Non-financial information and technical disclosure in analysts' forecasts for the microprocessor industry

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Abstract

This paper investigates the role of non-financial information and technical disclosure in the production of analyst earnings-forecasts, and their association with stock price changes. We focus in particular on the microprocessor industry, and its leading company (Intel Corporation), in the 2000-07 period. Traditionally, the substantial theoretical and empirical literature on analysts' forecasts has focused primarily on the value relevance of financial information and financial disclosure in the production of analyst forecasts (Kothari, 2001). The value of non-financial information in predicting future financial performance has also been extensively documented (Amir and Lev, 1996; Chandra et al., 1999; Miller and O'Leary, 2000, 2005; Rajgopal et al., 2003; Gu and Wu, 2005). We test whether other sources of technical information and related disclosure events are relevant in explaining analyst earnings-forecast revisions, and their impact on stock price changes. Our results confirm that non-financial information, when considered jointly with financial variables that indicate the fundamental value of the company, explain a large part of forecast revisions, which in turn show a significant association with future stock price changes. Moreover the magnitude of earnings-

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forecast revisions preceded by financial disclosure is the same as the magnitude of revisions preceded by other corporate disclosure events. The correlation between analyst earnings-forecast revisions and contemporaneous stock price changes is the same when forecast revisions are preceded by financial disclosure and when forecasts are not preceded by any financial disclosure. With respect to the specific information content of technical disclosure, in most years the contemporaneous change in stock price associated with analyst revisions is negative (and substantially large) when forecast revisions are preceded by technical disclosure, whereas it is either positive or null when forecasts are preceded by financial disclosure. Analysts' earnings forecasts are especially informative when preceded by technical disclosure, which induces reduction in market prices; financial disclosure alone does not always induce changes in market prices (with the exception of years 2005 and 2006). We conclude that non-financial information and technical disclosures are relevant in explaining analyst earnings-forecast revisions, and their impact on stock price changes in the case of the microprocessor industry. We suggest that this may have implications for other knowledge-intensive industries.

1. Introduction[*]

This paper investigates the role of non-financial information and technical disclosure in the production of analysts' forecast revisions, and the relationship between analysts' forecasts and market prices. We take as our example a particular knowledge-intensive industry, namely microprocessors. Traditionally, the substantial theoretical and empirical literature on analysts' forecasts has focused primarily on the value relevance of financial information and financial disclosure in the production of analysts' forecasts (see for a review of the literature Kothari, 2001). The value of non-financial information in predicting future financial (i.e. accounting or stock price) performance has also been extensively documented (see among the others: Amir and Lev, 1996; Ittner and Larcker, 1998; Banker and Mashruwala, 2007; Xu et al., 2007; Tellis and Johnson, 2007). However, very few studies examine the role of non-financial information in the context of analysts' forecasts (Chandra et al., 1999; Rajgopal et al., 2003; Gu and Wang, 2005).

The relative lack of attention to the relevance of non-traditional types of information and disclosure in the literature on analysts' forecasts provides the major motivation for this study. Drawing on fieldwork conducted by Miller and O'Leary (2000, 2005, 2007), we predict that other sources of information and other disclosure events are relevant in explaining analyst earnings-forecast revisions, and their impact on stock price changes. Consistent with the agenda proposed in Miller (2008), we aim to understand which information flows and which disclosure events analysts use to produce their forecasts of future stock prices. We seek also to understand the association of earnings-forecast revisions with stock price changes. Specifically, this paper aims to answer the following questions: are analysts' forecasts efficient in using all the information available at the time of their forecasts; is non-financial information as useful as financial information in the production of analysts' forecasts; is technical disclosure as relevant as financial disclosure in the production of analysts' forecasts;

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and does the release of forecasts based on technical disclosure provide new or incremental information to the stock market?

The main contribution of this paper is to extend the existing literature on disclosure by focusing, for the first time, on the properties of individual analysts' forecasts with respect to non-financial information, and by using event studies to identify the role of technical disclosure in inducing revisions in analysts' forecasts and consequently changes in market prices. In addition to the research implications of our findings, we suggest that significant policy implications follow. Regulatory authorities and listed companies should, we argue, attend to the role of non-financial information and technical disclosure in increasing the informational efficiency of secondary markets, and thus in enabling investors and investment banks to make better investment decisions. To the extent that our predictions concerning non-financial information and technical disclosure are supported, financial authorities (and companies) should seek ways to integrate such information and disclosure events in conventional corporate reporting, so as to improve market efficiency.

The motivation for this study comes from fieldwork on information flows and disclosure practices for the microprocessor industry (Miller and O'Leary, 2000, 2005)[1]. On the basis of interviews with analysts specialising in the microprocessor industry, and in relation to Intel Corporation in particular, the authors argue that analysts base their evaluations of long-term value creation capacity on a broad range of information. Of primary importance, they suggest, is non-financial information. While the significance of non-financial information in the micro-processor industry is perhaps unusually high, they suggest that this phenomenon is likely to be found in all knowledge-intensive industries characterised by short product and process life-cycles. Their argument is that since complex and recurrent knowledge-based innovation is routine in such industries, the import of innovations and the impounding of their effects in stock prices is likely to depend to a significant extent on the circulation and interpretation of non-financial data.

