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Limited Attention, Information Disclosure, and Financial Reporting

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Limited Attention, Information Disclosure, and Financial Reporting

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Abstract:

This paper models firms' choices between alternative means of presenting information, and the effects of different presentations on market prices when investors have limited attention and processing power. In a market equilibrium with partially attentive investors, we examine the effects of alternative: levels of discretion in *pro forma* earnings disclosure, methods of accounting for employee option compensation, and degrees of aggregation in reporting.

Key Words: limited attention, behavioral accounting, investor psychology, capital markets, accounting regulation, disclosure, market efficiency

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Abstract

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1 Introduction

Firms and regulators care not just about the information made publicly available to investors, but the form in which it is revealed. One issue of great concern to practitioners is whether information items should be *recognized* as part of earnings, or merely *disclosed* as a footnote. Another is the prominence with which different kinds of information are displayed in financial statements. There is also intense concern as to the form of disclosure, even when the information content of the alternative formats is identical. Evidently regulators and commentators think that investors are imperfect processors of publicly available information. Such concerns are reflected in the structure of accounting regulation, and in politically charged debates over such issues as merger accounting, whether employee option compensation should be expensed, and to what extent firms should be free to make *pro forma* disclosures that differ from GAAP definitions of earnings.

In contrast, in the economic paradigm that underlies existing analytic research on financial reporting, the choice between recognition versus disclosure, and between equivalent forms of disclosure or reporting, has no effect on investor perceptions. In existing models of reporting, investors are fully rational, and market prices are set efficiently to reflect all publicly available information.¹ This approach has provided important insights into the interplay of financial reporting, optimal contracts, and capital markets. However, from the perspective of this traditional approach, the passionate interest of practitioners in the regulation of informationally equivalent disclosures and reports is a major puzzle.²

This paper offers an approach to the analytical modelling of financial reporting and

¹Some models of disclosure that are embedded in rational expectations settings allow for liquidity shocks, but the usual interpretation of these settings is that the market is efficient with respect to public information and that liquidity trading reflects unmodelled portfolio rebalancing considerations, not imperfect rationality. It is also possible that owing to political or contracting constraints, informationally equivalent disclosure/reporting regimes may matter to market participants. This in turn raises the question of whether such constraints themselves derive from limited attention and processing power.

²For example, SFAS 130 “Reporting Comprehensive Income,” which was issued in 1997, shifted the prominence of the reporting of certain components of income without introducing any new recognition or measurement rules— see Hirst and Hopkins (1998). As another example, see the discussion of the political battle over the expensing of employee share option compensation in Section 5. Dechow and Skinner (2000) comment that in contrast with the views of many academics in the accounting field, regulators would probably remain concerned about earnings management even if financial statements were sufficiently detailed to allow investors to undo managers’ accounting choices fully.

disclosure which encompasses these issues. Our approach departs from existing theory in assuming that investors have *limited attention* and processing power. An immediate but far-reaching consequence of limited attention is that informationally equivalent disclosures can have different effects on investor perceptions depending on the form of presentation. Limited attention has implications for non-equivalent disclosures as well.

In our model, owing to limits to investor attention, information that is presented in salient, easily processed form is assumed to be absorbed more easily than information that is less salient, or that is only implicit in the public information set. Thus, investors neglect relevant aspects of the economic environments they face. For example, investors may neglect the distinctive features of different divisions of a diversified firm, or may not adequately adjust their interpretations of disclosures to take into account the strategic incentives of firms to manipulate observers' perceptions. We model these possibilities by assuming that each investor has only a probability of attending to the relevant consideration.³ Furthermore, we assume that investors are risk averse, so that highly attentive investors are limited in the extent to which they are willing to bear risk in order to exploit mispricing.

The models we offer are stark. Inattention seems foolish, as inattentive investors lose money by ignoring aspects of the economic environment. However, if time and attention are costly, such behavior may be reasonable. Furthermore, our approach could be extended to allow for noise (such as liquidity shocks), in which case individuals would merely underweight, rather than completely ignore relevant aspects of the strategic environment. Our modeling approach is designed to describe simply the role of limited attention, and provide a first step toward a theory of how limited attention influences accounting reporting choices.

To display some of the range of relevance of limited attention for reporting and for reporting-related disclosure, we apply this approach to three specific contexts. These applications show how the approach can help explain puzzling stylized facts, generate untested empirical implications, and offer new considerations for policy. The first application is to *pro forma* earnings disclosure. We consider the effect of discretion in firms' disclosure of non-GAAP earnings measures in *pro forma* earnings announcements. We find that *pro forma* disclosures bias investors' perceptions upwards, yet can make stock prices more accurately reflect fundamental value.

³An interesting case of this is neglect of a newly arrived information signal. We do not examine simple neglect of a new signal in this paper, but this possibility can be captured in the special case of extreme underreaction in the 'heuristic trader' models of securities trading of Fischer and Verrecchia (1999) and Verrecchia (2001), which we discuss further below.

The second application is to an issue of timing allocation, the possible reporting of employee stock option compensation as an expense at the time that the options are granted. We take as a premise that the compensation must be disclosed up front, and examine how neglect of this compensation prior to option exercise can cause overvaluation, and can induce a relation between the size of this compensation and subsequent abnormal stock returns. However, the analysis also predicts that full expensing of these options leads to market *undervaluation*, consistent with the noisy protests of high-tech firms against the expensing of these options. Surprisingly, the expensing rule that supports accurate market valuations turns out to depend on the persistence of earnings.

The final application is to an issue of aggregation in financial reporting. We examine the effects on investor perceptions of segment reporting versus aggregate reporting versus divestiture in a diversified firm. We find that during periods of high foreseen general earnings growth, investors who focus on the recent growth rate of a firm's aggregate earnings will tend to overweight low growth segments at the expense of high growth segments, and in consequence will tend to undervalue the firm. More importantly, the model suggests a direction for analyzing reporting aggregation when attention is limited.

There is a remarkable disjunction in the accounting literature between the experimental research versus analytical models of financial information processing. Experimental research has provided a provocative array of evidence that both naive and sophisticated investors and professional analysts are systematically biased in their interpretation of accounting data, and that these biases affect market prices. As Libby, Bloomfield, and Nelson (2001) describe the evidence,

... the information that decision makers rely upon in their judgments is limited, and the information emphasized clearly changes depending on the financial judgment being made, and other elements of the environment. In fact, awareness of cosmetic differences (and ability to 'do the math') does not ensure full consideration of their implications for valuation. The same is true of knowledge of management's tendency to opportunistically employ vague reporting standards or analysts' tendency to bias their reports.

Furthermore, in an insightful recent discussion, Bloomfield (2002) suggests that failures in information processing information can help explain empirical patterns related to accounting information.

In contrast, analytical models of disclosure and reporting, often published in the same journals without reference to the experimental literature, have almost uniformly assumed full rationality of decisions and pricing. One goal of this paper is to begin the

search for complementarities between the insights derived from experimental study and through analytical modelling in accounting.

There are some important exceptions to the assumption of perfect information processing in accounting models of reporting or disclosure. In Bushman, Gigler, and Indjejikian (1996), some investors are better than others at processing financial reports to generate information superior to that of a market maker. Their analysis examines implications for liquidity and welfare of SEC proposals for two-tiered financial reporting. The focus of our analysis is not on how skillful investors are in generating new private signals, but on their failure to take into account certain aspects of their environment.

In the heuristic trading models of disclosure of Fischer and Verrecchia (1999) and Verrecchia (2001), ‘heuristic’ investors are assumed to either under- or over-react to an information signal. Fischer and Verrecchia then explore the conditions under which heuristic investors can survive in competition with rational Bayesian investors. They offer a general analysis of the profitability of different forms of irrational trading. Their analysis implicitly allows for limited attention by allowing for the possibility that some investors underreact to the public signal.

We build upon these important contributions by allowing for forms of investor errors not present in the heuristic trader models. In our approach, errors derive from a failure of investors to attend to some non-salient or hard-to-process aspect of the economic environment, which need not be a newly-arrived signal (see also footnote 3). Our modelling focus is also different; we examine here the effects of limited attention in specific disclosure and reporting contexts. However, in order to address the survival issue emphasized by Fischer and Verrecchia, in Section 7 we discuss why limited attention is likely to remain important for capital markets in the long-term.

The general approach followed here is similar in spirit to that of Hirshleifer, Lim, and Teoh (2001), who examine the decision of an informed party individual of whether to disclose. A fraction of the audience fails to attend either to a disclosed information signal, or to the failure of the informed party to disclose. In their model the former discourages disclosure whereas the latter encourages it, so that disclosure may be incomplete even if there are no proprietary costs. However, they do not examine accounting disclosure and reporting choices.

The remainder of the paper is structured as follows. Section 2 discusses the psychology of limited attention. Section 3 outlines the general setting. Section 4 analyzes the disclosure of *pro forma* earnings. Section 5 analyzes the reporting of managerial option compensation. Section 6 analyzes the effects of aggregation in reporting with reference

to segment reporting and divestiture. Section 7 examines whether limited attention can affect market prices. Section 8 discusses the relation of the model to existing research in behavioral finance. Section 9 concludes.

2 Review of Theory and Evidence on Limited Attention and Information Processing

Limited attention is a necessary consequence of the vast amount of information available in the environment, and of limits to information processing power. Attention must be selective and requires effort (substitution of cognitive resources from other tasks); see, e.g., Kahneman (1973). Several well-known decision biases, including narrow framing (a tendency to analyze problems in a specific context without adequately reflecting broader considerations) probably derive from limits to attention and processing power.

Attention is required both to encode environmental stimuli (such as a corporate information disclosure), and to process ideas in conscious thought (as in the analysis of a corporate disclosure or of a failure of a company to disclose). As discussed in Fiske (1995), the encoding process involves taking external information and representing it internally in a way that enables its use. Conscious thought involves a focus on particular ideas or memories to the exclusion of others. For example, if an individual focuses on understanding the implications of the financial report of one firm, he may be unable to study another firm carefully and in a timely way.

Some stimuli tend to be perceived and encoded more easily than others. The *salience* of a stimulus is its ‘prominence,’ tendency to ‘stand out’, or its degree of contrast with other stimuli in the environment. The effects of salience are “robust and wide-ranging” (Fiske and Taylor (1991), ch.7). Salience influences judgments about causality, importance of the stimulus, and how extreme it is. For example, if the salience of a footnote disclosure is not high, some investors may fail to process it.

Attention tends to be drawn to stimuli that are goal-related, but can also be misdirected. For example, attention is drawn to vivid stimuli.⁴ In contrast, people tend to underweight abstract, statistical, and base-rate information (see, e.g., Kahneman and Tversky (1973) and Nisbett and Ross (1980)). This suggests that the amount of attention that observers direct toward a disclosure or aspect of the economic environment

⁴Vividness is greatest for concrete descriptions and scenarios, stories about personal experiences, information that falls into an easily summarized pattern, stimuli that trigger emotional responses, or which are more ‘proximate in a sensory, temporal or spatial way’ (Nisbett and Ross (1980), p. 45).

need not correspond closely to its economic importance.

How attention is directed in conscious thought depends on the ease with which memories are accessed. In the *availability heuristic* (Tversky and Kahneman (1973)), individuals assess the frequency or likelihood of a phenomenon according to their ability to retrieve confirmatory examples from memory. To the extent that facts that are more salient or vivid are more available, attentional biases can bias beliefs.

A literature in psychology has examined how subjects learn by observation over time to predict a variable that is stochastically related to multiple cues (see, e.g., Kruschke and Johansen (1999)). A pervasive finding is that *cue competition* occurs: salient cues weaken the effects of less salient ones, and the presence of irrelevant cues causes subjects to use relevant cues and base rates (unconditional frequencies) less.

Limited information processing capacity tends to induce individuals to use information in the form it is displayed rather than modifying it appropriately (see, e.g., Slovic (1972), Payne, Bettman, and Johnson (1993)). Libby, Bloomfield, and Nelson (2001) discuss how a reliance on category structures reduces the costs of processing information, but can also induce errors such as functional fixation.

