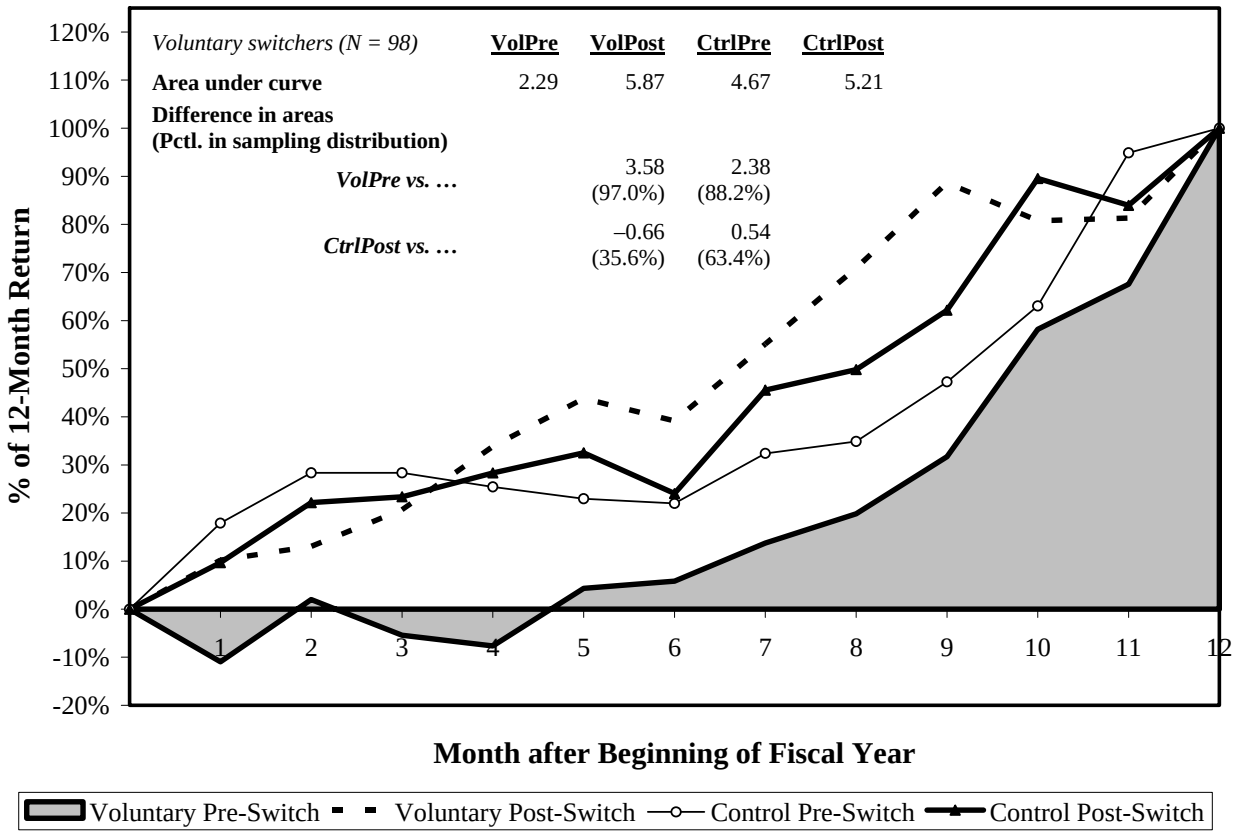


Fig. 5. Earnings timeliness surrounding mandatory increase in interim reporting (1967–72). Plots reflect percentage of 12-month cumulative earnings-based hedge portfolio return ($EHPRet_{12}$) earned as of end of each month during 12-month period after beginning of event-year; that is, $y_m = \frac{EHPRet_m}{EHPRet_{12}} \times 100$, m = 1,12. Hedge portfolio comprises long (short) position in top (bottom) 27% of firms ranked on change in annual earnings per share scaled by price. Plots are shown for switching firms in the year of the mandatory increase in reporting frequency (ManPost) and in the preceding year (ManPre). In addition, two plots are shown for matched control sample (matched on industry and size) of firms that maintained the same reporting frequency (quarterly) around the switch period. Area under graph is $IPT = \frac{1}{2}\sum_{m=1}^{12}(BH_{m-1} + BH_m)/BH_{12} = \sum_{m=1}^{11}(BH_m/BH_{12}) + 0.5$. See appendix for test-statistic details.