They argue also for a definition of disclosure that is broader than traditionally used. They suggest that disclosure should not be understood as limited to public and formally sanctioned information released by the company. Instead, the disclosure

[1] Miller and O'Leary (2000) is part of a series of PricewaterhouseCoopers' Papers in which the demands for companies to make more information available to the market on a voluntary basis is explored.

process within the ecosystem should be regarded as a continuum from the 'formal' to the 'informal'. By 'formal disclosure' they mean, for instance, data disclosed by the firm under Securities and Exchange Commission's regulation through mechanisms such as annual and quarterly financial reports, interim announcements, analysts meetings and conference calls. By 'informal disclosure', they mean disclosure that includes a range of mechanisms and sources such as: data disclosed to technical analysts under Non-Disclosure Agreement (NDA), data which remains confidential, but which in turn allows a more informed evaluation of other pieces of information; products and technology data disclosed to Original Equipment Manufacturers (OEMs), which subsequently become publicly available; information that circulates between the firm, buy-side and sell-side analysts, and members of technical analyst community through personal contact; and technical disclosures concerning, for instance, product and technology roadmaps, as well as product mix and product cost information (Miller and O'Leary, 2000, p.3). It is important to make clear that this proposed distinction between formal and informal disclosure is distinct from the voluntary disclosure literature.

The aim here is to explore this issue from a quantitative perspective. Our current hypothesis (about the impact of technical disclosure and non-financial information) focuses on one aspect of the phenomenon that Miller and O'Leary term 'informal disclosure'. We consider technical disclosures as a sort of shorthand for the information flows across a network of firms that is a pre-condition for certain types of industries. The economic intuition would be that it is too costly to restrict its flow, too costly to 'own' completely (every firm would have to own its own university and post-doctoral research community), and anyhow competitive advantage derives (in some industries) from the application of technical knowledge rather than from its ownership.

The paper is organised as follows. Section 2 presents the motivations of the revision of the literature on analyst forecast. Following on, section 3 considers the methodological issues concerning the measurement of analyst informativeness and earnings-forecast revisions, and the impact of non-financial information and technical disclosure on earnings-forecast revisions. It also illustrates the sample and data. Finally section 4 describes the empirical results, and section 5 concludes.

2. *Literature and motivations*

Analysts' forecasts of future stock prices are of interest for several reasons. Analysts' forecasts can affect the degree of informational efficiency of secondary markets (Hong et al., 2000). Moreover, brokerage firms and investment banks spend hundreds of millions of dollars annually producing analysts' recommendations, which in turn exert a strong impact on the performance of the financial industry (Dugar and Nathan, 1995; Lin and McNichols, 1998; Cowen et al., 2006). Finally, investors pore over analysts' forecasts to obtain insights about the future prospects of a stock, with the result that analysts' recommendations tend to exercise a strong impact on investment decisions (Givoly and Lakonishok, 1984; Francis and Soffer, 1997; Chen et al., 2005).

Unlike most prior researches, we focus on individual analysts[2], to take into account the diversity of individual analysts' forecasts, and the interaction between analysts' forecasts and disclosure events. The review of the extensive literature on analysts' forecasts (see Kothari, 2001) reveals that few papers (Givoly and Lakonishok, 1979; Lys and Sohn, 1990; Dugar and Nathan, 1995; Lang and Lundholm, 1996; Irvine, 2000; Hong et al., 2000; Frankel et al., 2006; Cowen et al., 2006) focus on the properties of individual analyst's forecasts. Specifically, these researches investigate whether analysts' forecasts are efficient in using all the information reflected in security prices prior to the time of their forecast releases (Lys and Sohn, 1990), whether analyst reports impact on market prices in the test of the so-called analyst informativeness (Givoly and Lakonishok, 1979; Lys and Sohn, 1990; Frankel et al., 2006), the determinants of analyst informativeness (Frankel et al., 2006), the relationship between analyst following and analyst informativeness (Lang and Lundholm, 1996; Hong et al., 2000), and whether there are systematic analyst/firm factors that explain optimism (Dugar and Nathan, 1995; Irvine, 2000; Cowen et al., 2006). Specifically, on the information content of individual analysts' forecast, Lys and Sohn (1990), by testing the stock price reaction to the report and the surprise in an analyst forecast, conclude that analyst forecasts contain some but not all of the information that was reflected in security prices prior to the forecast release date. Frankel et al. (2006), by estimating the

[2] Like most of the researches on analysts' forecasts, however, we focus on sell-side analysts, typically considered to be the primary producers of earnings' forecasts.

absolute stock price reaction on the dates that analysts release forecast revisions, find that analyst research, on average, is significantly informative for almost 24,000 firm-year observations from 1995 to 2002.

Although the vast majority of studies investigates the properties of consensus analysts' forecasts (specifically the accuracy of analysts' forecasts and their association with stock prices)[3], very few of them investigate the usefulness of non-financial information (for instance, order backlog and diversity/innovation in technology) for consensus forecasts. Chandra et al. (1999) investigate analyst use of forward-looking, industry-wide disclosures of a major indicator (the book-to-bill ratio) in forecasting sales for the semiconductor industry. Although their results do not show a significant association between analyst sales forecast revisions and changes in the book-to-bill ratio, they provide evidence that analysts rely on this indicator to distinguish between permanent and transitory sales trends. Rajgopal et al. (2003) examine whether analysts incorporate the predictive ability of one leading indicator (order backlog) in forecasting future earnings. Their findings suggest that although analysts correctly incorporate backlog information into their forecasts, the market fixates on the order backlog itself without appreciating that forecasts already incorporate this information. Gu and Wang