Libby, Bloomfield, and Nelson (2001) and Maines (1995) provide excellent surveys of the experimental literature on financial information processing. Libby, Bloomfield, and Nelson remark of early experimental literature on the processing of accounting information by investors and analysts that “Some participants in nearly every study of this type demonstrate some degree of functional fixation; they do not fully adjust for differences in the effects of accounting alternatives on the bottom line...,” and that “...we have begun to understand that placement, categorization, and labelling all play a role in the simplifications that even professional analysts apply when evaluating accounting information.”

Several experimental studies have found that the disclosure of equivalent information about a firm presented in different ways affects the valuations and trades of investors and even experienced financial analysts.⁵ There is also evidence that individuals fail to make use of all publicly available information (see, e.g., Lipe (1998) on the use of

⁵Such effects have been found in the context of recognition versus disclosure of pension liabilities (Harper, Mister, and Strawser (1987)), classification of the same hybrid financial instrument as debt, equity or mezzanine financing in the balance sheet (Hopkins (1996)), the previewing of negative earnings news with an adverse qualitative preannouncement (Libby and Tan (1999)), and the use of the purchase method of accounting for business combinations with the premium was ratably amortized versus the use of pooling-of-interest (Hopkins, Houston, and Peters (2000)) and the inclusion of other comprehensive income items in the income statement rather than in the statement of changes in shareholders' equity (Hirst and Hopkins (1998)), as well as in market settings (Dietrich et al (2001)).

covariances).

There is also evidence of the importance of limited attention in practice. Hand (1990) found that the reannounced gains from debt-equity swaps in quarterly earnings announcements were significantly related to mean abnormal returns. Amir (1993) found that footnote disclosure of post-retirement benefits was underweighted by investors until the policy discussions leading up to SFAS 106, which made the long-term costs of these benefits more salient. In Aboody (1996), investors value recognized write-down information more strongly than disclosed write-down information in the oil and gas industry. Davis-Friday et al (1999) found some modest evidence that recognized non-pension retiree benefits were weighted more heavily in market prices than disclosed liabilities among SFAS No. 106 adopters. Schrand and Walther (2000) provide evidence that managers select the form of the prior-period earnings benchmark when announcing earnings. Prior period gains were more likely to be announced than prior period losses in the sample, apparently to lower the benchmark for current-period evaluation.

Accrual-based predictability of stock returns (see, e.g., Sloan (1996), Teoh et al (1998a, 1998b)), post-earnings announcement drift (Bernard and Thomas (1989)), and the tendency of analysts to neglect relevant financial statement information (Abarbanell and Bushee (1997), Teoh and Wong (2002)) are further indications that limited attention may be important for market prices. The finance and economics literatures provide a further body of evidence consistent with limited attention affecting securities prices (see, e.g., the evidence reviewed by Daniel, Hirshleifer, and Teoh (2002)).

3 The General Setting

We assume that each investor has only a probability of being attentive to a signal or aspect of the economic environment. We refer to those that end up attending to the consideration as attentive, and the others as inattentive. We denote the fraction that turn out to be inattentive as f .⁶ They form their beliefs using only a subset of all publicly available information, broadly construed. Investors may ignore some existing mechanical feature of the economic environment, or may neglect strategic incentives for managers to mislead. For example, in our *pro forma* earnings application, some investors ignore the fact that the firm can strategically adjust *pro forma* earnings in an ‘inappropriate’ way. We assume that inattentive investors, apart from the specific feature of the environment

⁶Inattention could be viewed as rational if there are costs of attention, but is not consistent with the rationality assumption traditionally employed in accounting or financial models.

that they ignore, update beliefs as rational Bayesians. Fraction $1 - f$ are attentive. They form expectations rationally and with full attention to all publicly available information. These could be different kinds of investors, or it could just be that each investor has a probability $1 - f$ of being attentive at a given time.

We do not model the profitability of traders explicitly, but we are keenly aware of the issue raised by Fischer and Verrecchia (1999) and Verrecchia (2001) that investors who are modeled as influencing price should be able to survive in a capital market. We discuss why imperfectly attentive investors can in the long run influence market price in greater detail in Section 7. Here we focus on one motivation for our approach, that attention is costly. Devoting attention to a particular attentional arena requires withdrawal of attention from some other activity. Attention demands time, which has a monetary opportunity cost.

So the probability that an investor fails to identify some aspect of a sector of the economic environment correctly, f , can be modelled as a decreasing function of the resources expended on attending to that sector, $f'(c) < 0$. (The individual could also hire an intermediary to pay attention on his behalf, but this solution is imperfect since attention is needed to choose an intermediary well; see footnote 16). When reducing f is costly, it is fairly evident that a positive level of f can survive in long-term equilibrium, so for brevity we take f as exogenously given.

There are 3 dates. At date 0 prior expectations are formed. At date 1, public information arrives about firm value or its components. There is no private information in the model. At date 2 the terminal payoff is realized and the firm is liquidated.

Previous authors have examined static models in which there are two types of investors, rational and imperfectly rational, all of whom are risk averse expected utility maximizers, but in which the imperfectly rational investors optimize with respect to incorrect beliefs. A standard finding in the literature is that, in equilibrium, prices reflect a weighted average of the beliefs of the rational and irrational traders, as adjusted by a risk premium (see, e.g., Daniel, Hirshleifer, and Subrahmanyam (2001)). So long as each group has significant risk-bearing capacity, both influence prices significantly.

As a preliminary building block for the subsequent analysis we will verify in our setting that the market valuation of the firm is the weighted average of the beliefs of investors who attend fully or partially to the economic environment of the firm. In so doing, we assume that individuals do not fully discount for their imperfect attention in forming expectations.

There are two motivations for such imperfect adjustment. First, the same constraints

on processing power and memory that make it hard to attend to an aspect of the environment also make it hard to adjust optimally for the failure to attend to an item. The fact that the format of presentation of decisions problems affects choices indicates not just that attention and processing power are limited, but that individuals are unable to compensate optimally for these limitations.

There is evidence supportive of the proposition that people fail to adjust perfectly for the consequences of imperfect attention. For examples, if individuals were on the whole highly sophisticated they would largely debias the availability heuristic (see Section 2) of Tversky and Kahneman (1973)) by downgrading their frequency estimates for items that are easy to recall because of vivid, salient characteristics (as opposed to high frequency in the environment). Furthermore, people also tend to underweight the probabilities of event contingencies that are not explicitly available for consideration; e.g., in a list of possible causes of an event, the probability of ‘other causes’ is underestimated (Fischhoff, Slovic, and Lichtenstein (1978)).

Overconfidence provides a second further reason for imperfect adjustment. An overconfident individual may wrongly think that he has already taken into account all the important considerations. Such an individual may not perceive the urgency of working hard to adjust for biases (on poor use of outcome feedback in evaluating judgment accuracy as related to overconfidence, see Einhorn and Hogarth (1978) and Einhorn (1980)).

We therefore assume that an individual who neglects some aspect of the economic environment does not update his beliefs in complete deference to the market price as determined by others who are more attentive. He may simply fail to attend adequately to market price, in the sense that he fails to reason sufficiently about why it is that the market price differs from his own valuation. There are some further possible reasons why observation of price may not bring a trader with limited attention ‘to his senses.’ First, he may attribute a surprising value of the market price to noise/liquidity trading. Second, he may think that it is other investors who are imperfectly rational.

In our model these further reasons converge, because no investor has private information. In such a setting a fully rational individual has nothing to learn from market price. An inattentive individual who mistakenly thinks he is processing information fully will also think he has nothing to learn from market price. We therefore follow the third route here rather than the first: inattentive investors do not update their beliefs based upon market price.⁷ Similar results would hold so long as some disagreement re-

⁷In the spirit of perfect Bayesian equilibrium concept, observing the ‘wrong’ price is like an off-

mains between the attentive and inattentive investors, i.e., inattentive investors do not completely abandon their beliefs in favor of the market price.

Individuals are identical except that some fail to attend fully to all available information and some do. There are no private information signals, nor any noise/liquidity shocks. Nevertheless, in equilibrium there is trade owing to imperfect rationality. Let a superscript of $\phi = \kappa$ or ρ denote a variable based upon inattentive or attentive (rational) beliefs respectively. Investors have mean-variance preferences,

$$E_1^\phi[C] - \frac{A}{2} \text{var}_1^\phi(C), \quad (1)$$

where C is terminal consumption, a 1 subscript denotes the availability to the individual (though not necessarily used by the individual) of date 1 information, and A is the coefficient of absolute risk aversion. (Such preferences are consistent with the combination of normality of returns and Constant Absolute Risk Aversion (CARA) utility.)

We assume an initial wealth endowment (i.e., claims to terminal consumption) of W^0 and the per capita endowment of the single risky security is x_0 . At date 1, the individual can buy or sell the security in exchange for ‘cash’ (claims to terminal consumption) at price S_1 . The position in the security he attains is denoted x . We denote the terminal payoff of the security as S_2 . Then an individual’s consumption is

$$C = W^0 - (x - x_0)S_1 + xS_2. \quad (2)$$

Thus, an individual of type ϕ solves

$$\max_{x^\phi} x^\phi (E_1^\phi[S_2] - S_1) - \frac{A}{2} \text{var}_1^\phi(x^\phi S_2). \quad (3)$$

3.1 Equilibrium as a Function of Investor Perceptions

Differentiating the objective with respect to x^ϕ , equating to zero and solving yields

$$x^\phi = \frac{E_1^\phi[S_2] - S_1}{A \text{var}_1^\phi(S_2)}. \quad (4)$$

Market price is determined by the security market clearing condition

$$f x^\kappa + (1 - f) x^\rho = x_0. \quad (5)$$

equilibrium event that should never occur, in which case such a failure to update can be consistent with equilibrium.

Substituting for x^κ and x^ρ from (4), and solving for S_1 gives

$$S_1 = \kappa E_1^\kappa[S_2] + (1 - \kappa) E_1^\rho[S_2] - \frac{Ax_0}{\alpha^\kappa + \alpha^\rho}, \quad (6)$$

where

$$\alpha^\kappa \equiv \frac{f}{\text{var}^\kappa(S_2)}, \quad \alpha^\rho \equiv \frac{1-f}{\text{var}^\rho(S_2)}, \quad \kappa \equiv \frac{\alpha^\kappa}{\alpha^\kappa + \alpha^\rho}. \quad (7)$$

By normality, κ is a constant independent of the signal realizations used by investors to condition beliefs.

The final term in (6) is the risk premium that the security earns by virtue of being in positive net supply ($x_0 > 0$). Nothing in our analysis requires risk premia, so without loss of generality we eliminate this nuisance term by setting $x_0 = 0$ to obtain

$$S_1 = \kappa E_1^\kappa[S_2] + (1 - \kappa) E_1^\rho[S_2]. \quad (8)$$

Not surprisingly, in view of past literature, (8) confirms that in equilibrium prices are a weighted average of the beliefs of different investors, with weight κ on inattentive investors and $1 - \kappa$ on attentive ones. By (7), *ceteris paribus* α^κ and κ are increasing in f . Thus, the greater the likelihood of each investor being inattentive, the greater the weight that inattentive investors play in determining prices. Fully attentive investors do not completely arbitrage away the mispricing generated by inattentive investors because doing so is risky.⁸

Equation (8) differs somewhat from the pricing equations in the heuristic trader models of Fischer and Verrecchia (1999) and Verrecchia (2001), which allow for non-competitive price effects and liquidity trading. Here, (8) is a building block for the subsequent analysis in which the market price is a weighted average of investor beliefs.

3.2 Specification of Limited Attention

Let the public information set possessed at date 1 by investors be $\psi = (\psi^1, \psi^2, \dots, \psi^K)$, where the ψ^k 's are a set of K information items, $k = 1, \dots, K$, and subscripts for date 1 on all variables are suppressed. For example, ψ^1 could be the date 1 earnings level ϵ_1 . It is assumed that all date 1 cash has already been paid out as dividends at the start of date 1, so that the market valuation of the firm at the end of date 1 involves forming an expectation of the terminal cash flow to be generated and passed on to shareholders.

⁸For example, if inattentive investors overvalue firms with non-expensed employee option grants, and if most high-tech firms were issuing such options, then an attentive investor who seeks to arbitrage the mispricing bears non-diversifiable risk associated with the industry factor.