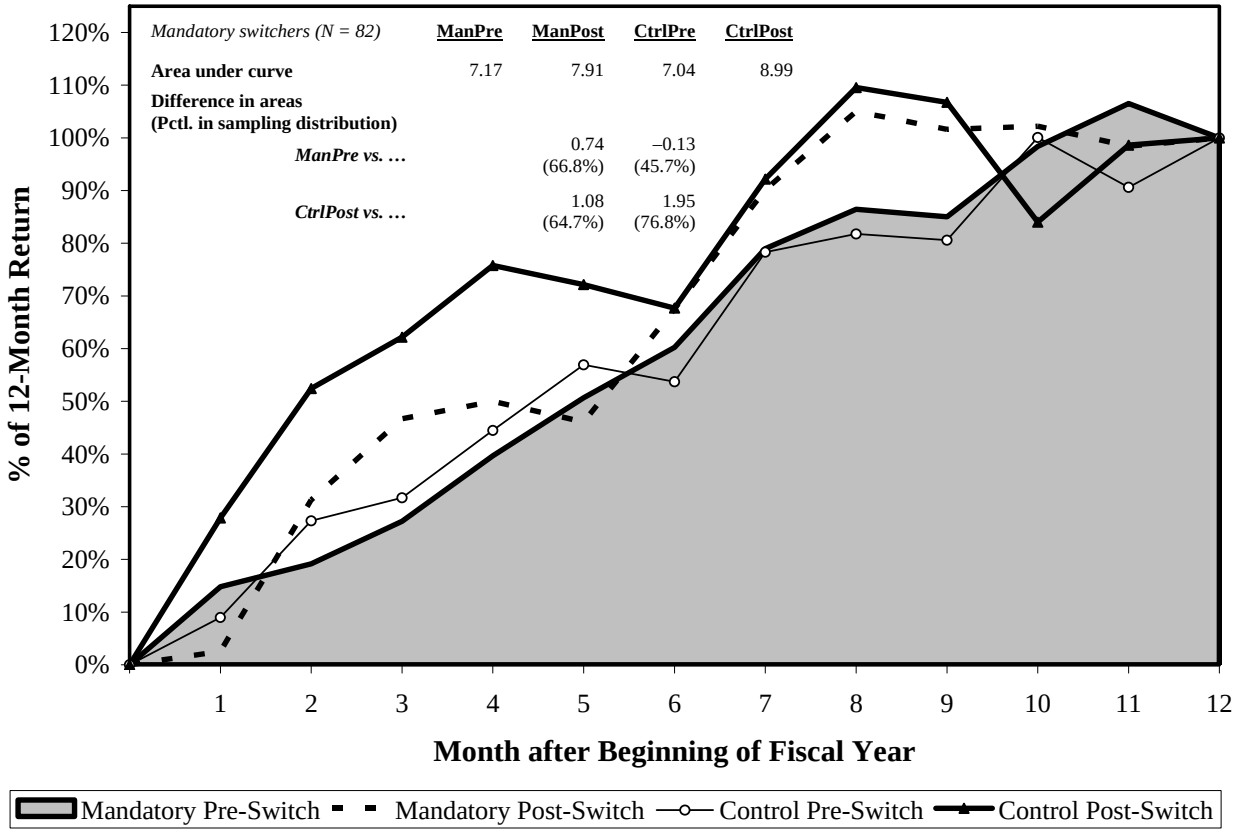


Table 1. Financial reporting frequency by exchange and industry: 1950-73.

Sample includes 28,824 firm-year observations of yearly reporting frequency for the period 1950-73. To be included in the sample, a firm must also have CRSP data for the year. The frequency of reporting was hand-collected from Moody's Industrial News Reports. We exclude heavily regulated industries from the analysis—utilities (SIC 49); finance, insurance, and real estate (SIC 60-67); railroads and other transportation (SIC 40-41)—as well as firms whose primary SIC code begins with 9. Data for AMEX firms become available in July 1962. N is the number of firms. Ann = % of firms in the year reporting annually, Semi = % of firms reporting semiannually, and Q = % of firms reporting either quarterly or 3 times per year.