[3] In the studies on consensus forecasts, the research interest relates to whether analysts incorporate all new earnings information immediately and without bias in their forecasts (Barefield and Comiskey, 1975; Brown et al., 1985; Ali et al., 1992; O'Brien, 1988; Lin and McNichols, 1998; Lim, 2001; Das et al., 1998; Easterwood and Nutt, 1999; Michaely and Womack, 1999; Dechow et al., 1999; Gu and Wu, 2003), and to whether analyst reports determine any price impact (Mendenhall, 1991; Abarbanell, 1991; Francis and Soffer, 1997). As regard to the forecast bias, the above empirical evidence shows that during the 1980s and most of the 1990s, analysts show optimism in interpreting earnings information. Several economic incentives explain this optimism: the relationship between research and investment banking divisions (Lin and McNichols, 1998; Michaely and Womack, 1999; Dechow et al., 1999), the increased access to information from management (Lim, 2001; Das et al., 1998), the earnings skewness (Gu and Wu, 2003). Nevertheless, in recent years, optimism appears to be declining (Brown, 1997, 1998, 2001; Brown et al., 2004). Several hypothesis may explain this decline in optimism: the remarkable regulatory changes that occurred in the U.S. under the "Global Analyst Research Settlement" and the "Regulation Fair Disclosure" (Kadan et al., 2004; Eleswarapu et al., 2004; Bailey et al., 2003; Heflin et al., 2003; Mohanram and Sunders, 2002), the learning process of analysts from evidence of past biases (Clement, 1999; Jacob et al., 1999; Mikhail et al., 1997), the decline in the equity market at the end of the 1990s (especially for technology, media and telecommunication sectors).

(2005) test the relation between analysts' forecasts error and non-financial information (diversity and innovation in technology) and find a positive association.

Surprisingly, however, as far as we are aware, there are no association studies on the impact of non-financial information on individual analysts' forecasts, and on the role of single events of technical disclosure on (either individual or consensus) analysts' forecasts and market prices. Our paper seeks to overcome this deficit, and to complement existing studies of the informativeness of individual analysts' forecasts, by suggesting that non-financial information and technical disclosure is of primary importance in the formation of analysts' forecasts.

First, following Lys and Sohn (1990) and Frankel et al. (2006), we analyse whether analysts' forecasts have an effect on security prices, or rather the extent to which they convey information to capital markets (the so-called information content of analysts' forecasts, also known as analyst informativeness).

Second, we investigate whether individual analysts use both financial and technical information when setting their estimates of future earnings. Specifically, we test the extent to which non-financial information contributes, when combined with financial information, to explaining changes in analyst earnings-forecast. As far as we are aware, although a small number of studies refer to the role of non-financial information in relation to consensus forecast errors (Rajgopal et al., 2003; Gu and Wang, 2005), none investigates the association between non-financial information and individual analysts' forecasts.

Finally, we analyse whether the information content of analyst earnings-revisions depends on whether the revisions are preceded by financial disclosure and/or technical disclosure, and also the impact of each of these forecasts' revisions on stock price changes. Lys and Sohn (1990) indicates that analyst earnings-forecasts are informative, regardless of whether they are preceded by accounting disclosure, but there have been no attempts to consider other types of disclosure. Here lies the main novelty of our paper, as no other studies deal with disclosure and individual analyst forecasts, and no study consider the role of other (than accounting) types of disclosure events.

3. Methodology

We employ a three-step procedure to investigate the relevant issues for this study. First, a variety of methodologies is used to test the information content of analyst earning forecasts, or rather whether analysts are on average informative. Second, a set of regressions is used to test the usefulness of non-financial information versus financial information, by examining their effects on the earnings-forecast revisions. Third, a regression analysis based on different sub-samples is employed to investigate the relevance of technical disclosure in comparison to financial disclosure in the production of analysts' forecasts, and consequently in the changes in stock prices. The reference methodology for the first and third issues is the one used in Lys and Sohn (1990), but extensions have been proposed to distinguish between different types of information/disclosure.

3.1. The Sample

The reference industry is the microprocessor market, and its leading company (Intel Corporation). Intel Corp is the world's largest designer and manufacturer of microprocessors, the logic-devices that are the core of personal, workstations and server computers. It now commands approximately 80% of the world microprocessor market. Therefore the association between the microprocessor industry and Intel Corp seems to be justified. Besides, given the nature of its business, both non-financial information and technical disclosure events are generally available.

The identification of the key features of Intel Corp should enable us to suggest other industries where the formation of analysts' forecasts, and their impact on market prices, follow a similar pattern. On the one hand, the firm operates in a knowledge-intensive industry, where the quantity and quality of non-financial information and the events of technical disclosure are particularly relevant. On the other hand, Intel may be defined as a "process firm", or rather a firm that is located in an information/knowledge process, that guards the process itself, and establishes forms of collaboration and coordination with other entities operating in the same process. This process can be defined as a hybrid organisational form (to adapt the definition in Miller et al., 2008), which shares substantial amounts of information among organisations of various type (e.g. producers of microprocessors, suppliers, consortium, governmental agencies, universities and research centres). Given that the output of the process is a systemic product (namely, the personal computer, which is formed by a variety of components of which the microprocessor is the main one), the producer of microprocessors (Intel) controls not merely the production process, but the information/knowledge process.[4] It follows that non-financial information and technical disclosure represent an essential instrument in the control of the information/knowledge process, and in the indirect control of the production process. In this sense, the disclosures can be seen as an emerging coordination mechanism.

As regard to Intel, individual analyst forecasts and revisions from 2000 to 2007 are used in this paper, based on data gathered from I/B/E/S detail database. In our setting numerous analysts follow Intel and issue earnings forecasts, we have 134 distinct sell-side analysts employed by 83 brokerage and investment firms, which represent both major firms (i.e. Merrill Lynch, Goldman Sachs, J.P. Morgan, Morgan Stanley) and other minor firms. The forecast revisions represent the release of new reports by individual analysts with revisions in quarterly and annual forecasts, totalling 3,837 observations over the sample period.[5] Each observation consists of the identity of the brokerage firm, the identity of the analyst, the forecast release date, the forecast earnings per share, the forecast period interval.

Summary statistics of the analyst forecasts in the sample are provided in Table 1. The number of revisions during each year is on average 480. The year with the highest number of revisions is 2005 (565), while 2007 is the year with the lowest number of revisions (379). The number of analysts issuing at least a revision during a year has been on average 49.6, with a minimum in 2001 (42) and a maximum in 2003 (58).