There is a structural relationship between information ψ and the terminal cash flow c_2 , which we summarize as

$$c_2 = H(\psi^1, \psi^2, \dots, \psi^K; p^1, p^2, \dots, p^N) + v, \quad (9)$$

and where $p = (p^1, p^2, \dots, p^N)$ is a vector of parameters that are either directly publicly observable, or which a rational attentive individual can infer from the structure of the market and the implied equilibrium; and where $E^\rho[v] = 0$ with v independent of ψ and p . We denote the rational expectation of the terminal cash flow as S_1^ρ ,

$$S_1^\rho(\psi; p) \equiv E[c_2 | \psi; p] = H(\psi^1, \psi^2, \dots, \psi^K; p). \quad (10)$$

Limited attention modifies this expectation in two ways. First, the observer may set one or more elements of ψ equal to specific ‘simple’ values,

$$\psi^k = (\psi^k)', \quad k = J, J + 1, \dots, K,$$

where $(\psi^k)'$ are specified values. Which parameters are fixed at special values, and what these specified values are can depend on accounting choices. For example, ψ^2 can be the level of a publicly visible cost which the firm has committed to at date 1 but which is not incurred until date 2. The expensing of this cost at date 1 may increase the probability that an investor attends to it; an investor who does not attend neglects the cost and sets $\psi^2 = (\psi^2)' = 0$. Thus, the framework can capture the effect of accounting allocation timing on investor perceptions.

Second, the investor may simplify the parameters of the structure of the economic environment. For example, if the p^i 's are either the growth rates of, or the degree of persistence in surprises in different accounting items, $i = 1, \dots, N$, then under an accounting treatment that aggregates these items, an inattentive investor may simplify by implicitly assuming that the growth rates or degrees of persistence for all the items are equal, $p^1 = p^2 = \dots = p^N$. Under disaggregated reporting, the investor may instead extrapolate each item separately. Thus, the framework can capture the effects of aggregation on investor perceptions. More generally, limited attention restricts some parameters to special values,

$$p^i = (p^i)', \quad i = L, L + 1, \dots, N.$$

In sum, allocation timing, aggregation, the format of presentation, and the reporting or disclosure of redundant information can influence the degree to which an investor

inattentively simplifies the values of public information signals or the values of environmental parameters. Thus, the expectation formed by inattentive investors is

$$S_1^\kappa = E^\kappa[c_2|\psi; p] = \tag{11}$$

$$H(\psi^1, \psi^2, \dots, \psi^{J-1}, (\psi^J)', (\psi^{J+1})', \dots, (\psi^K)'; p^1, p^2, \dots, p^{L-1}, (p^L)', (p^{L+1})', \dots, (p^N)').$$

Substituting these expectations into (8) generates the date 1 market price of the security.

This specification of limited attention is general; it describes an approach rather than a refutable hypothesis. The empirical content of the approach derives from specifying the details of the economic environment (as reflected in the H function) and the restrictions that limited attention places upon the ψ^k 's and the p^j 's. In the sections that follow we consider three applications as special cases of this approach.

4 *Pro Forma* Earnings Disclosure

In a time when a disappointing earnings number can cause a company's stock to tumble, more and more companies are focusing on “pro forma” earnings to back out some distorting factors. This is supposed to give investors a clearer view of a company's operations, but since there is no regulatory guidance for pro forma earnings, companies have increasingly used them to make their earnings look better. An expense may be non-cash or one-time in nature, yet still have significance.

—“*Pro Forma* Earnings: Not the Whole Story,” Mann (2001a)

There is substantial evidence that managers use special items to manage stock prices and market perceptions of firm performance (see, e.g., Elliott and Hanna (1996) and Kinney and Trezevant (1997)), and that reporting of special items has increased over time (see Collins, Maydew, and Weiss (1997), Elliott and Hanna (1996), Bradshaw and Sloan (2002)). A sharply growing practice in recent years has been the disclosure of *pro forma* non-GAAP definitions of earnings that exclude certain costs (see Bradshaw and Sloan (2002)). The purported reason for adjustments in *pro forma* disclosures is to reflect special circumstances that are not related to the firm's long term prospects, such as one-time charges, e.g., non-recurring items restructuring costs, extraordinary items, discontinued operations, or changes in accounting policy (see, e.g., Weil (2001), Barbash (2001)).

Pro forma earnings often differ substantially from GAAP earnings. For example, *The Economist* (2002a) discusses a study which asserts that “the companies that make up the Nasdaq 100 index together reported \$19.1 billion of profits in pro-forma earnings

announcements for the first three quarters of last year. ... those same companies reported to the Securities and Exchange Commission (SEC) a total loss for the same period of \$82.3 billion,” a difference of over \$100 billion dollars.

A frequent criticism of *pro forma* earnings disclosures is that many companies fail to state clearly which items are being excluded (see Mann (2001b)), in contrast with the full-disclosure ‘unravelling’ prediction of the earliest disclosure models (see Grossman (1981), Milgrom (1981)). Incomplete disclosure may reflect costs of doing so such as the revelation of information to competitors (see, e.g., the discussion and references in Verrecchia (2001)). However, a fuller GAAP disclosure often follows the *pro forma* disclosure within a fairly short period.⁹ An alternative possibility is that firms take advantage of a tendency for investors with limited attention to treat *pro forma* earnings as appropriate even when they are not.¹⁰ When firms do reveal GAAP as well as *pro forma* earnings in a single disclosure, firms often place the high *pro forma* earnings numbers conspicuously at the top of their news releases, consistent with exploitation of attentional biases.¹¹

We offer a model which reflects both legitimate reasons for reporting *pro forma* earnings, and the possibility of manipulating such disclosure to exploit limited investor or analyst attention. There are three dates, 0, 1, and 2. At the end of date 0, the manager learns what GAAP earnings will be at date 1, and whether there are special circumstances that may make GAAP earnings less relevant for terminal cash flows (as specified below). After learning GAAP earnings, the manager also decides whether to disclose *pro forma* earnings as equal to GAAP earnings, or with an adjustment. Regardless of whether the manager chooses to adjust, investors independently observe

⁹As Mann (2001b) comments, “One of the problems in all of this is the facile nature of financial reporting. Investors want the bottom line, so when a company reports its earnings in pro forma, the media is only so happy to oblige. Never mind that the earnings as reported to the SEC come out some two weeks later, by that time the headlines have long since passed.”

¹⁰According to *The Economist*, “In theory, investors and other users of accounts know perfectly well that pro-forma numbers should be treated with deep scepticism. In practice, pro-forma earnings releases do allow companies to mislead investors: they grab the headlines and since they are the first pieces of information that a share analyst has to talk to traders about, they drive valuations and share prices.”

¹¹“About 1,000 words after reporting its *pro forma* net income of \$160 million, for example, JDS Uniphase’s latest release on quarterly earnings notes that by ‘generally accepted accounting principles,’ the company actually lost \$1.3 billion,” according to Barbash (2001). Limited investor attention seems to be reflected in the form of business communication channels. As stated in the same news story, “Whenever hypothetical numbers appear at the top of a news release, the real numbers should accompany them at the top as well. The first few lines tend to lead the news stories rushed to the public by wire services, which then appear on Internet-based ticker symbol news trackers.” Bradshaw and Sloan (2002) report a sharp increase in the discussion of *pro forma* earnings before discussing GAAP earnings in disclosures in recent years.

the size of the potential adjustment. At date 1, GAAP earnings are reported. At date 2 the final cash flow is realized.

We assume that GAAP earnings ϵ_1 is a noisy indicator of terminal cash flow. To lay out the effect of limited attention as starkly as possible, we assume that the relation of GAAP earnings to terminal cash flow depends on a state variable that is publicly observable by both manager and investors. Inattentive investors do not pay attention to the state. If the state of the world $\varphi = N$ (Normal), then

$$\epsilon_1 = c_2 + \delta, \tag{13}$$

where c_2 is the terminal cash flow, δ is random noise that is independent of both the state and c_2 , and both variables are normally distributed. In other words, GAAP earnings is an unbiased noisy predictor of the terminal cash flow. There is no information available about δ , so given the information available to investors, in the N state ϵ_1 is the most accurate possible predictor of the terminal cash flow.

If the state of the world is $\varphi = E$ (Exceptional), then GAAP earnings contain the further exogenous independent stochastic noise term a , where $E[a] = 0$, and

$$\epsilon_1 = c_2 - a + \delta. \tag{14}$$

The realization of a becomes observable to all at the end of date 0. (The analysis would be identical if we were to assume that investors do not observe a until date 1.)

Pro forma earnings can be disclosed either as GAAP earnings, or with an adjustment, purportedly to undo the bias in GAAP earnings, such as the exclusion of an extraordinary item. The effect of excluding the item on *pro forma* earnings is public information, but inattentive investors rely on the firm's disclosure in judging whether such an exclusion is 'appropriate.' Limited attention takes the form of investors failing to discount for the strategic incentive of the firm to manipulate *pro forma* disclosures to improve perceptions of the firm.

Thus, we assume that *pro forma* earnings can be disclosed as either

$$e_1 = \begin{cases} \epsilon_1 \\ \epsilon_1 + a. \end{cases} \tag{15}$$

If management adjusts by a as part of his *pro forma* disclosure, management publicly states that it is included, so investors who are attentive can invert and infer GAAP earnings from the *pro forma* earnings disclosure. However, inattentive investors simply treat *pro forma* earnings as if they were adjusted to be maximally informative. Thus, limited attention implies a form of functional fixation.

In the exceptional state E , the *pro forma* adjusted earnings are

$$\begin{aligned} e_1 = \epsilon_1 + a &= (c_2 - a + \delta) + a \\ &= c_2 + \delta. \end{aligned} \tag{16}$$

So if management were to adjust for a in *pro forma* earnings appropriately, i.e., if and only if $\varphi = E$, then *pro forma* earnings would always satisfy $e_1 = c_2 + \delta$. Conditional on the normal state, the noise component of *pro forma* earnings as a signal about c_2 is identical to the noise component of GAAP earnings, δ . Conditional on the exceptional state, the ex ante noise in *pro forma* earnings is still δ , whereas the noise in GAAP earnings is $\delta - a$, where δ and a are independent of each other and of the state. It follows that unconditionally GAAP earnings is a white noise garbling of *pro forma* earnings; *pro forma* earnings is a more accurate signal about c_2 .

This suggests that adjustments in *pro forma* earnings can help investors with limited attention form more accurate perceptions about the terminal cash flow, consistent with the view of defenders of *pro forma* disclosures such as Financial Executives International and the National Investor Relations Institute (see Barbash (2001)). However, if management seeks to boost the market's valuation of the firm, management can exploit limited investor attention by adjusting for a when doing so is not appropriate (in the normal state), or by failing to make the adjustment when doing so is appropriate (in the exceptional state).

Based on the analysis of Section 3, market weight κ of investors naively assume that the firm will adjust appropriately. These investors naively believe that *pro forma* earnings are chosen to be maximally informative. The stock price is determined as a weighted average of these inattentive beliefs and fully attentive rational beliefs that condition correctly upon the state of the world.¹²

The manager's objective places weight on two considerations. First is a desire to maintain a high date 1 stock price. The second is a desire to be perceived as behaving appropriately in his decisions as to disclosure of *pro forma* earnings. I.e., the manager wants observers to believe that he included the adjustment a if and only if it was appropriate to do so.¹³

¹²Both attentive and inattentive investors think that they can correctly infer $c_2 + \delta$. Thus, for a given market price at date 1, future stock returns from date 1 to date 2 are perceived to be normally distributed, consistent with the mean-variance assumption of Section 3.

¹³The source of the personal benefit to the manager of being perceived (by attentive observers) as making appropriate decisions is outside our model. Managers may simply prefer to behave honestly, or may benefit from acquiring a reputation for honesty. A manager with a reputation for honesty in

Let the manager's action be $\theta = \text{Adjust (A) or GAAP (G)}$. Given state φ and potential adjustment value a , the manager's objective trades off the current stock price S_1 against long-term reputation in different states:

$$U(\theta) = \lambda S_1 + \lambda' I^E[\varphi] I^A[\theta] + (1 - I^E[\varphi])(1 - I^A[\theta]), \quad (17)$$

where $\lambda > 0$ and $\lambda' \geq 0$ are weights on different components, $I^E(\theta)$ is an indicator function which is equal to one in the state $\sigma = E$ in which making the adjustment is appropriate and zero otherwise, and $I^A[\theta]$ is an indicator function which is equal to one if the manager chooses the action $\theta = A$, and is equal to zero otherwise. The parameter coefficient λ measures the weight the manager places upon maintaining a high stock price, λ' is the weight on maintaining a reputation for appropriate behavior in the exceptional state, and coefficient 1 is the weight on maintaining reputation in the normal state. (Since only the ratios of the weights matter for decisions, including a third weight parameter on the Normal state would be redundant.)