	Mining & construction (SIC 10-17)				Light manufacturing (SIC 20-27)				Heavy manufacturing (SIC 28-39)				Wholesale & retail trade (SIC 50-59)				Services & other (SIC 70-88)				All Industries			
NYSE																								
Year	**N**	**Ann**	**Semi**	**Q***	**N**	**Ann**	**Semi**	**Q***	**N**	**Ann**	**Semi**	**Q***	**N**	**Ann**	**Semi**	**Q***	**N**	**Ann**	**Semi**	**Q***	**N**	**Ann**	**Semi**	**Q***
1950-52	121	8%	4%	88%	516	15%	8%	77%	1,368	2%	6%	92%	245	7%	34%	59%	50	0%	12%	88%	2,300	6%	10%	85%
1953-55	124	3%	4%	93%	530	13%	9%	77%	1,388	1%	5%	95%	254	4%	33%	64%	57	0%	5%	95%	2,353	4%	9%	87%
1956-58	123	0%	5%	95%	515	8%	13%	80%	1,424	1%	4%	95%	252	1%	29%	70%	58	0%	5%	95%	2,372	2%	9%	89%
1959-61	126	0%	1%	99%	498	4%	12%	84%	1,531	0%	3%	96%	256	1%	20%	79%	59	0%	2%	98%	2,470	1%	7%	92%
1962-64	127	0%	1%	99%	526	3%	10%	87%	1,633	1%	2%	97%	288	0%	8%	92%	58	2%	3%	95%	2,632	1%	5%	95%
1965-67	139	0%	1%	99%	556	3%	5%	92%	1,643	1%	3%	97%	307	1%	7%	93%	57	4%	2%	95%	2,702	1%	4%	95%
1968-70	160	1%	2%	98%	550	1%	4%	95%	1,582	1%	2%	98%	339	1%	4%	95%	79	0%	1%	99%	2,710	1%	2%	97%
1971-73	163	0%	0%	100%	586	1%	2%	97%	1,631	0%	1%	98%	384	1%	1%	98%	147	2%	3%	95%	2,911	1%	1%	98%
AMEX																								
1962-64	220	7%	30%	63%	244	7%	25%	67%	856	5%	22%	73%	210	5%	30%	66%	89	9%	24%	67%	1,619	6%	24%	70%
1965-67	227	7%	17%	76%	317	4%	17%	79%	1,071	3%	11%	86%	290	2%	17%	81%	120	3%	18%	80%	2,025	4%	14%	83%
1968-70	202	3%	7%	90%	337	2%	12%	85%	1,268	2%	5%	94%	322	1%	6%	93%	178	7%	8%	85%	2,307	2%	6%	91%
1971-73	208	2%	4%	94%	388	3%	5%	92%	1,227	2%	3%	95%	359	1%	3%	96%	241	3%	6%	91%	2,423	2%	4%	94%

* Firms reporting three times per year (2.1% of sample) are combined with those reporting four times per year.

Table 2. Descriptive statistics by subperiod and frequency of reporting.

Table contains descriptive statistics by reporting frequency for the periods 1951-55, 1956-62, and 1963-69. Individual firm-year observations are included in the analysis if reporting frequency is available, total assets are greater than $100,000 in years t and $t-1$ from Compustat (adjusted for inflation using the Gross National Product Implicit Price Deflator, base year 1962), and CRSP return data is available for each month of the fiscal year. Variable definitions are below.