[4] This process could be described as a form of architectural control (to adapt the definition by Morris and Ferguson, 1993). The production process of personal computers requires the independent production of all its component (microprocessor, monitor, hard disk, etc.) that often is realised by several firms with the support of independent entities. The architecture is the set of rules and standards that enables components to work together. The microprocessor is the main component of the architecture. It follows that changes to the microprocessor require changes to the architecture itself, and consequently to all the other components.

[5] We have not used analyst consensus forecasts because we need to explore the diversity of analyst earnings forecast and the interaction between analyst earnings forecasts and non-financial information and technical disclosure events.

Interesting, during the years 2000-06, both the number of revisions and the number of analysts have been increasing (even if not monotonically). Given that many analysts issue forecasts, multiple analyst reports can be released on a given day, and thus the average number of analyst reports released per report date matters. The average number of different analysts issuing revision on a given date (provided that there is at least one report on that day) is 1.91, with a maximum in 2005 (2.24) and a minimum in 2007 (1.51). Thus for most of the quarters in our sample Intel averaged about two analyst reports on a trading day. The average number of revisions per analyst in each year over the sample period is 9.63, with a maximum in 2005 (10.87) and a minimum in 2007 (7.73).

Intel stock prices and the Nasdaq Composite Index have been obtained from Datastream for each trading day (excluding scheduled market holidays). Also annual and quarterly financial data for Intel (net income, gross margin, and total revenues) have been obtained from Datastream. Financial disclosure events (and their respective dates) are either the preliminary earnings announcements collected from Compustat or the earlier of the SEC receipt dates from 10Ks and annual reports.

The identification of non-financial information and technical disclosure events is complex, and dependent on the types of technical disclosures it is possible to identify empirically (and publicly). The idea is therefore to refer to the sources identified by Miller and O'Leary (2000) in their qualitative study, or rather to the sources used by the very small group of independent technical analysts, separate from the sell-side analysts. Technical analysts "play a pivotal role in the evaluation of products and processes in the industry… and function both as a 'filter' and as a third-party evaluation and validation resource for analysts" (Miller and O'Leary, 2000, p. 2). In this study, technical non-financial data on Intel's products have been obtained by a technical analyst, who produced an In-Stat Report on "Intel Manufacturing Capacity and Die Costs" (McGregor, 2005; 2007), where data on the most relevant features of microprocessors (total chip cost, average die size and average die costs)[6] are provided

[6] Microprocessors are built from silicon wafers, which are thin disks. Each wafer contains many chips of the same type. An individual chip is called a *die*. Since most chips are square or rectangular, they are usually laid out in a grid pattern, and arranged to fit as many as possible on the wafer. Single wafer can

on a quarterly basis from 2000 to 2007. The processor die size directly affects the number of dies that can be made from a single wafer, as well as affecting the yield of good chips from the wafer. This yield, in turn, is a key factor in determining the cost of a processor and how rapidly new generations of processors can be introduced. The total manufacturing cost of a processor is named chip cost, given as the sum of the die cost and the packing cost (a critical cost area for modern processors). Thus, we expect that lower die size, lower die cost, and lower chip cost of Intel's processors lead to a better performance of the company.

Descriptive statistics of the financial and non-financial determinants used are provided in Table 2.

3.2. The information content of analyst earning forecasts

We first investigate the information content of analyst earnings forecast, or rather whether analysts are on average informative. The information content of analyst earnings forecasts is tested by using two different methodologies: a more traditional approach proposed by Lys and Sohn (1990), aiming at measuring the information content of analyst forecasts in the announcement period and in the revision period; and a more recent approach developed by Frankel et al. (2006) based on the construction of an index of analyst informativeness. Finally we investigate the association between the unexpected component of analyst forecasts and market returns.

3.2.1. The information content of analyst earning forecasts in the revision and announcement period

The initial approach here employed to test the information content of analyst earning forecasts is the traditional one proposed by Lys and Sohn (1990), which distinguishes the information content of two periods: the revision and the announcement period. This derives from the fact that the sequence of events related to a forecast announcement can be viewed as composed by two periods. First, the forecast revision period, which starts at the release date of the last forecast (t-τ) and ends one day prior to the release date of the new forecast (t-1). Second, the announcement period, which is

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hold more chips if they are smaller. Because chips are so small, many external factors (i.e. particle of dust or tiny impurities in the silicon) can cause defects of the die.

defined as the two day period centered around the release of the current forecast (from t to t+1)[7].

The change in the value of the current earning forecast (at time t) in comparison to the previous forecast (at time t-τ) is named earnings-forecast revision ($\Delta FEPS_t$)[8]:

$$\Delta FEPS_t = [FEPS_{yt} - FEPS_{y,t-\tau}] \qquad (1)$$

The relation between the earnings-forecast revisions and past security and market returns enables us to investigate whether analysts earnings forecasts reflect information available to investors prior to the forecast release date, and analyst-specific information not known to investors prior to the forecast release date. The first component of the analysts' information set implies a direct correlation between revisions and stock returns in the revision period, while the second component implies a direct correlation between revisions and stock returns in the announcement period (Lys and Sohn, 1990), which can be tested by estimating the following regression with fixed analyst effects:

$$\Delta FEPS_{yt} = \gamma_0 + \gamma_1 R_{yt}^{RP} + \gamma_2 RM_{yt}^{RP} + \gamma_3 R_{yt}^{AP} + \gamma_4 RM_{yt}^{AP} + \varepsilon_{yt} \qquad (3)$$

where for analyst *y*, *t* is the forecast-release date, $\Delta FEPS_{yt}$ is the earnings-per-share forecast revision, R^{RP}_{yt} and RM^{AP}_{yt} are, respectively, the cumulative returns for Intel in the forecast-revision period and forecast-announcement period, and RM^{RP}_{yt} and RM^{AP}_{yt} are, respectively, the cumulative returns on the market portfolio (Nasdaq Composite Index) in the revision and announcement periods. Regressions are estimated with analyst fixed effects to control for any analysts specific feature that affect their revisions[9].