Fully attentive individuals update in response to the *pro forma* earnings announcement, knowledge of a , and knowledge of the state, so regardless of whether management makes the adjustment they update based upon the signal $c_2 + \delta$. As is standard in normal learning models, the Bayesian update under normal distributions given a prior mean \bar{c}_2 and signal $c_2 + \delta$ is therefore

$$S_1^p = (1 - \omega)\bar{c}_2 + \omega(c_2 + \delta), \quad (18)$$

where

$$\omega \equiv \frac{\nu_\delta}{\nu_{c_2} + \nu_\delta}, \quad (19)$$

$\nu_{c_2} = 1/\sigma_{c_2}^2$ is the precision of the prior cash flow distribution, and $\nu_\delta = 1/\sigma_\delta^2$ is the precision of δ . Thus, ω is a measure of the informativeness of (properly-adjusted) earnings as an indicator of the terminal cash flow.

We will show that in equilibrium management follows a threshold decision rule:

The Threshold Decision Rule

disclosure may be valuable to firms that wish to commit to investors that disclosures will be accurate. Alternatively, the benefit could be at the firm level, allowing the firm to avoid regulatory action or shareholder litigation. Consistent with such a concern, Mann (2001b) reports that "SEC Chairman Harvey Pitt has in the past few weeks come out and repeatedly warned companies that their dependence upon *pro forma* accounting for their investor communications could get them into trouble with the commission if it is found that the presentation obscures the true results rather than clarifies them. For example, if a *pro forma* statement turns an accounting loss into a profit without clearly explaining how, the SEC may now look at this report as being fraudulent."

For a given state φ , include an adjustment a as part of *pro forma* earnings if and only if $a \geq a^\varphi$, where a^φ is a threshold value, and

$$a^E \leq 0 < a^N, \quad (20)$$

where

$$a^E = -\frac{\lambda'}{\lambda\kappa\omega}, \quad a^N = \frac{1}{\lambda\kappa\omega}. \quad (21)$$

Intuitively, in a given state φ , if the manager adjusts when $a = a_0$, then he even more strongly prefers to adjust for any value $a > a_0$. Doing so this would increase more (or reduce less) the market's valuation of the firm. If the manager has absolutely no concern for accuracy, he will adjust if and only if $a > 0$ (i.e., he sets $a^E = a^N = 0$). However, if he places some value on having the firm's adjustment choice being viewed as appropriate by attentive investors, he will set $a^N > 0$. In state N , the market valuation benefit of including an adjustment if a is only very slightly positive is outweighed by the personal cost of being known by attentive investors to have made an inappropriate adjustment. Similarly, in state E he sets $a^E \leq 0$. If the state is Exceptional, the market valuation cost of including a very slightly negative value of a in his disclosure *may* be outweighed by the personal cost of being seen by attentive investors to have failed to make a needed adjustment. But a plausible case is $\lambda' = 0$, implying $a^E = 0$, because it is likely that a disclosure that accords with GAAP earnings is a 'safe harbor' that would not harm the manager's or firm's reputation. We now verify the threshold decision rule as equilibrium behavior.

In state N , attentive investors mentally adjust *pro forma* earnings e_1 according to

$$c_2 + \delta = \begin{cases} e_1 & \text{if } a < a^N \\ e_1 - a & \text{if } a \geq a^N. \end{cases} \quad (22)$$

Similarly, in state E , attentive investors adjust *pro forma* earnings according to

$$c_2 + \delta = \begin{cases} e_1 + a & \text{if } a < a^E \\ e_1 & \text{if } a \geq a^E. \end{cases} \quad (23)$$

So as in equation (10) of Subsection 3.2, the rational, full-attention valuation $H(\varphi, a, e_1)$ in state N can be expressed in terms of the *pro forma* earnings disclosure as

$$H(N, a, e_1) = E^p[c_2|N, a, e_1; a^N, a^E] = \begin{cases} (1 - \omega)\bar{c}_2 + \omega e_1 & \text{if } a < a^N \\ (1 - \omega)\bar{c}_2 + \omega(e_1 - a) & \text{if } a \geq a^N. \end{cases} \quad (24)$$

Similarly, in state E the full-attention valuation is

$$H(E, a, e_1; a^N, a^E) = E^\rho[c_2|E, a, e_1; a^N, a^E] = \begin{cases} (1 - \omega)\bar{c}_2 + \omega(e_1 + a) & \text{if } a < a^E \\ (1 - \omega)\bar{c}_2 + \omega e_1 & \text{if } a \geq a^E. \end{cases} \quad (25)$$

The limited attention valuation treats the *pro forma* earnings disclosure as appropriate. Consistent with the general specification of the effects of limited attention given by equation (11), this is equivalent to the individual forming expectations with a simplifying parametric restriction. This is that his expectations satisfy (24) and (25) with incorrect parameter values $a^N = \infty, a^E = -\infty$.

Suppose now that a manager observes state E and potential adjustment value a . If the manager does indeed adjust, as is appropriate, then the limited attention valuation is equal to the full attention valuation as given in (18). The actual stock price is then the weighted average

$$S_1(A) = \kappa S_1^\rho + (1 - \kappa)S_1^\rho = S_1^\rho.$$

If the manager does not adjust, then inattentive investors treat GAAP earnings as appropriate and use $e_1 = c_2 + \delta - a$ instead of $c_2 + \delta$ in their Bayesian updating. In consequence, they value the stock as

$$(1 - \omega)\bar{c}_2 + \omega(c_2 + \delta - a) = S_1^\rho - \omega a. \quad (26)$$

It follows that the stock price in this situation is the weighted average

$$\begin{aligned} S_1(G) &= \kappa(S_1^\rho - \omega a) + (1 - \kappa)S_1^\rho \\ &= S_1^\rho - \omega\kappa a. \end{aligned} \quad (27)$$

This reflects the fact that investors agree on the stock price, except for their differing assessments of the need for an adjustment by a .

By the objective function (17), the manager compares the utility of adjusting, $\lambda S_1^\rho + \lambda'$, with the utility of not adjusting, $\lambda(S_1^\rho - \kappa\omega a)$. The difference, $U(A) - U(G) = \lambda' + \lambda\kappa\omega a$, is linearly increasing in a , so for sufficiently high a the manager adjusts, and for sufficiently low a he does not. Equating the two utilities yields the critical value for the exceptional state, $a^E = -\lambda'/\lambda\kappa\omega$, which is negative if $\lambda' > 0$ and is 0 if $\lambda' = 0$. This confirms part of the threshold rule.

In a similar fashion, if the manager observes state N and appropriately does not adjust, then inattentive investors value the stock as S_1^ρ , so the stock price is $S_1(G) = S_1^\rho$.

But if the manager does adjust, inattentive investors value the stock based on *pro forma* earnings $c_2 + \delta + a$, so their expectation of the terminal cash flow is

$$(1 - \omega)\bar{c}_2 + \omega(c_2 + \delta + a) = S_1^p + \omega a. \quad (28)$$

It follows that the stock price in this situation is the weighted average

$$\begin{aligned} S_1(A) &= \kappa(S_1^p + \omega a) + (1 - \kappa)S_1^p \\ &= S_1^p + \omega\kappa a \end{aligned} \quad (29)$$

By (17), the manager compares the utility of adjusting, $\lambda(S_1^p + \kappa\omega a)$, with the utility of not adjusting, $\lambda S_1^p + 1$. The difference, $U(A) - U(G) = \omega\lambda a\kappa - 1$, is linearly increasing in a . So again the manager adjusts if and only if a exceeds a critical value. Equating the two utilities yields the critical value for the normal state, $a^N = 1/\lambda\omega\kappa > 0$. This confirms the remainder of the threshold rule.

This analysis implies both intuitive and surprising comparative statics for the effects of exogenous parameters upon the probability that a biased *pro forma* earnings disclosure will be issued in a normal state. By (21), higher a^N and a^E are associated with a lower probability of a *pro forma* earnings disclosure. Thus, the comparative statics on a_N and a_E give corresponding implications for probability of *pro forma* disclosure.

In practice, the safe harbor of GAAP makes it likely that $\lambda' = 0$, $a^E = 0$, so that only upward adjustments occur. Thus, the more interesting comparative statics are for critical value a^N in the normal state. By (21), we have:

Proposition 1 *If some investors have limited attention in their evaluation of pro forma earnings announcements, then the probability of an adjusted pro forma earnings disclosure in the N state is increasing in, and in the E state is decreasing in:*

1. λ , the managerial preference for a higher current stock price;
2. κ , the weight of inattentive beliefs on the stock price; and
3. ω , the signal to noise ratio of properly-adjusted earnings.

When $\lambda' = 0$, $a^E = 0$, so that only upward adjustments occur, the unconditional probability of a pro forma earnings disclosure is increasing in λ , κ , and ω .

Intuitively, stronger incentives for managers to manipulate investor perceptions, and more credulous (inattentive) investors increase the likelihood of inappropriate upward

pro forma disclosure in the normal state. If, as is realistic, GAAP provides a ‘safe harbor’ for managers ($\lambda' = 0$) so that only upward-adjusted *pro forma* disclosure occurs, then these implications hold unconditionally as well.

If, however, $\lambda' > 0$ so that the firm sometimes is pressured to disclose *pro forma* earnings below GAAP earnings, then stronger incentives to manipulate and greater investor credulity cause a reduction in the amount of pessimistic disclosure in state E .

Most interesting is the comparative statics on ω . It is typically presumed that any effects of investor irrationality will tend to be strongest when investors are poorly informed. Here, higher ω , which by (19) is the signal to noise ratio for properly-adjusted earnings as an indicator of the firm’s true economic condition, implies a *lower* critical value a^N . Thus, more accurate public information is associated with a *higher* probability of upward *pro forma* adjustment. Intuitively, when earnings (*pro forma* or otherwise) are viewed by investors as a stronger indicator of value, there is a stronger incentive for firms to manipulate perceptions of earnings.

We now consider the effect of the threshold rule on bias in *pro forma* earnings and on investor misvaluation. The credulous expectation that inattentive investors form of the future cash flow is equal to *pro forma* earnings, $E^\kappa[c_2] = e_1$. The actual relation between *pro forma* earnings and cash flow in state N is

$$e_1 = \begin{cases} \epsilon_1 & = c_2 + \delta & \text{if } a < a^N \\ \epsilon_1 + a & = c_2 + \delta + a & \text{if } a \geq a^N, \end{cases} \quad (30)$$

and in state E is

$$e_1 = \begin{cases} \epsilon_1 & = c_2 + \delta - a & \text{if } a < a^E \\ \epsilon_1 + a & = c_2 + \delta & \text{if } a \geq a^E. \end{cases} \quad (31)$$

We now tabulate possible equilibrium stock prices. In state N ,

$$S_1 = \begin{cases} S_1^p & \text{if } a < a^N \\ S_1^p + \omega\kappa a & \text{if } a \geq a^N. \end{cases} \quad (32)$$

Similarly, in state E the date 1 stock price is

$$S_1 = \begin{cases} S_1^p - \omega\kappa a & \text{if } a < a^E \\ S_1^p & \text{if } a \geq a^E. \end{cases} \quad (33)$$

Since $a^N > 0$ and $a^E \leq 0$, a is only added when it is positive, and is only subtracted when it is negative or zero. The firm sometimes adjusts upward when doing so is inappropriate, and never adjusts down when doing so would be inappropriate. It follows that $S_1 \geq S_1^p$, where the inequality is strict for some realizations of the state and value

of a . Thus, at the start of date 0 prior to these realizations, $E_0[S_1] > E_0[S_1^\rho]$. In other words, market expectations and stock prices are on average upward biased as a consequence of the strategic adjustment of pro forma earnings. This proves:

Proposition 2 *If some investors have limited attention in their evaluation of pro forma earnings announcements, then:*

1. *On average pro forma earnings are higher than GAAP earnings, and are an upward biased predictors of terminal cash flow;*
2. *Average investor expectations of terminal cash flow are upward biased; and*
3. *Stock prices are on average higher than they would be if investor attention were perfect.*

Consistent with Part 1, Bradshaw and Sloan (2002) find a very strong bias toward the disclosure of higher *pro forma* earnings than GAAP earnings. In this spirit, Barbash (2001) reports that “Lynn Turner, the SEC’s chief accountant, has an acronym for news releases deploying *pro forma* results. He calls them ‘EBS releases.’ He says that means ‘Everything but Bad Stuff.’” Consistent with Part 3, Johnson and Schwartz (2001) find that *pro forma* firms have higher valuation multiples than non-*pro forma* firms.