	1951-55 NYSE firms						1956-62 NYSE firms				1963-69 NYSE & AMEX firms			
	Firms Reporting Annually		Firms Reporting Semiannually		Firms Reporting Quarterly		Firms Reporting Semiannually		Firms Reporting Quarterly		Firms Reporting Semiannually		Firms Reporting Quarterly	
($s in millions)	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
	N = 59		N = 169		N = 1423		N = 313		N = 2953		N = 567		N = 7409	
Firm size														
Total assets	$152.5	$85.6	$170.7	$74.9	$253.6	$85.0	$135.4	$60.2	$315.7	$95.1	$69.0	$16.3	$263.9	$55.3
Market value of equity	78.3	27.3	161.2	49.4	259.7	55.8	114.1	39.0	413.8	82.1	66.9	13.9	339.0	52.1
Size decile (1=smallest)	5.6	6.0	6.4	7.0	6.6	7.0	5.2	5.0	6.5	7.0	3.8	3.0	5.7	6.0
Information asymmetry														
Assets in place	1.47	1.34	1.13	1.08	1.06	1.02	1.65	1.24	1.03	0.86	1.09	0.91	0.85	0.75
Std. dev. of market model residuals	0.043	0.041	0.045	0.039	0.052	0.048	0.052	0.047	0.060	0.055	0.096	0.077	0.082	0.070
Agency costs														
Leverage	0.43	0.44	0.38	0.36	0.37	0.35	0.57	0.49	0.35	0.29	0.41	0.37	0.35	0.31
Disclosure or proprietary costs														
Four-firm concentration ratio	0.45	0.37	0.70	0.67	0.57	0.53	0.53	0.48	0.51	0.49	0.46	0.44	0.44	0.39
Informativeness of more frequent disclosure														
Operating cycle	0.15	0.10	0.13	0.12	0.22	0.19	0.21	0.18	0.26	0.23	0.22	0.20	0.26	0.24
Firm performance														
Lagged return on assets	5.0%	5.4%	7.5%	6.8%	8.1%	7.6%	4.1%	5.4%	7.1%	6.6%	4.4%	5.0%	6.7%	6.4%
Lagged 12-month market-adjusted return	-7.9%	-10.2%	-6.2%	-6.6%	1.3%	-1.7%	4.3%	2.3%	2.9%	-2.1%	14.0%	0.8%	14.1%	1.3%
Risk														
Book-to-market ratio	1.95	1.74	1.20	1.07	1.09	0.98	1.15	0.98	0.89	0.75	0.90	0.72	0.71	0.59
Return volatility	0.050	0.045	0.050	0.046	0.062	0.059	0.082	0.066	0.077	0.071	0.114	0.097	0.100	0.088
Return volatility scaled by average market return volatility	2.48	2.17	2.42	2.16	2.99	2.77	2.34	2.04	2.59	2.40	3.55	3.00	2.98	2.64

Table 2. Descriptive statistics by subperiod and frequency of reporting (cont'd.).

Reporting frequencies were hand-collected from *Moody's Industrial New Reports* .

Total assets is COMPUSTAT item #6. Market value of equity (MVE) = price per share x number of shares outstanding at year-end (per CRSP).

Size decile is the decile portfolio ranking of the firm ranked according to its market capitalization for the prior year, using all active firms on CRSP for that year.

Assets in place = total assets [item #6] /([total liabilities [item #181] + MVE).

Std. dev. of market model residuals = the standard deviation of firm-month market-model residuals for year $t-1$.

Leverage = total liabilities [#181]/(total liabilities [#181] + MVE).

Four-firm concentration ratio = the fraction of a firm's industry (two-digit SIC code) sales attributable to the four largest firms in that industry.

Operating cycle as fraction of year = (days in inventory +days in AR) / 365
Days in inventory = 365 * {(Inventory$_t$ [#3] + Inventory$_{t-1}$[#3])/2} / COGS$_t$ [#41]
Days in AR = 365 * {(AR$_t$ [#2] + AR$_{t-1}$[#2])/2} / Sales$_t$ [#12]

Lagged return on assets = net income before extraordinary items [#18] / average total assets [#6]

Lagged 12-month market-adjusted return = stock market return for firm i for year $t-1$ less the stock return to the entire value-weighted market on CRSP

Book value of equity = total assets [#6] - total liabilities [# 181]. If item #181 is missing, we estimate it as the sum of item numbers 5, 9, 35, 38, and 75. If item numbers 35, 38, or 75 are missing, we set them equal to zero.

Book-to-market ratio is ratio of book value of equity to market value of equity.