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[7] The analysis was repeated with the announcement period expanded to day –1 and +1 relative to the forecast-release date (as done in Lys and Sohn, 1990), without qualitatively changing our results.

[8] In order to facilitate cross-sectional comparisons of regression coefficient, we also calculate earnings-forecast revision by using the actual earnings per share deflation:

$$\Delta FEPS_t = [FEPS_{yt} - FEPS_{y,t-\tau}] / EPS_{t-\tau} \qquad (2)$$

[9] As an alternative to the regressions with fixed analyst effects, the clustering-by-analyst approach is used (i.e. the standard errors of the coefficient estimates are adjusted for the non-independence of time-series observations). Our results are confirmed when using this alternative clustering by analyst.

According to Lys and Sohn (1990), the coefficients of $R^{AP}{}_{y}$ and $RM^{AP}{}_{y}$ indicate whether analyst earnings forecasts are informative (or rather, whether forecast revisions are correlated with stock returns in the announcement period), while the coefficients of $R^{RP}{}_{y}$ and $RM^{RP}{}_{y}$ indicate whether revisions reflect information that became known to investors in the forecast revision period. If analysts reflect changes in investors' expectations, $\gamma_1 = \gamma_3 > 0$, and $\gamma_2 = \gamma_4 < 0$.

3.2.2. *The index of analyst informativeness*

An alternative approach to test the information content of analyst earning forecast is based on the measurement of an index of "analysts informativeness" (AI), recently calculated by Franckel *et al.* (2006) on the basis of the following steps. First, to sum the absolute returns on all the forecast revision dates for Intel Corp. in a given calendar quarter (year). Second, to divide it by the sum of the absolute returns for all trading days for Intel Corp. for the calendar quarter (year). Finally, to divide this ratio by the number of forecast revision dates in a given calendar quarter (year).[10] In symbols, the measure of the average informativeness of an analyst report date is:

$$AI_t = \frac{\sum_{t=1\ to\ NREV} \left| R_{t,Intel} - R_{t,Nasdaq} \right|}{\sum_{t=1\ to\ NDAYS} \left| R_{t,Intel} - R_{t,Nasdaq} \right|} * \frac{1}{NREVS} \qquad (4)$$

where: $R_{t,Intel}$ is Intel's stock return on day t, $R_{t,Nasdaq}$ is the return on the Nasdaq Composite Index on day t (the benchmark index of the market where Intel Corp. is listed), $t = 1$ *to NREVS* are analyst forecast revision dates for Intel in a given quarter (year), *NREVS* is the number of unique days on which at least one analyst forecast appears on the I/B/E/S detail dataset, whether the analyst forecast can be a revision or a reiteration, *NDAYS* is the number of trading days in a quarter (year).

To infer the analyst informativeness, the value of AI has to be compared with the AI benchmark, the index calculated assuming that no analysts supply any information in any trading day. In this case the absolute return on a forecast revision date should be equal on average to the absolute return on any other trading day. Assuming a given calendar year with on average 250 trading days, each trading day would yield, on average, 1/250th of the sum of the absolute returns and thus AI benchmark would equal 0.004 (see Frankel *et al.*, 2006). Thus for the forecast to be informative AI has to be higher than 0.004.

3.2.3. Unexpected analyst forecasts and analyst informativeness

The information content of analyst earnings forecast can also be tested by analysing the association between the unexpected component of an analyst's forecast and the stock return for the day of the forecast. This test basically reconciles the above mentioned traditional approach by Lys and Sohn (1990) and the above mentioned recent index of analyst informativeness introduced by Frankel et al. (2006). This association measure captures the magnitude of the news content, or rather how much the analyst forecast is a surprise to the market, and how large is the correspondent stock price reaction.

The traditional view of a positive association between the surprise in analyst forecast revisions and stock returns (Lys and Sohn, 1990) is investigated here by testing whether analyst informativeness is increasing in the magnitude of the surprise in the analyst's forecast revision of annual earnings (as done by Frankel *et al.*, 2006). This requires firstly to measure the unexpected component of the forecast of annual earnings by analyst y released at day t on month m (UAF_{ytm}) for each one-year ahead forecast revision:

$$UAF_{ytm} = \frac{\left| FEPS_{ytm} - ConFEPS_{m-1} \right|}{P_{m-1}} \tag{5}$$

where $FEPS_{ytm}$ is the one-year ahead earnings-per-share forecast made by analyst y for Intel realised on day t on month m, Cons $FEPS_{m-1}$ the consensus (mean) forecast reported on I/B/E/S in month m-1, and P_{m-1} the price for Intel for the previous month.

Once the UAF has been estimated, we rank the absolute values of the surprise in analyst forecasts, and allocate them to three different portfolios (note that when more than one analyst has issued a forecast revision on a given date, the surprise is calculated

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[10] When multiple forecast revisions are issued on the same trading day, the AI measure treats the collection of reports as one report (as done in Frankel *et al.*, 2006). Moreover, the event window for each analyst report date is a single day (again analogously to Frankel *et al.*, 2006).

as the average absolute value of the surprises in analysts' forecasts). We then calculate analyst informativeness within each UAF portfolio. Finally, we examine the association between UAF and AI, and perform the paired-portfolios T-test.[11]

3.3. *Financial and non-financial information as determinants of analyst earnings-forecast revisions*

In order to test the relevance of non-financial versus financial information in the production of analysts' forecasts, we need to analyse the information content of analyst forecasts. The aim is to test whether, on average, individual analyst earnings forecasts contain not only information that was reflected in security prices but also non-financial information prior to the forecast release date.