We next consider the relation between excess *pro forma* earnings Δe_1 , defined as the differential between *pro forma* earnings and GAAP earnings, $e_1 - \epsilon_1$, and the amount of misvaluation, ΔS_1 , defined as $S_1 - S_1^\rho$. We will derive the average relation between these variables in each of the two states, and then unconditionally. First, by (30) and (31), in state φ ,

$$\Delta e_1 = \begin{cases} 0 & \text{if } a < a^\varphi \\ a & \text{if } a \geq a^\varphi. \end{cases} \quad (34)$$

We now calculate the average overvaluation conditional on the size of excess pro forma earnings Δe_1 . There will be no adjustment in *pro forma* disclosure unless the potential adjustment $a > a^E$. If $a^E < \Delta e_1 < a^N$, then by the threshold rule the state must be E , because in state N such a small adjustment would not be made. Thus, by (33) the average misvaluation conditional on an adjustment occurring and on the size of the potential adjustment a , where $a < a^N$, is

$$E[S_1 - S_1^\rho | a, a^E < \Delta e_1 = a < a^N] = 0. \quad (35)$$

If the observed excess *pro forma* earnings is higher, $a^N < \Delta e_1$, then by the threshold rule the adjustment could have occurred in either state. Since *pro forma* disclosure

occurs in either state whenever $a > a^N$, the probability of state N conditional on a *pro forma* disclosure with $a^N < \Delta e_1$ is equal to the prior probability $Pr(N)$. However, the adjustment only causes misvaluation in the N state. It follows that

$$\begin{aligned} E[\Delta S_1 | a, a^N < a = \Delta e_1,] &= Pr(N)(S_1^p + \omega \kappa a) + [1 - Pr(N)]S_1^p - S_1^p \\ &= Pr(N)\omega \kappa a. \end{aligned} \tag{36}$$

Taken together, (35) and (36) imply a piecewise-linear continuous non-decreasing relation between excess *pro forma* earnings and the size of the misvaluation, with critical threshold a^N (see Figure 1). Thus, the analysis predicts that the higher are excess *pro forma* earnings, the more negative are the subsequent abnormal returns.

Actual market prices must, in the long run, correct to the rational expectation of the terminal cash flow. So the long-run abnormal return in the model is on average just the negative of the quantities calculated in (35) and (36). Thus, higher excess *pro forma* earnings are associated with more negative average subsequent abnormal returns.

Some comparative statics conclusions about the effects of ω , κ , and $Pr(N)$ on the slope of the relationship between misvaluation and Δe_1 follows almost immediately from (35) and (36). Not only does the upward-sloping portion of the piecewise linear relation become steeper as these parameters increase, but (by Proposition 1) the critical threshold at which the positively-sloped portion begins, a^N , decreases— to $(a^N)' < a^N$ in Figure 1. Thus, the slope is uniformly non-decreasing in these parameters, and in some regions is strictly increasing. We summarize these results as follows.

Proposition 3 *If some investors have limited attention in their evaluation of pro forma earnings announcements, then:*

1. *The larger are excess pro forma earnings, the greater (more positive) on average is overvaluation, and the more negative is the average subsequent abnormal return.*
2. *The slope of the relationship between excess pro forma earnings and misvaluation is weakly increasing (with strict inequality for sufficiently large Δe_1) in the fraction of investors who are inattentive (κ), the ex ante probability of the normal state ($Pr(N)$), and the informativeness of earnings (ω). The slope of the relationship between excess pro forma earnings and subsequent abnormal returns is weakly decreasing with these parameters.*

Recent papers have confirmed the Part 1 implication that higher excess *pro forma* earnings is associated with more negative subsequent average abnormal returns (see Lougee

and Marquardt (2002), and Doyle, Lundholm, and Soliman (2002)). However, Johnson and Schwartz (2001) report that the relation of valuation multiples to excess *pro forma* earnings is inconsistent across alternative valuation measures. Further empirical research to resolve this issue is called for.

The bias in market prices introduced by adjustments in *pro forma* earnings announcements offers a possible motivation for regulation of this practice. Indeed, recently the Securities and Exchange Commission has been pressuring firms to reconcile *pro forma* numbers with GAAP numbers conspicuously within *pro forma* disclosures.

However, there are also advantages to adjusted *pro forma* disclosure, so the regulatory issues are subtle. Consider for example the extreme case in which the manager places very high weight on making appropriate *pro forma* reports. In this case he would set $a^E \approx -\infty$, and $a^N \approx \infty$. The accuracy would approach the ideal accuracy, with the signal noise in the earnings disclosure close to its minimum possible value σ_δ^2 . The benefit of more accurate market beliefs would then outweigh the very slight upward bias that *pro forma* reporting induces in this case.

Proposition 4 *A manager who exploits limited attention in his pro forma reports can generate pro forma earnings that are more accurate than GAAP earnings.*

Proof: Consider a value of $\lambda > 0$ that is arbitrarily small. Then the managerial disclosure policy is arbitrarily close to the appropriate one (adjust if and only if the state is E). This eliminates virtually all the a noise from GAAP earnings, while the bias becomes arbitrarily small. ||

Thus, in this setting *pro forma* adjustments may *help* investors with limited attention analyze the firm appropriately. Consistent with this implication, Brown and Sivakumar (2001) find that *pro forma* earnings are more accurate predictors of future earnings than are GAAP earnings. Even an SEC report warning against abuse of *pro forma* earnings also argued that *pro forma* earnings can “provide a meaningful comparison to results from the same period of prior years,” (see Mann (2001b)).

Bradshaw and Sloan (2002) find that stock prices are more closely linked to *pro forma* earnings than to GAAP earnings in recent years. This could derive either from greater value relevance of *pro forma* earnings, or from the high salience in the presentation of *pro forma* disclosures for investors with limited attention.

In particular, the incentive to adjust appropriately is decreasing with λ (the weight on the current stock price in the manager’s objective). Empirically, this suggests that

pro forma reports will be less accurate for firms that have high pressure to maintain stock prices, such as, e.g., firms that are subject to severe takeover threats.

5 Time Allocation: The Case of Managerial Option Compensation

But the newer technologies, and the productivity and bull stock market they have fostered, are also accentuating some accounting difficulties that tend to bias up reported earnings. One is the apparent overestimate of earnings that occurs as a result of the distortion in the accounting for stock options. ...not charging their fair value against income, ... serves to understate ongoing labor compensation charges against corporate earnings.

—Remarks by Federal Reserve Board Chairman Alan Greenspan, “New challenges for monetary policy,” August 27, 1999.

Commentators have often alleged that investors fail to pay sufficient attention to unrecognized managerial option compensation of high tech firms. For example, in discussing the movement by the FASB toward requiring marking-to-market of the cost of employee stock options, a director at PricewaterhouseCoopers, Ohl (2000), comments that “Ironically, information on the ‘true cost’ of options is already available in the footnotes on employee options that all public companies are required to report. Many users overlook these footnotes or do not regard them as a useful source of information.” Many critics have further alleged that such lack of investor attention caused overvaluation of high-tech firms, and that this contributed to the internet boom and crash of the late 1990s (see, e.g., Orr (2001)). These concerns arise because firms are permitted to value employee options when granted at intrinsic value, so that options that are issued with exercise price equal to the current market price are not expensed. The magnitude of the potential effect on earnings of option compensation has been substantial.¹⁴

It is also striking that the FASB proposal to expense employee stock option compensation owing to stormy protests in the 1990s by high-tech firms whose earnings would

¹⁴Botosan and Plumlee (2001) report that in a sample of 100 firms identified by *Fortune* as fastest-growing companies, in the 5 years since SFAS 123 stock option expense would have reduced median earnings per share by 14%, and ROA would have been reduced by 13.5%. Furthermore, there was non-compliance by 12% of firms. Their analysis also suggests that the stock option expense was likely to double in the next 5 years. A Merrill Lynch study (reported by Orr (2001)) found that Yahoo!’s 2000 earnings were 1,887% higher than it would have been if stock option expense had been included. Out of 37 major high-tech companies, earnings would have been approximately 60% lower than reported if these companies had expensed all stock options given to employees.

have been reduced. Dechow, Hutton, and Sloan (1996) provide evidence that firms that protested the 1993 FASB proposal of expensing of stock options paid higher compensation, used more options in their compensation plans, and used options more intensively for top management relative to other employees. They conclude that the protests were motivated by a desire for managers to hide the costs of the option compensation. According to *The Economist* (2002b), p. 58, “The FASB had to back away from changing this after intense lobbying by companies, accountants, and politicians. The IASB is currently under similar pressure as it considers the same issue.”

Expending resources on lobbying about informationally equivalent reporting versus disclosure requirements is puzzling from a fully rational perspective. The structure of compensation contracts can be inferred from information in footnotes and proxy statements. From a pure reporting standpoint, firms should not care which among a set of informationally equivalent reporting/disclosure regimes is imposed. Thus, the opposition by firms to expensing employee option compensation seems to reflect a belief that investors tend to overlook information that is not presented saliently.

In our model, the manager is granted warrants (call options) at date 0 which, if exercised, comprise fraction x of the firm’s shares. The options cannot be exercised until terminal date 2. The sum of the exercise prices for all the options is K . Then at date 2 the manager’s net option compensation is

$$\max[0, x(F + K + \eta) - K], \quad (37)$$

where $F + \eta$ is the terminal cash flow of the firm, $E[\eta] = 0$, and K is both the cash inflow to the corporation from the manager’s option exercise (contained in the expression within the parentheses), and also is the cost to the manager of exercise (the term outside the parentheses). The terminal value obtained by other shareholders is therefore

$$\min[F + \eta, (1 - x)(F + K + \eta)].$$

To illustrate some simple points minimally, we normalize the exercise price K to zero, so that the options are sure to be exercised. We divide the F component of operating payoff into components publicly resolved at dates 1 and 2, $F = F_1 + F_2$, so that the total firm operating payoff is $F_1 + F_2 + \eta$, where η is independent of F_1 and F_2 . Date 1 earnings ϵ_1 is equal to F_1 as adjusted for any options costs that are expensed.

We allow for persistence in firm cash flows; F_2 is related to the date 1 component by

$$F_2 = \gamma F_1 + \delta, \quad (38)$$

where δ is white noise. To accommodate firm growth, the F_t 's could more broadly be interpreted as deviations from a steady growth trend in cash flows.

In order to focus on the degree of attention directed toward option grants, we assume that all investors are fully attentive to earnings news, so they take into account earnings ϵ_1 . (Similar results apply if this assumption is relaxed.) However, unless there is required reporting of option compensation as a cost, fraction f and market weight κ of investors do not attend at dates 0 or 1 to the stock option grant. Instead, inattentive investors extrapolate date 1 earnings using persistence parameter γ to form their expectation of terminal value per share.

For example, if the options are not expensed at all, then investors with limited attention value current shares as if they could claim the full $F + \eta$. A market weight of $1 - \kappa$ is comprised of investors who attend to the fraction x of the future cash flow destined for managers, as in (37) with $K = 0$.