Return volatility is the standard deviation of the 15 monthly holding-period returns for each firm-year observation, ending 3 months after fiscal year-end.

Table 3. Earnings timeliness as a function of reporting frequency.

Table compares sample firms' intraperiod (Panel A) and long-horizon (Panel B) earnings timeliness as a function of reporting frequency for three distinct subperiods from 1951 to 1969. The number of observations in Panel A corresponds to the number of firms used to derive the hedge portfolio timeliness metrics. Different data constraints cause the number of observations used in the regression-based tests to differ from the number of observations used in the hedge portfolio tests. Requiring that these tests include the same observations yields qualitatively similar results. Earnings timeliness is measured as follows:

Panel A: Intraperiod Timeliness. *Intraperiod timeliness graphs:* Area under a plot of the percentage of 12-month cumulative earnings-based hedge portfolio returns earned by earnings-based hedge portfolio as of the end of each month during 12-month period after beginning of event-year (see section 4.1.1 for additional description). *Intraperiod timeliness regression:* Estimated slope coefficient α_{f0} and absolute t-statistic from following regression, which includes inverse Mill's ratio, IMR, to correct for endogenous selection of reporting frequency f (see section 4.2.2 for additional description): $IPT_{it} = \alpha_{f0} + \alpha_{f1} \times IMR_{it} + \varepsilon_{it}$. Test statistics have been corrected for serial correlation in firm observations using the robust variance estimator for cluster-correlated data described in Rogers (1993).

Panel B: Long-Horizon Timeliness. Slope coefficient estimates and absolute t-statistics corrected for serial correlation from the following pooled cross-sectional reverse returns-earnings regression: $EARN_{it} = \beta_{f0} + \beta_{f1} \times NEG_{it} + \beta_{f2} \times RET_{it} + \beta_{f3} \times NEG_{it} \times RET_{it} + \beta_{f4} \times IMR_{it} + \eta_{it}$. Test statistics have been corrected for serial correlation in firm observations using robust variance estimator for cluster-correlated data described in Rogers (1993). Coefficient estimates for intercept and bad-news intercept dummy are not reported. Regression includes inverse Mill's ratio, IMR, to correct for endogenous selection of reporting frequency f (see section 4.2.2 for additional description).

	1951-55			*1956-62*			*1963-69*		
	S	**Q**	**Difference**	**S**	**Q**	**Difference**	**S**	**Q**	**Difference**
Panel A: Intraperiod Timeliness									
Area under hedge portfolio return curve (see Fig. 3)	4.86	6.45	1.60 [b]	5.77	6.28	0.52	6.11	6.15	0.04
Percentile in sampling distribution [☆]			94.6%			69.6%			50.0%
Average intraperiod timeliness coefficient, α_{f0}	4.71 [a]	6.10 [a]	1.39 [b]	6.39 [a]	5.35 [a]	-1.04	6.29 [a]	6.17 [a]	-0.12
	(10.50)	(16.94)	(3.39)	(23.34)	(11.40)	(1.58)	(13.24)	(19.74)	(0.17)
IMR slope coefficient, α_{f1} $(\times 10^4)$	-0.94 [b]	0.12		0.10	0.32		0.21	0.11	
	(2.03)	(0.44)		(0.40)	(0.89)		(0.86)	(0.29)	
No. of observations	169	1423		313	2953		567	7409	
Panel B: Long-Horizon Timeliness									
Good-news slope coefficient, β_{f2}	0.17 [a]	0.05 [a]	-0.11 [a]	0.06 [c]	0.05 [a]	0.00	0.03 [a]	0.04 [a]	0.01
	(5.70)	(6.93)	(4.62)	(2.33)	(6.13)	(0.17)	(4.00)	(7.67)	(1.80)
Incremental bad-news slope coefficient, β_{f3}	-0.07	0.22 [a]	0.29 [b]	0.09	0.03 [c]	-0.06	0.06	0.04 [a]	-0.01
	(0.95)	(5.61)	(3.54)	(1.42)	(2.12)	(1.01)	(1.76)	(4.11)	(0.48)
IMR slope coefficient, β_{f4}	-0.09	0.00		-0.09	-0.17 [c]		0.03	-0.02	
	(1.01)	(0.07)		(0.75)	(2.13)		(0.36)	(0.56)	
R^2	29.6%	17.9%	-11.7%	19.6%	24.3%	4.7%	13.7%	23.6%	9.9%
Coefficient of variation of earnings	0.023	0.045	0.022	0.079	0.051	-0.028	0.272	0.107	-0.165

Table 3. Earnings timeliness as a function of reporting frequency (cont'd.).