The investigation of the relevance of non-financial vs. financial information is first based on the earnings-forecast revisions, previously measured accordingly to Lys and Sohn (1990). The relationship between analyst earnings-forecast revisions and financial information represents the benchmark time-series model (named Model A):

$$\Delta FEPS_t = \alpha_0 + \alpha_1 \Delta \ln(NI_t) + \varepsilon_t \qquad (7)$$

where: $\Delta FEPS_t$ = change of the earnings-forecast revision in each quarter t;

$\Delta \ln(NI_t)$ = change in the natural logarithm of net income of Intel for each quarter t.

To control for the use by financial analyst of a wider set of fundamental accounting indicators in their forecasts (as suggested by Lev and Thiagarajan, 1993), we then include two fundamental signals in addition to the change in net income (named Model B). The two fundamental accounting variables used here are gross margin and net revenues, given that they represent the two main items of the income statement of any company in the microprocessor industry:

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[11] A final alternative methodology used to investigate the information content of analyst earnings forecasts is based on the estimation of the following AI-UAF regression, which captures whether on average individual analyst forecasts contain information that was reflected in security prices prior to the forecast-release date:

$$AI_{yt} = \alpha_0 + \alpha_1 UAF_{ytm} + \varepsilon_t \qquad (6)$$

where UAF_{ytm} is measured as in equation (5) here above.

$$\Delta FEPS_t = \alpha_0 + \alpha_1 \Delta \ln(NI_t) + \alpha_2 \Delta \ln(GM_t) + \alpha_3 \Delta \ln(REV_t) + \varepsilon_t \quad (8)$$

where: $\Delta\ln(GM_t)$ = change of the natural logarithm of the gross margin for Intel;

$\Delta\ln(REV_t)$ = change of the natural logarithm of the net revenues for Intel.

To control for the role of non-financial information in determining analyst informativess, we include the non-financial information for each quarter t, as an additional independent variable[12], together with accounting net income (named Model C):

$$\Delta FEPS_t = \alpha_0 + \alpha_1 \Delta \ln(NI_t) + \alpha_2 \Delta \ln(Chip\cos t_t) + \varepsilon_t \quad (9)$$

$$\Delta FEPS_t = \alpha_0 + \alpha_1 \Delta \ln(NI_t) + \alpha_2 \Delta \ln(Die\,size_t) + \varepsilon_t \quad (10)$$

$$\Delta FEPS_t = \alpha_0 + \alpha_1 \Delta \ln(NI_t) + \alpha_2 \Delta \ln(Die\cos t_t) + \varepsilon_t \quad (11)$$

where: Chip cost = total chip cost for Intel’s microprocessors in each quarter t;

Die size = die size for Intel’s microprocessors in each quarter t.

Die cost = estimated cost for each Intel’s die.

Finally, to control for the role of non-financial information in determining analyst informativess in addition to fundamental information, we include several non-financial information for each quarter t, as an additional independent variable, together with fundamental accounting data (gross margin and net revenues), named Model D:

$$\Delta FEPS_t = \alpha_0 + \alpha_1 \Delta \ln(NI_t) + \alpha_2 \Delta \ln(GM_t) + \alpha_3 \Delta \ln(REV_t) + \alpha_4 \Delta \ln(Chip\cos t_t) + \varepsilon_t \quad (12)$$

$$\Delta FEPS_t = \alpha_0 + \alpha_1 \Delta \ln(NI_t) + \alpha_2 \Delta \ln(GM_t) + \alpha_3 \Delta \ln(REV_t) + \alpha_4 \Delta \ln(Die\,size_t) + \varepsilon_t \quad (13)$$

$$\Delta FEPS_t = \alpha_0 + \alpha_1 \Delta \ln(NI_t) + \alpha_2 \Delta \ln(GM_t) + \alpha_3 \Delta \ln(REV_t) + \alpha_4 \Delta \ln(Die\,s\cos t_t) + \varepsilon_t \quad (14)$$

3.4. Technical vs. financial disclosure and earnings-forecast revisions

Prior research indicates that accounting disclosure is an important source of information to analyst forecasts, and forecasts provide additional information that investors did not already infer from the preceding accounting disclosure (Lys and Sohn, 1990). Little is known however as regard to the role of technical disclosure. To test the relevance of financial versus technical disclosure, we investigate how the information content of financial disclosure compares to technical disclosure that result in analyst

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[12] The non-financial variables are included one at a time because they are related one to the other, and collinearity problems would affect a multivariate regression.

earnings-forecast revisions, and whether the information conveyed by forecasts depends upon whether forecasts are preceded by financial and/or technical disclosure events.

To measure the magnitude of earnings-forecast revisions preceded by either financial or technical disclosure, we follow two steps. First, following Lys and Sohn (1990), we investigate whether the information content of analyst earnings forecasts that are preceded by financial disclosures differ from that of forecasts where no financial disclosure occurred between two consecutive forecast-release dates. Second, advancing Lys and Sohn (1990), we investigate whether the information content of analyst earnings forecasts that are preceded by technical disclosures differ from that of forecasts where financial disclosure occurred before a forecast-release dates[13]. This enables us to compare the magnitude of forecast revisions preceded by financial disclosure with that of revisions preceded by technical disclosure.

To identify the data set of the disclosure events, two of the researchers independently identified a full set of press releases for the relevant period (July 2004-December 2007). The three researchers then reviewed together all events, and classified them according to high/low impact, and according to impact on the firm or on the industry as a whole. For those events that did not fit into this binary classification, a third residual category was created so as not to loose any data points. The definition of high impact events was in terms of their anticipated effect on issues such as overall market creation, breaktrough technology innovation affecting production processes, and technology innovation affecting product design and therefore capability for the industry as a whole.