Specifically, we will examine different reporting regimes based on the fraction of the options grant that is expensed at date 1. We define the realized economic cost of the option grant to the firm, ξ as the net cash flow ultimately obtained by management and other employees from their options, i.e., option compensation. Under the amortization regime, fraction β of the expected cost is expensed, so that earnings are

$$\epsilon_1 = F_1 - \beta E[\xi|F_1]. \quad (39)$$

We refer to the special case $\beta = 0$ as the *no reporting regime*, and the special case $\beta = 1$ as the *full expensing regime*. By (37), at date 2 the manager's option compensation is $x(F + \eta)$, since $K = 0$. The expected option compensation cost at date 1 given F_1 is

$$E[\xi|F_1] = (1 + \gamma)xF_1. \quad (40)$$

The rational, full attention stock price at date 1 is therefore

$$S_1^p = (1 + \gamma)(1 - x)F_1. \quad (41)$$

If inattentive investors wrongly perceive that $\xi = 0$ in (40), then they interpret high ϵ_1 as indicating high F_1 and, by (38), high F_2 . Thus, limited attention makes these investors 'credulous' in extrapolating from ϵ_1 to F_2 . In contrast, required expensing of option compensation makes its effect more salient.

We consider an amortization (A) regime in which fraction β of the expected compensation cost is expensed at date 1, $0 < \beta < 1$. We can then solve for the fully rational

stock price in terms of the date 1 earnings using the condition

$$\begin{aligned}
S_1^\rho &= (1 + \gamma)(1 - x)F_1 \\
&= (1 + \gamma)(1 - x)[\epsilon_1 + \beta(1 + \gamma)xF_1] \\
&= (1 + \gamma)(1 - x) \left[\epsilon_1 + \frac{\beta(1 + \gamma)xS_1^\rho}{(1 + \gamma)(1 - x)} \right],
\end{aligned} \tag{42}$$

where the last equality holds by (41). Solving for S_1^ρ , the full-attention valuation can be expressed in terms of date 1 earnings as in the form of (10) of Subsection 3.2,

$$H(\epsilon_1; x, \gamma) = S_1^\rho = \left[\frac{(1 + \gamma)(1 - x)}{1 - \beta(1 + \gamma)x} \right] \epsilon_1. \tag{43}$$

Inattentive investors ignore the option obligation, so limited attention imposes the incorrect constraint $x = 0$. Thus, by (39) and (40), at date 1 the firm is valued as

$$\begin{aligned}
S_1^\beta(A) &= (1 - \kappa)S_1^\rho + \kappa(1 + \gamma)\epsilon_1 \\
&= (1 - \kappa)S_1^\rho + \kappa(1 + \gamma)[1 - \beta x(1 + \gamma)]F_1.
\end{aligned} \tag{44}$$

We compare this with the limiting endpoints in which $\beta = 0$ or $\beta = 1$.

In the no reporting (N) regime ($\beta = 0$), the stock price is

$$S_1(N) = (1 - \kappa)S_1^\rho + \kappa(1 + \gamma)F_1. \tag{45}$$

By (41), the misvaluation is

$$\Delta S_1(N) \equiv S_1(N) - S_1^\rho = \kappa(1 + \gamma)xF_1.$$

In this case, consistent with the critical views of commentators, failure to report option compensation fools investors, so the firm is overvalued by the market. Overvaluation is increasing in the amount of option compensation x , and in the persistence of earnings γ , and the fraction of the investors who are inattentive κ .

In the full expensing (E) regime ($\beta = 1$), the firm is valued as the weighted average

$$\begin{aligned}
S_1(E) &= (1 - \kappa)S_1^\rho + \kappa(1 + \gamma)\epsilon_1 \\
&= (1 - \kappa)S_1^\rho + \kappa(1 + \gamma)[1 - x(1 + \gamma)]F_1,
\end{aligned}$$

so by (41), the misvaluation is

$$\Delta S_1(E) \equiv S_1(E) - S_1^\rho = -\kappa(1 + \gamma)\gamma x F_1.$$

Investors undervalue the firm because the earnings hit is magnified. In effect, it is as if they mistake the date 1 reduction in earnings, which pays for the manager's long-term compensation, as being merely an installment in a continuing stream of compensation.

Undervaluation is increasing in the amount of option compensation x , and in the persistence of earnings γ . Thus, the analysis implies that in a full-expensing regime, the direction of effect of these parameters is the reverse of that in the no-expensing regime: greater option compensation and greater persistence of earnings are associated with more positive average abnormal returns.

An appropriate choice of the amortization coefficient β can generate a market price at date 1 equal to that under full attention. Equating S_1^p from (41) with $S_1^\beta(A)$ from (44) yields $\beta = 1/1 + \gamma$. Thus, if a regulatory goal is to help the market achieve accurate perceptions of the firm's financial condition, there is an optimal expensing policy. Furthermore, this policy depends on the persistence of earnings! This implication differs from conventional full-attention models. These results are summarized as follows.

Proposition 5 *If some investors have limited attention, then:*

1. *Under a no-reporting (full expensing) regime in which the expected cost of employee option compensation is not expensed (fully expensed) at the time at which the options are granted:*
 - *The market overvalues (undervalues) the firm relative to fundamental value.*
 - *Higher employee option compensation is associated with greater overvaluation (undervaluation), and with more negative (positive) subsequent average abnormal returns;*
 - *The greater the persistence of earnings, the greater the overvaluation (undervaluation) associated with a given level of employee option compensation, and the more negative (positive) the average long-run abnormal returns.*
2. *Under an amortization regime expensing regime in which fraction β of the expected cost of managerial option compensation is expensed at the time at which the options are granted, the market values the firm correctly if $\beta = 1/(1 + \gamma)$.*

Consistent with Part 1, Garvey and Milbourn (2001) find that the magnitude of unrecognized option compensation is a negative predictor of subsequent abnormal stock returns. Furthermore, Bell et al (2002) provide evidence based upon the residual income model suggesting that investors overvalue firms with high levels of employee stock options.

However, the implication of our model that subsequent average abnormal returns will be more negative when the persistence of earnings is higher has not, to our knowledge, been tested.

Part 1 explains why firms care about the expensing regime. Thus, the analysis is consistent with firms campaigning politically against required reporting of option expenses (see Dechow, Hutton, and Sloan (1996)). Furthermore, Part 1 suggests that the opposition of firms to full expensing of executive options may, surprisingly, have a degree of merit. Under limited attention, just as no-expensing leads to overvaluation, full expensing leads to undervaluation.

The intuition behind the basic point that no-expensing leads to overvaluation and full-expensing to undervaluation seems to extend to a steady-state setting in which a firm has continuing growth, option grants and option exercises. At each date t , investor observation of the actual option exercise clears out past undervaluation (which derived from overextrapolation of the date $t - 1$ expensing of the option). But the issuance of new options generates new undervaluation, so that investor perceptions remain one step behind. This conjectural argument remains to be verified in an explicit model.

Part 2 implies that the higher is the persistence of earnings γ , the lower the fraction of options costs that would need to be expensed to induce correct market valuation. More generally, in a dynamic setting with positive exercise price the amortization scheme needed to achieve correct valuation would be complex. The robust conclusion here is not that regulation can easily ensure correct valuation, but that the degree of earnings persistence is one consideration for a policymaker who seeks to align market perceptions with firm fundamentals.

Our analysis of executive option compensation has taken firms' option-granting and investment behavior as exogenous. More generally, using an objective similar to that in Section 4, this behavior can be endogenized. In such a setting, requiring the expensing of options would reduce the attractiveness for the firm of option compensation relative to cash or other compensation.¹⁵ Furthermore, if options are not expensed, firms may have an incentive to issue overpriced equity to finance greater investment. This is consistent with the arguments of some high-tech advocates that the expensing of options would lead to a substantial reduction in entrepreneurial activity (see, e.g., Doerr and White (2002)),

¹⁵Such a concern seems to have influenced the decision of CalPERS, the largest pension fund in the U.S., to postpone action on a staff recommendation to require companies to expense employee stock options (see *Los Angeles Times* (2002)). Indeed, the article attributes to well-known venture capitalist John Doerr the claim that "stock options would disappear as a recruiting tool for start-up firms if their potential value had to be deducted from earnings, reducing companies' reported profit."

but does not imply that full expensing leads to lower welfare than a no-expensing regime.

A further conjectural implication is that in a no-expensing regime, firms with high earnings persistence will compensate employees with options (to avoid extrapolation of non-option compensation expenses) more than firms with low earnings persistence. In contrast, under full expensing, firms with high persistence will avoid option compensation more (as they are more prone to over-extrapolation of option expenses). Thus, the cross-sectional profile of firms that engage in heavy employee stock option compensation is predicted to reverse if proposals currently under debate in the U.S. congress to require full expensing are passed.

6 Aggregation in Financial Reporting: The Case of Segment Reporting

When attention is limited, the degree to which accounts are aggregated in financial statements matters even if investors possess enough information to disaggregate on their own. GAAP provides for discretion in the way that these aggregates are formed, leading to the possibility of financial reporting management. In the modern age of electronic information technology, it would be feasible to require tremendous amounts of transaction by transaction information to be reported, which would reduce the scope for financial reporting management. However, if attention is limited, it is not obvious whether providing more information allows investors to achieve better outcomes.

To see how reporting aggregation influences investor perceptions, we consider investors who only have a probability of attending to publicly available information about the individual components of aggregate earnings. If an individual does not attend separately to each component, he extrapolates aggregate earnings at the average growth rate for aggregate earnings. If he does attend separately, he extrapolates each component at its own growth rate.

We assume that the probability that investors attend to the growth rates of the separate earnings components is higher under disaggregated reporting than under aggregated reporting. Each of the earnings components is publicly available information (e.g., through analyst and news media reports), but the inclusion of this information in financial statements makes it more salient to investors.

For concreteness, we consider the issue of aggregated reporting versus segment reporting versus divestiture in a multidivisional firm. Our focus in this application is on incorrect extrapolation of growth rates. Related issues are likely to arise more generally

in the aggregation of accounting items, and misattributions investors may make as to the reason for level of an aggregated item. Suppose a firm has N segments with different growth rates. The earnings at dates 0, 1, and 2 are:

$$\epsilon_0 = \sum_{i=1}^N u_i, \quad \epsilon_1 = \sum_{i=1}^N u_i g_i, \quad \epsilon_2 = \sum_{i=1}^N (g_i)^2 u_i + \delta_i, \quad (46)$$

where the δ_i 's are i.i.d., $E[\delta_i] = 0$ for all i . Here u_i is the date 0 earnings of division i , g_i is the expected growth rate of division i , and the δ_i 's reflect uncertainty about segment performance. For simplicity we have made growth at date 1 non-stochastic, though this is not essential. We focus only on firms with positive earnings segments ($u_i > 0$). (In our simple setting, a negative value of earnings at date 0 would extrapolate to negative expected earnings at all remaining dates, in which case the firm should immediately liquidate or otherwise dispose of the segment at date 0.)

In projecting future earnings the investor or analyst needs to analyze the business for each segment, projecting each at its appropriate rate of growth. A fully attentive investor uses all the u_i 's and g_i 's to forecast date 2 earnings as

$$E_1^\rho[\epsilon_2] = \sum_{i=1}^N (g_i)^2 u_i. \quad (47)$$

Thus, the rational, full-attention valuation can be expressed in the form of (10) of Subsection 3.2 as $H(u_1, u_2, \dots, u_N; g_1, g_2, \dots, g_N)$, where H is defined to be function on the RHS of (47).

Our assumption that average segment growth rates are constant is most applicable to an economy or family of industries which has recently entered a new and sustained phase of higher foreseen earning growth, so that differences in divisional growth rates can persist for relatively long periods before reverting toward zero. Even if all investors are aware of the start of this high-growth phase, we will show that aggregated reporting causes a bias in inattentive forecasts of future earnings growth.