IPT ≡ Firm-specific measure of intraperiod timeliness, defined as the area under a plot of the firm's monthly buy-and-hold return divided by the firm's 12-month buy-and-hold return: $IPT = \frac{1}{2}\sum_{m=1}^{12}(BH_{m-1} + BH_m)/BH_{12} = \sum_{m=1}^{11}(BH_m/BH_{12}) + 0.5$

RET ≡ 12-month buy-and-hold return from 4th month after start of fiscal year through 3 months after year-end.

NEG ≡ equals one if RET is negative and zero otherwise.

EARN ≡ annual earnings before extraordinary items divided by beginning-of-year market value of equity.

☆ Significance of differences in hedge portfolio areas is measured using permutation tests similar to McNichols (1984). *Percentile in sampling distribution* represents where observed difference lies in distribution of differences obtained by performing 1,000 permutations. See appendix and McNichols (1984) for further discussion.

a, b, c Difference is significant at the 1%, 5%, or 10% level, respectively.

Table 4. Distribution of firms increasing reporting frequency from semiannual to quarterly.

Table contains yearly distribution of 180 firms that increased financial reporting frequency from semiannual to quarterly. To be included in the table, firms must report at the lower frequency for at least two years prior to increase, report at the higher frequency for at least one year after switch, and have stock market return data for each of those four years. CRSP coverage of AMEX firms began in July 1962, so the first AMEX firms in the switching sample are in 1965.

	Voluntary Increasers			**Mandatory Increasers**	
1952	7		**1967**	12	
1953	3		**1968**	24	
1954	6		**1969**	18	NYSE &
1955	2		**1970**	16	AMEX firms
1956	4		**1971**	12	
1957	10			82	
1958	3	NYSE firms only			
1959	2	(1952–64)			
1960	3				
1961	3				
1962	5				
1963	7				
1964	4				
1965	18	NYSE &			
1966	21	AMEX firms			
	98				

Table 5. Descriptive statistics: Reporting-frequency increasers and control groups.

Table describes characteristics of firms that voluntarily increased reporting frequency from semiannual to quarterly (Panel A) and firms that did so only when the SEC mandated the increase (Panel B). Results are also presented for control samples, matched on both size and industry, whose reporting frequency was constant (quarterly) during the periods of voluntary (Panel A) and mandatory (Panel B) reporting-frequency increases.