Furthermore, to investigate the ability of disclosure events to provide additional information to investors, we compare forecasts revisions where at least one financial disclosure event occurred in the forecast revision period and forecasts where no corporate financial disclosures were issued in the forecast revision period. Following Lys and Sohn (1990), this can be tested as:

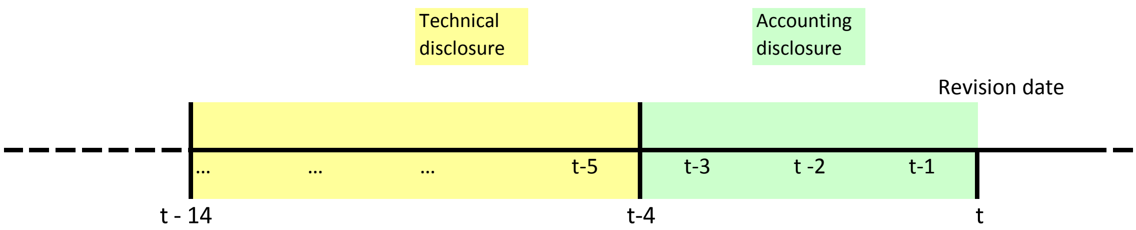
$$\Delta FEPS_{yt} = \gamma_0 + \gamma_t R_{yt}^{RP} + \gamma_2 RM_{yt}^{RP} + \sum_{k=1}^{2} \gamma_{3k} D_{kyt} R_{yt}^{AP} + \gamma_4 RM_{yt}^{AP} + \varepsilon_{yt} \qquad (15)$$

[13] Differently from Lys and Sohn (1990), the reference is not any more to the entire forecast-revision period but to the last two weeks to avoid the overlapping of technical and financial disclosure in the same period that otherwise would bias the results.

where D_{1yt} = 1 for forecast revisions with at least one corporate accounting disclosures in the forecast-revision period, zero otherwise; D_{2yt} = 1 for forecast revisions with no accounting disclosure events in the forecast-revision period, zero otherwise.

Finally, we compare forecasts revisions where at least one financial or one technical disclosure event occurred in the forecast revision period. To avoid to confuse the two types of disclosure, as shown in Figure 1, we assume to have financial disclosure if at least one corporate accounting disclosures took place in the last four days of the forecast-revision period, and technical disclosure if any technical events in between the period commencing five days prior to the revision and ending two weeks prior to the revision date. The length of each sub-period is based on the statistics on the number of days needed to incorporate technical and financial disclosure.

Figure 1: Sequence of events relative to financial and technical disclosure



Specifically, to investigate the relevance of technical disclosure in providing additional information to investors in comparison to accounting disclosure, advancing Lys and Sohn (1990), we estimate:

$$\Delta FEPS_{yt} = \gamma_0 + \gamma_t R_{yt}^{RP} + \gamma_2 RM_{yt}^{RP} + \sum_{k=1}^{3} \gamma_{3k} D_{kyt} R_{yt}^{AP} + \gamma_4 RM_{yt}^{AP} + \varepsilon_{yt} \qquad (16)$$

where D_{1yt} = 1 for forecast revisions with at least one corporate accounting disclosures in the last four days of the forecast-revision period, zero otherwise; D_{2yt} = 1 for forecast revisions with technical disclosure events in between the period commencing five days prior to the revision and ending two weeks prior to the revision, zero otherwise; D_{3yt} = 1 for forecast revisions with neither technical disclosure nor accounting disclosure, zero otherwise.

4. *Empirical results*

To test the information content of analyst forecasts we first estimate earnings forecast revisions. Table 3 shows summary statistics for analyst earnings-forecast revisions. On average over the years 2000-2007, analysts revised their annual and quarterly earnings forecasts upwards with an average ΔFEPS of 0.00287. In two years only (2001 and 2006) the average ΔFEPS has been negative (in Lys and Sohn, 1990, the sign of the change was negative on average for the 1980-86 period). Table 4 indicates the analyst fixed effects regression results of the information content in the revision and announcement period (as formalised in equation 3). The regression first suggests that analyst fixed effects are zero: the null hypothesis that fixed effects are zero has to be accepted. The average coefficient for the two-days announcement period return is 0.446 (for both annual and quarterly revisions), statistically significant at the 1% level. This is coherent with the expected sign and with prior studies (Lys and Sohn, 1990), and indicates that earnings-forecast revisions reflect information that was not available to investors at day –1. In short, this shows that analyst forecasts are informative. The average coefficient for the return in the forecast revision period is positive (0.158) and statistically significant at the 1% level. Also this sign is as expected, and indicates that analyst earnings forecasts reflect at least some of the information that was available to investors prior to the release of the new forecast.

Table 5 reports the average annual and quarterly AI over the years 2000-2007. Under the null hypothesis of zero incremental informativeness of an analyst report, annual AI would be around 0.004 (=1/250 trading days in a year, as shown in the column AI benchmark). Both annual AI mean and annual AI median in Table 5 exceed 0.004. Similarly, on a quarterly basis, quarterly AI mean (and median) exceed quarterly AI benchmark (with very few exception). This indicates that analyst reports are informative on average, consistently with the findings in Frankel *et al.*, 2006. Moreover, consistently with our previous findings, the AI measure increases, not monotonically, over time: this suggests that the informativeness of analyst reports has been increasing over the last 8 years.