We assume that inattentive investors do not distinguish segments, and therefore extrapolate the firm's earnings at its overall earnings growth rate. This is equivalent to imposing the incorrect restriction on the structural parameters that

$$g_1 = g_2 = \dots = g_N = \frac{\epsilon_1}{\epsilon_0}.$$

Thus, an inattentive investor estimates the growth rate to be

$$r^\kappa \equiv \frac{\epsilon_1}{\epsilon_0} = \frac{\sum_{i=1}^N u_i g_i}{\sum_{i=1}^N u_i}, \quad (48)$$

and extrapolates using r^κ to forecast date 2 earnings as

$$\begin{aligned} E_1^\kappa[\epsilon_2] &= r^\kappa \epsilon_1 \\ &= \frac{\left(\sum_{i=1}^N u_i g_i\right)^2}{\sum_{i=1}^N u_i}. \end{aligned} \quad (49)$$

Let S_1^μ denote the market valuation of the firm at date 1 under alternative reporting rules $\mu = A$ (aggregated reporting), S (segment reporting), and D (divestiture, i.e., separately traded firms). We assume that date 0 and date 1 earnings are paid out as dividends at date 0 and at the start of date 1 and therefore are not a part of the ex dividend date 1 valuation. Then investors value the firm as

$$\begin{aligned} S_1^\mu &= \kappa^\mu E_1^\kappa[\epsilon_2] + (1 - \kappa^\mu) E_1^\rho[\epsilon_2] \\ &= \kappa^\mu \left[\frac{\left(\sum_{i=1}^N u_i g_i\right)^2}{\sum_{i=1}^N u_i} \right] + (1 - \kappa^\mu) \left[\sum_{i=1}^N (g_i)^2 u_i \right] \\ &= S_1^\rho - \kappa^\mu \left\{ \frac{\left[\sum_{i=1}^N (g_i)^2 u_i \right] \left(\sum_{i=1}^N u_i \right) - \left(\sum_{i=1}^N u_i g_i \right)^2}{\sum_{i=1}^N u_i} \right\} \\ &= S_1^\rho - \kappa^\mu \left\{ \frac{\sum_{i=1}^N \sum_{j>i} [(g_i)^2 + (g_j)^2] u_i u_j - \sum_{i=1}^N \sum_{j>i} 2g_i g_j u_i u_j}{\sum_{i=1}^N u_i} \right\} \\ &= S_1^\rho - \kappa^\mu \left[\frac{\sum_{i=1}^N \sum_{j>i} (g_i - g_j)^2 u_i u_j}{\sum_{i=1}^N u_i} \right] \\ &\leq S_1^\rho, \end{aligned} \quad (50)$$

where the last inequality holds strictly so long as the g_i 's are not all equal. It is evident from the last equation that the more unequal are the g_i 's, the smaller is S_1^μ . Similarly, since (for a given sum) products are larger when the components are closer to equal, S_1^μ tends to be smaller when the divisions are closer to equal in size (u_i 's close to equal).

Thus, so long as the divisions have unequal growth rates, the market value of the firm is lower under aggregate reporting than under segment reporting. High-growth segments are 'hidden-gems' whose high rate of growth are implicitly underestimated. There are also 'skeleton-in-the-closet' segments whose low rates of growth are implicitly overestimated. However, these misjudgments do not, on average, cancel out. Intuitively, investors undervalue the effect of the increasing weight of high-growth segments over time, so that under aggregate reporting the stock is undervalued by the market.

Analysts often support the divestiture of hidden gems based upon the biblical recommendation “don’t hide your light under a bushel.” Our analysis implies that under some circumstances this view has merit.

Extrapolating the entire firm at its past growth rate ignores the increasing weight in firm value of faster-growing segments over time. Since average segment growth rates are constant, this shift in weight tends to increase the average growth rate of the firm.

Under segment reporting ($\mu = S$), a higher fraction of individuals attend to the segments separately, $\kappa^S < \kappa^A$. Equation (50) holds with $\kappa^\mu = \kappa^S$. Thus, $S_1^S > S_1^A$. After a focusing transaction such as an asset sale, everyone values the segments separately, so each is valued according to its own growth rate, $S_1^D = S_1^p$. It follows immediately from (50) as applied to aggregate reporting (κ^A) and to segment reporting (κ^S) that $S_1^D > S_1^S > S_1^A$. We summarize this analysis as follows.

Proposition 6 *In a setting with constant segment growth rates,*

1. *If not all segments are growing at the same rate, then the market values the firm more highly under segment reporting than under aggregate reporting, and more highly under divestiture than under segment reporting.*
2. *Holding constant growth rates, the difference in valuation between aggregate reporting, segment reporting and focusing regimes is greatest when divisions are equal in size.*
3. *Holding constant size, a mean preserving spread in the growth rates of different divisions increases the difference in valuation between aggregate reporting, segment reporting, and focusing regimes.*

Two immediate empirical implications follow:

Implication: *During periods of high foreseen growth, total firm value on average rises when the firm spins off, carves out or divests a segment.*

Disaggregation encourages the market to weigh rapidly growing segments more heavily, so total firm value increases. Several papers have found that increased corporate focus achieved through spinoffs, carveouts, and asset sales are associated with upward market revaluations (see Schipper and Smith (1986), Comment and Jarrell (1995), Daley, Mehrotra, and Sivakumar (1997)). The analysis also predicts a diversification discount in firm valuation during high growth periods. The degree to which the evidence supports

the diversification discount is currently under debate (see, e.g., Lang and Stulz (1994), Berger and Ofek (1995)), Campa and Kedia (2002)).

Implication: *During periods of high foreseen growth, total firm value on average rises more in focusing transactions if the divested segment's growth rate differs substantially from the growth rates in the remaining firm.*

Daley, Mehrotra, and Sivakumar (1997) report that the abnormal returns associated with announcement of spinoffs are higher when the divested division is in a different industry from the parent firm. In our setting, such cases would on average have higher announcement returns if divisions in different industries are more likely to have very different growth rates.

The analysis also predicts which divisions will tend to be sold.

Implication: *During periods of high foreseen growth, managers who seek to increase the market valuation of their firm will tend to divest segments (through carveout, spinoff, or sale) whose growth rate differs from the average growth rate of the firm.*

Thus, firms will tend to divest either very slow growth or very high growth divisions.

In contrast with our constant growth assumption, in general segments with unusually high growth rates will tend to revert to a central mean. Such reversion will tend to be more rapid at times when the economy or relevant industries are entering a sustained phase of lower earnings growth. Intuitively, in these circumstances we would expect the relative valuations derived here to be reversed. Individual extrapolation of each segment would place higher weight on recently-growing segments, which on average will grow much less rapidly in the future. This implies *lower* future earnings growth than extrapolation of aggregate earnings.

Thus, empirical testing of the segment reporting model requires estimation of start and end dates for phases of high foreseen growth in the economy as a whole, or the set of industries in which the firm has segments. Such dates could be estimated, for example, using long-term real interest rates, macroeconomic forecasts, or stock index prices.

An appealing alternative explanation for the empirical findings is that diversification makes monitoring harder (see, e.g., Lang and Stulz (1994)). Perhaps more important than the specific predictions of this application is the illustration of a means of analyzing how aggregation affects investor attention. One interesting direction for future work is to analyze how aggregation may cause investors to misattribute shocks between more- versus less-persistent items or segments. Firms may have a strategic incentive to

disaggregate in its reports if it has recently performed well on highly persistent items or segments, and relatively poorly on more transient items or segments. In the opposite case where much of the firm's good performance derives from transient items, the firm may choose to aggregate. This suggests that firms that choose to aggregate will tend to be overvalued, and will tend to have stronger performance in their less persistent segments than in their more persistent ones.

7 Can Limited Attention Affect Prices?

Despite the evidence of limited attention effects described in Section 2, on conceptual grounds some researchers have strong prior beliefs that imperfect rationality cannot affect securities prices. In order to address these priors, we now discuss why limited attention can matter.

A literature in behavioral finance and accounting has argued that arbitrage by sophisticated investors (including institutional investors) is limited, so that investor naivete can influence prices; see, e.g., Shleifer and Vishny (1997), Hirshleifer (2001), and Lee (2001).¹⁶ Several theoretical papers have found that individuals who irrationally underestimate risk or trade too aggressively can on average earn higher expected profits and/or higher expected utility than fully rational traders.¹⁷

Most of the analyses of survival involve investors who simply misinterpret newly arrived signals, rather than ignoring a strategic feature of the economic environment.

¹⁶It is often suggested that the expertise of analysts, hedge funds or investment banks will improve arbitrage enough to eliminate any significant mispricing. However, advisors and intermediaries have incentives to cater to or exploit the irrationalities of potential clients. Thus, intermediaries will only arbitrage away mispricing to the extent that clients who are naive in their own trading become smart when they choose intermediaries.

¹⁷DeLong, Shleifer, Summers, and Waldmann (1991) find that investors who underestimate risk hold riskier securities, thereby earning higher risk premia. Kyle and Wang (1997), Fischer and Verrecchia (1999), and Verrecchia (2001) find that in imperfectly competitive securities markets, irrationally aggressive trading by informed traders can intimidate rational informed traders, thereby allowing overconfident or aggressive-heuristic traders to earn higher expected utility and profits. However, Verrecchia (2001) finds that when survival depends on the level of expected utility achieved, in an imperfectly competitive securities market, if the market is Bayesian *on average*, then heuristic traders must earn lower expected utility than rational traders. On the other hand, Hirshleifer and Luo (2001) find that even in a competitive securities market, overconfident informed investors can earn higher expected profits than rational informed investors by exploiting superior information more aggressively.

The interpretation of these findings depends on whether long-run survival is based upon achieving high expected utility or high profits, a topic of debate in the literature. For analysis based upon and discussion of the differing criteria for survivability, see Blume and Easley (1990), DeLong, Shleifer, Summers, and Waldmann (1991), Palomino (1996) and Hirshleifer and Luo (2001) .

Unlike these models, in our paper no investors have superior private information. However, the broad intuition of these studies suggests that limited attention could promote survival (or at least high profitability) if it can promote aggressive trading and high risk bearing. Overconfidence may often be a source of limited attention. Investors who overestimate their understanding of the economic environment may tend to neglect details and engage in shoddy analysis. To the extent that attentional failures are associated with overconfidence, limited attention may be correlated with aggressive trading and profitability.

Nevertheless, we do *not* want to rest our argument for modelling limited attention on the questionable claim that individuals who are attending poorly tend to earn more. Even if individuals with superior attention on average earn more, perfect attention cannot dominate markets, because even the smartest individuals have limited time and attention. As discussed in Section 3, attending carefully to one arena must have an opportunity cost in another arena. There is no presumption that those who happen to allocate more attention to one particular arena are more survivable in the long run.

It could be argued that wealth will tend flow into the hands of attentional superstars, leading to highly efficient prices. However, this process is likely to be slow and noisy, as the unpredictable component of asset returns volatility is large. Furthermore, wealth is reshuffled in the process of generational succession, and by the regression phenomenon much of the resources accumulated by sophisticated investors flows to less attentive heirs. Furthermore, in the process of getting rich, individuals may become less rational. This can occur through aging, or as a result of psychological biases in the learning process. In sum, attentional mispricing effects are not ruled out on prior conceptual grounds.

8 Relation to Research in Behavioral Finance

Economists such as Adam Smith, Irving Fisher and John Maynard Keynes argued that imperfect rationality affects investment decisions and market outcomes. Simon (1955) emphasized the importance of limits to processing power for economic choices. Behavioral financial economists have long contended that capital market evidence is consistent with imperfectly rational influences on trading, market prices, and the market reaction to new information (see, e.g., DeBondt and Thaler (1995); Fama (1998) provides a contrary perspective). In particular, Daniel, Hirshleifer, and Teoh (2002) have argued that limited attention helps explain important aspects of the evidence. Furthermore, Shiller (2000) has argued that a shift in investor attention arising in part from increased avail-

ability of the stock market in the news media and in public discourse caused the U.S. stock market to become drastically overpriced in the late 1990's.

Recent theoretical research in finance has offered alternative, psychology-based approaches to the modelling of price-setting. Since these approaches differ from the dominant analytical paradigm in financial accounting, the implications for accounting issues are potentially wide-ranging. We describe a subset of models briefly; the survey of Hirshleifer (2001) provides broader coverage. Only a subset of recent psychology-based finance models explicitly consider accounting information, and even those that do so include only a general accounting signal called "earnings." The current paper makes a start at equilibrium analysis of price setting when imperfectly rational investors observe a richer set of financial reporting and disclosure information. But clearly much more remains to be done.

Early theoretical work in behavioral finance used the modelling simplification of mechanistic noise traders to derive implications about excess volatility in security returns, return autocorrelations, and the pricing of closed-end mutual funds (Cutler, Poterba, and Summers (1990), DeLong et al (1990a, 1990b), Frankel and Froot (1990), and Campbell and Kyle (1993)).