	Increasers, Pre-Switch		Control, Pre-Switch		Increasers, Post-Switch	
	Mean	Median	Mean	Median	Mean	Median
Panel A: Voluntary increasers versus control group (N=98)						
Firm size						
Total assets	117.03	31.48	112.41	33.62	134.95	38.44
Market value of equity	131.96	22.35	91.15	18.15	134.19	24.43
Size decile (1=smallest)	4.72	4.50	4.69	4.00	4.93	4.00
Information asymmetry						
Assets in place	1.03	0.99	1.07	1.05	0.95	0.95
Std. dev. of market model residuals	0.08	0.06	0.07 [d]	0.06	0.08	0.06
Agency costs						
Leverage	0.37	0.35	0.40	0.40	0.35	0.32
Disclosure or proprietary costs						
Four-firm concentration ratio	0.59	0.60	0.59	0.60	0.57	0.57
Informativeness of more frequent disclosure						
Production cycle	0.15	0.12	0.16	0.11	0.17	0.13
Firm performance						
Return on assets	2.19%	4.80%	6.08%	5.27%	6.60% [d]	6.32% [c]
Lagged 12-month market-adjusted return	12.29%	1.80%	-1.42% [c]	-3.23% [d]	8.70%	-2.90%
Risk						
Book-to-market ratio	1.03	0.91	1.06	0.98	1.07	0.86
Return volatility	0.09	0.07	0.08	0.07	0.09	0.07
Return volatility scaled by average market return volatility	3.23	2.83	2.87	2.60	2.81 [d]	2.39
Panel B: Mandatory increasers versus control group (N=82)						
Firm size						
Total assets	68.02	13.75	58.93	23.46 [c]	80.69	24.97 [c]
Market value of equity	65.88	15.86	58.84	15.51	84.21	21.42
Size decile (1=smallest)	3.28	2.00	3.56	3.00	3.83	3.00
Information asymmetry						
Assets in place	0.78	0.79	0.83	0.84	0.76	0.76
Std. dev. of market model residuals	0.12	0.11	0.11 [d]	0.09	0.13	0.11
Agency costs						
Leverage	0.33	0.29	0.36	0.33	0.30	0.26
Disclosure or proprietary costs						
Four-firm concentration ratio	0.46	0.46	0.46	0.46	0.45	0.44
Informativeness of more frequent disclosure						
Production cycle	0.16	0.16	0.19	0.19	0.17	0.15
Firm performance						
Return on assets	4.45%	3.61%	5.32%	4.96% [d]	3.42%	4.15%
Lagged 12-month market-adjusted return	30.93%	11.30%	21.45%	1.38%	15.22%	-4.74% [c]
Risk						
Book-to-market ratio	0.79	0.66	0.85	0.70	0.85	0.61
Return volatility	0.14	0.12	0.13	0.11	0.14	0.13
Return volatility scaled by average market return volatility	3.69	3.40	3.41	2.96	3.79	3.40

See Table 2 for description of variables.

[c, d] Reported mean (median) is significantly different from the mean (median) of the pre-switch increasers at the 10% or 15% level, respectively.

Table 6. Changes in earnings timeliness: Reporting-frequency increasers and control groups.

Table describes changes in the intraperiod (Panel A) and long-horizon (Panel B) earnings timeliness of firms that voluntarily increased reporting frequency from semiannual to quarterly and firms that did so only when the SEC mandated the increase. Results are also presented for control samples, matched on both size and industry, whose reporting frequency was constant (quarterly) during the periods of voluntary and mandatory reporting-frequency increases. Number of observations in Panel A corresponds to the number of firms used to derive the hedge portfolio timeliness metrics. Different data constraints cause the number of observations used in the regression-based tests to differ from the number of observations used in the hedge portfolio tests. Requiring that these tests include the same observations yields qualitatively similar results. Earnings timeliness is measured as follows:

Panel A: Intraperiod Timeliness. *Intraperiod timeliness graphs:* Area under a plot of the percentage of 12-month cumulative earnings-based hedge portfolio returns earned by earnings-based hedge portfolio as of the end of each month during 12-month period after beginning of event-year (see section 4.1.1 for additional description). *Intraperiod timeliness regression:* Estimated slope coefficients and absolute values of t-statistics from following regression, which includes inverse Mill's ratio, *IMR,* to correct for endogenous selection of reporting frequency f (see section 4.2.2 for additional description): $IPT_{it} = \alpha_{f0} + \alpha_{f1} \, x \, IMR_{it} + \varepsilon_{it}$.

Panel B: Long-Horizon Timeliness. Slope coefficient estimates and absolute values of t-statistics from following reverse returns-earnings regression: $EARN_{it} = \beta_{f0} + \beta_{f1} \, x \, NEG_{it} + \beta_{f2} \, x \, RET_{it} + \beta_{f3} \, x \, NEG_{it} \, x \, RET_{it} + \beta_{f4} \, x \, IMR_{it} + \eta_{it}$. Coefficient estimates for intercept and bad-news intercept dummy are not reported. Regression includes inverse Mill's ratio, *IMR,* to correct for endogenous selection of reporting frequency f (see section 4.2.2 for additional description).

	Switching Sample			*Control Sample*		
	Pre-Switch	**Post-Switch**	**Difference**	**Pre-Switch**	**Post-Switch**	**Difference**
Panel A: Intraperiod Timeliness						
A1. Voluntary Increasers						
Area under hedge portfolio return curve (see Fig. 4)	2.29	5.87	3.58 [b]	4.67	5.21	0.54
Percentile in sampling distribution [☆]			97.0%			63.4%
Average intraperiod timeliness coefficient, a_{f0}	5.36 [a]	6.38 [a]	1.02 [c]	5.49 [a]	5.91 [a]	0.43
	(15.63)	(15.70)	(1.93)	(12.32)	(10.10)	(0.58)
IMR slope coefficient, α_{f1}	-0.63	0.35		0.54	0.17	
	(1.14)	(0.49)		(0.72)	(0.22)	
No. of observations	98	98		98	98	
A2. Mandatory Increasers						
Area under hedge portfolio return curve (see Fig. 5)	7.17	7.91	0.74	7.04	8.99	1.95
Percentile in sampling distribution [☆]			66.8%			76.8%
Average intraperiod timeliness coefficient, α_{f0}	6.35 [a]	6.87 [a]	0.52	6.46 [a]	6.68 [a]	0.23
	(12.34)	(15.67)	(0.77)	(12.32)	(10.10)	(0.24)
IMR slope coefficient, α_{f1}	0.97	0.81		0.59	0.32	
	(1.26)	(1.33)		(0.59)	(0.33)	
No. of observations	82	82		82	82	

Table 6. Changes in earnings timeliness: Reporting-frequency increasers and control groups (cont'd.).

	Switching Sample			*Control Sample*		
	Pre-Switch	**Post-Switch**	**Difference**	**Pre-Switch**	**Post-Switch**	**Difference**
Panel B: Long-Horizon Timeliness						
B1. Voluntary Increasers						
Good-news slope coefficient, β_{f2}	0.12 [a]	0.07 [a]	-0.05	0.05 [b]	0.07	0.02
	(2.72)	(3.25)	(1.05)	(2.22)	(1.44)	(0.32)
Incremental bad-news slope coefficient, β_{f3}	-0.22 [b]	0.29	0.50 [c]	0.17	0.19	0.02
	(2.11)	(1.09)	(1.77)	(0.62)	(1.32)	(0.06)
IMR slope coefficient, β_{f4}	-0.12 [a]	-0.06 [b]		-0.07 [a]	0.02	
	(3.41)	(1.99)		(2.72)	(0.54)	
R^2	34.4%	21.6%	-12.8%	17.0%	8.9%	-8.1%
Coefficient of variation of earnings	0.120	0.138	0.018	0.097	0.129	0.032
B2. Mandatory Increasers						
Good-news slope coefficient, β_{f2}	-0.01	0.03 [c]	0.04	0.13 [a]	0.01	-0.12 [a]
	(0.29)	(1.70)	(1.13)	(6.39)	(0.39)	(3.13)
Incremental bad-news slope coefficient, β_{f3}	-0.02	0.06	0.08	-0.07	0.08	0.15
	(0.27)	(1.51)	(0.98)	(1.19)	(0.33)	(0.61)
IMR slope coefficient, α_{f1}	0.02	0.05		-0.03	-0.05	
	(0.42)	(0.82)		(1.31)	(1.64)	
R^2	2.2%	4.1%	1.9%	41.2%	10.8%	-30.4%
Coefficient of variation of earnings	0.312	0.433	0.121	0.122	0.204	0.082

IPT ≡ Firm-specific measure of intraperiod timeliness, defined as area under a plot of the firm's monthly buy-and-hold return divided by firm's 12-month buy-and-hold return: $\Sigma_{m=1,11}(BHRet_m/BHRet_{12}) + 0.5$.

RET ≡ 12-month buy-and-hold return from 4th month after start of fiscal year through 3 months after year-end.

NEG ≡ equals one if RET is negative and zero otherwise.

EARN ≡ annual earnings before extraordinary items divided by beginning-of-year market value of equity.

[☆] Significance of differences in hedge portfolio areas measured using permutation tests similar to McNichols (1984). *Percentile in sampling distribution* represents where observed difference lies in distribution of differences obtained by performing 1,000 permutations. See appendix and McNichols (1984) for further discussion.

[a, b, c] Difference is significant at the 1%, 5%, or 10% level, respectively.