A criticism levelled against the noise trader approach is that any pattern of stock return behavior can potentially be explained by an appropriate exogenous assumption about the trading behavior of some set of investors. Indeed, it has been argued that behavioral approaches in general are too protean. In this regard, we agree with the comment of Verrecchia (2001) that "The major difficulty with substituting some heuristic use of information for Bayes rule is that potentially it explains everything, which, in turn, suggests that it explains nothing." However, as emphasized by DeBondt and Thaler (1995), psychology-based models are (or should be) subject to discipline as well: the assumptions about investor biases should be consistent with evidence about how people actually do behave.¹⁸ In this sense psychology-based models can be more disciplined than fully rational ones.

More recent work has endogenized the decisions of irrational traders, and has attempted to ground assumptions of investor behavior upon a psychological foundation. One set of recent analytical papers has examined the implications of investor overconfidence for such issues as the determinants of trading volume and excess volatility

¹⁸Thus, it is unacceptable in psychological modelling to attribute each capital market pattern to a different made-to-order psychological bias. A more attractive procedure is to identify important psychological regularities and then deduce their implications for a wide range of capital market phenomena.

(Odean (1998)), short-run stock return momentum versus long-run reversal, the tendency for mean long-run abnormal returns subsequent to discretionary corporate events to have the same sign as the average event-date stock price reaction, and the tendency for earnings surprises to predict subsequent abnormal returns (Daniel, Hirshleifer and Subrahmanyam (1998, 2001)). Some work in this genre has assumed that the degree of investor confidence is static, and other work has allowed for biased self-attribution in the learning process (Daniel, Hirshleifer, and Subrahmanyam (1998) and Gervais and Odean (2001)), a well-documented bias in which individuals attribute successes to their own qualities and failures to chance, increasing overconfidence.

A model of asset pricing analogous to the Capital Asset Pricing Model can be developed when some or all investors are overconfident about the precision of their private information signals (see Daniel, Hirshleifer, and Subrahmanyam (2001)). As a result, a security's expected return is determined by both its risk and by its current level of mispricing. This model has implications for the relative ability of firm size, book/market ratios and other fundamental-adjusted price variables to predict the cross-section of returns in competition with risk measures such as beta, and for the explanatory power of the empirical 3-factor regression model of Fama and French (1996).

The theoretical finance literature on overconfidence does not consider limited attention. However, from a psychological perspective overconfidence may influence the degree of attention devoted to investment decisions. The overconfidence induced by investment success could cause individuals to devote less effort toward, or to be less receptive to useful facts, information, or methods of analysis in subsequent decisions. The finding of Arkes, Dawes, and Christensen (1986) that experts made less use of useful decision-making tools than non-experts is consistent with this possibility.

Another direction for explaining return autocorrelation patterns has been to combine conservatism (Edwards (1968)), a tendency for individuals under certain circumstances to underreact to new information signals, with representativeness (see, e.g., Tversky and Kahneman (1974)), a tendency for individuals to judge probabilities based on pattern similarity rather than using Bayes rule. In Barberis, Shleifer, and Vishny (1998), owing to conservatism investors underreact to a single earnings surprise, but owing to representativeness overreact to sequences of similar surprises. Although their model does not explicitly consider limited attention, the use of the representativeness heuristic to place earnings patterns into categories simplistically (e.g., overextrapolation of trends) instead of performing a careful Bayesian analysis is probably an indirect consequence of limited attention/processing power. More generally, representativeness could lead

investors to jump too readily to conclusions as they try to detect patterns in financial ratios indicative of the firm's financial condition.

Another approach to studying stock return momentum and reversal has focused on investors who use different subsets of the information available to them. In Hong and Stein (1999), stock return momentum and reversal results in a setting in which newswatchers condition on information signals but not on market prices, whereas trend chasers condition only on a subset of past prices. Limited attention may offer a possible motivation for their approach.

Other authors have applied loss aversion (as described, e.g., by Kahneman, Knetsch, and Thaler (1991)) to explain anomalous stock return behavior. Loss aversion, a component of prospect theory (Kahneman and Tversky (1979)) is the experimental regularity that individuals display substantial aversion to even very small gambles that can have either positive or negative outcomes relative to a salient reference point. This reference point can change depending on the phrasing of the decision problem and over time as the individual faces different decision problems. Such reference-based optimization may be a second-best solution when attention and processing power are limited. Recent work has explored the ability of loss aversion to explain both the equity premium puzzle (Benartzi and Thaler (1995), Barberis, Huang, and Santos (2001)) and the cross-section of stock returns (Barberis and Huang (2001)).

Based upon a survey of empirical evidence in accounting, finance and economics, Daniel, Hirshleifer, and Teoh (2002) argue that firms exploit the limited attention of investors in a variety of ways, by: issuing overvalued equity shares and repurchasing undervalued shares, managing earnings upward prior to the issuance of new equity, guiding analysts in their earnings forecasts, campaigning politically to influence accounting rules, and other means. They argue that in consequence limited attention should be considered in setting accounting and regulatory policy. The current paper provides explicit analysis and derives empirical implications related to some of the positive issues raised intuitively by Daniel, Hirshleifer, and Teoh (2002), as well as other issues.

9 Conclusion

This paper has examined the consequences of limited attention for disclosure, financial reporting policy and market trading. Our approach addresses the issue of why practitioners care about the choice between recognition versus disclosure, and between informationally equivalent forms of disclosure. Owing to limited attention, such choices

can affect investor perceptions and market price. In our approach, investors sometimes neglect relevant aspects of the economic environments they face, such as strategic incentives of firms to manipulate investor perceptions. To show the range of applicability of this approach, we analyze the relation of limited attention to *pro forma* disclosure of non-GAAP earnings measures, the effects of expensing employee stock option compensation when granted, and to aggregated versus segment reporting in diversified firms. The analysis helps explain some puzzling stylized facts, and offers several further untested empirical implications.

As an early effort at modeling limited attention in accounting, the analysis is necessarily simplified in many ways. Several limitations of our analysis stand out. First, this paper focuses on the capital market reporting function of financial statements and disclosures, rather than such issues as optimal contracting, performance measurement, taxes, and political constraints (see, e.g., Watts and Zimmerman (1986)), Lambert (2001)). These considerations may affect the conclusions of the analysis. At the same time, incorporating limited attention and processing power explicitly in our models is likely to enrich our understanding of these issues. Such cognitive limitations may help endogenize the common assumption that certain public information signals are non-contractible; that so-called ‘rationally ignorant’ voters allow political outcomes to be swayed by concentrated interest groups; and that the political process often fixates unduly upon salient items (such as large losses on derivative positions as opposed to the gains being hedged).

Second, limits to attention are exogenous, and we do not explicitly analyze how investors allocate attention. Third, our focus is not primarily on earnings management (though the actions we consider may affect reported earnings), but on choices between seemingly equivalent presentations of information, and on the substantive effects of these choices on investors. Fourth, we consider limited attention at a snapshot in time. Eventually, investors should learn at least to some extent from past market errors (such as undervaluing executive option liabilities). Thus, the effects we describe are likely to be strongest at times when fundamentals, reporting behavior, or accounting rules have recently shifted, or when a new crop of investors has recently arrived. Fifth, it would be premature to draw direct policy implications from our approach. Our approach broadly suggests that concerns by regulators about exploitation by firms of investor inattention merit careful consideration. Our analysis can also serve the modest role of suggesting considerations (such as the possible relevance of earnings persistence for option expensing rules) which might not otherwise come to mind.

We close by suggesting several further directions for possible application of a limited

attention approach to reporting and disclosure issues.

- **Earnings management.** Limited attention provides a motivation for functional fixation on the part of investors, and may help explain why earnings management can affect investor perceptions even though the accruals used to manage earnings are publicly visible. It may further explain the correlation of accruals with subsequent abnormal stock returns (see, e.g., Sloan (1996), Teoh, Welch, and Wong (1998a), Xie (2001)). We are currently exploring this issue.
- **Off balance sheet liabilities.** Limited attention may help explain why investors are insufficiently skeptical of firms that are positioned to conceal liabilities, such as off-balance sheet contractual provisions.
- **Hedge accounting and fair value accounting.** Limited attention suggests that firms that hedge may be viewed by investors as more risky than those that do not if hedge profits are marked-to-market whereas the long-term business risk the firm is hedging is not marked to market.
- **Conservatism and undervaluation.** The principle of accounting conservatism, the history-based the history-based nature of accounting numbers, and the emphasis of accounting on objectivity and verifiability tend to delay the incorporation of value-relevant information in accounting figures. To the extent that firms are typically profitable, limited attention would seem to imply a broad (though not uniform) tendency toward equity undervaluation and high mean equity returns, which is broadly consistent with the equity premium puzzle of Mehra and Prescott (1985). It would be interesting to explore the relation of accounting conservatism across countries, and the movement to fair value accounting over time, to national mean equity premia.

Finally, limited attention can help explain, without appealing to political or contracting constraints certain peculiarities in the structure of accounting rules. In this age of information technology, requiring full reporting of all transactions is less costly than in the past. Actual accounting reports differ from this benchmark in ways that, from a pure reporting perspective, are either irrelevant or deleterious. For example, accounting rules permit *aggregation*, which throws away information.

A limited attention approach suggests that even from a pure reporting perspective, aggregation can make sense, because investors may have trouble processing disaggregated

information. Similarly, redundancy can be helpful when different presentations ease the processing of that information for different uses. An interesting further direction for research will be to explore whether limited attention helps explain in greater detail the structure of financial reporting and regulation.

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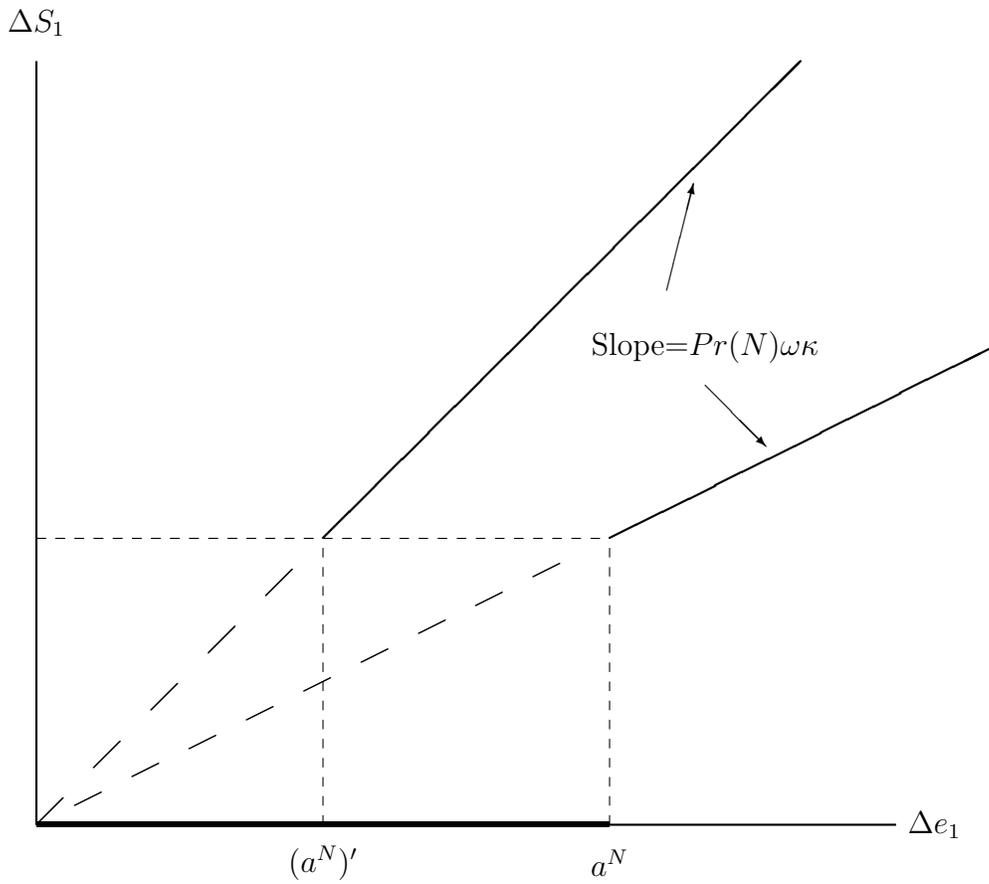


Figure 1:

Misvaluation as a function of excess *pro forma* earnings. Effect of increase in κ , $Pr(N)$, or ω .