Table 6 confirms the existence of a positive association between the unexpected component of an analyst's forecast and the stock return for the day of the forecast: the market's reaction to the surprise in analysts' revisions is proportional to the magnitude of the surprise. For the three portfolios ranked by absolute forecast surprise, AI increases with the magnitude of UAF. The mean for the lowest absolute forecast surprise portfolio is 0.003783, which is lower than the 0.005093 measured for the highest absolute forecast surprise portfolio. The paired-portfolios T test (testing whether the means are different across portfolios) shows that the mean AI of portfolio 2 is statistically larger than portfolio 1, and the mean of portfolio 3 is larger than portfolio 1.[14]

Table 7 reports the results on the relevance of financial vs. non-financial information as determinants of earnings-forecast revisions[15]. In columns A and B of table 7 we report the results of regressing the changes of earnings-forecast revisions on the changes of bottom-line net income and on the components of net income, without including any of the technical variables. We find that net income has a positive and statistically significant coefficient of 0.935 (column A). Including the components of net income in the regression (column B), we find that gross margin has a positive and significant coefficient of 0.733. Additionally, the coefficient on net revenues is a significant 4.987. This implies that analysts view the changes in net sales to be of great use in valuing the firm. Finally, the explanatory power of model B is much higher than the explanatory power of model A: R^2 jumps to 56.4% from 29.1%. Such an increase indicates that fundamental signals show large incremental value relevance over earnings changes.

In the remaining columns of table 7 we report the results of examining the incremental explanatory power of the non-financial variables in addition to financial metrics. When included alongside bottom-line net income we find that die size, die cost and chip cost have significantly negative coefficients of -2.192, –1.006 and –1.778 respectively. Additionally, combined with the components of net income, die size, die cost and chip cost have a significantly negative coefficient, equal to –2.431, –0.912 and –1.557 respectively. The magnitude of the technical die and chip coefficients suggests that changes in die size, die cost and chip cost have a significant effect on analysts earnings-forecast revisions. For instance, a 1 percent decrease in die size implies a 2.431 percent increase in earnings-forecast revision.

Moreover, the high explanatory power of model C and D indicates that non-financial data explain a relatively large portion of the variation in analyst revisions. The

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[14] The alternative methodology based on the regression between analyst informativeness and the unexpected component of the analyst's earnings-forecast confirms this result: the positive coefficient of UAF (equal to 0.494) is significant at 0.05.

three versions of model C referring to net income and non-financial variables explain around 45.3%, 36.2% and 43.5% of the earnings-recast revisions (R^2 = 0.453 when total chip cost is an explanatory variable, R^2 = 0.362 when die size is used, and R^2 = 0.435 when die cost is employed). This value is much higher than the explanatory power measured using only the net income measure (R^2 = 0.291). Similarly, model D referring to net income decomposition and non-financial variables explains around 66.3%, 62.7% and 65.6% of the earnings-recast revisions (R^2 = 0.663 when total chip cost is an explanatory variable, R^2 = 0.627 when die size is used, and R^2 = 0.656 when die cost is employed), a value much higher than the one measured previously for earnings and fundamental signal measures (R^2 = 0.511).

The evidence on the relevance of financial disclosure in analyst earnings-forecast revisions is reported in Table 8. Several interesting facts emerge. The number of total revisions preceded by financial disclosure (3,022) is almost four times that of revisions not preceded by accounting disclosure (815). Accordingly, the number of revisions per analyst preceded by financial disclosure (22.72) is larger than the number of revision not preceded by financial disclosure (9.06). The length of the forecast-revision period is 63 calendar days for revisions with at least one financial disclosure event in the forecast revision period, and 36 for revisions not preceded by any financial disclosure. The t-test (31.77 significant at 1%) confirms that the length of the forecast revision period is smaller for the non-disclosure sub-sample. Even more importantly, the mean absolute values of the forecast revision are substantially identical (0.13045 and 0.13381) for the two sub-samples. The t-test (0.01123 non significant) confirms that the magnitude of the forecast revisions following financial disclosure is the same as the magnitude of forecast revisions with no financial disclosure in the forecast-revision period. This result indicates that on average the information content of financial disclosure is not different from the information content of other corporate disclosure events that result in analysts earnings-forecast revisions, and emphasises the need to further investigate the role of technical disclosure.

The impact of technical versus financial disclosure on analyst earnings-forecast revisions is reported in Table 9. Here we observe that the number of total revisions

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[15] To control for cross-correlations in the residuals across time, we repeat our tests separated for each of the quarters ending at March, June, September, and December from 1995 to 2005.

preceded by financial disclosure (1074) is higher than that of revisions preceded by highly-relevant technical disclosure (825)[16]. Nevertheless, more analysts issue revisions preceded by technical disclosure rather than by financial disclosure. Note however that the number of revisions per analyst preceded by financial disclosure (16.03) is much larger than the number of revision not preceded by financial disclosure (11.79). Interestingly, the number of days which is required to react to financial disclosure (1.03 days is the average required time over the period 2004-2007) is lower than the one needed to react to technical disclosure (9.33 days is the average required time over 2004-2007). This means that the time required to revise forecasts is longer for technical disclosure than for financial disclosure, and this could be explained by the role played by technical analysts. Finally, the magnitudes of the forecast revision following highly-relevant technical[17] disclosure tend to be larger than the magnitudes of the forecast revisions following financial disclosure in years under observation. The t-test for differences of means reveals even more interesting results. In two of the years under observation, the revision associated to technical disclosure has been negative and statistically significant (-0.02967 significant at 10% in 2004, and -0.07578 significant at 1% in 2007): this suggests that the magnitude of the forecast revisions following technical disclosure is higher than the magnitude of forecast revisions with financial disclosure, and this is especially true when the forecast revision has to be negative. This result indicates that on average analysts earnings-forecast revisions are induced more by technical disclosure than financial disclosure in their downward revisions. In the other two years instead the magnitude of the forecast revision following highly-relevant technical and financial disclosure are substantially identical (respectively 0.00732 and 0.01527 non statistically significant): this result indicates that on average analysts

[16] Some of the forecast-revision dates are preceded by both financial and technical disclosure. As a robustness test, we formed other two sub-samples: revisions preceded by accounting disclosure only (dummy equal to one for accounting disclosure and dummy equal to zero for technical disclosure) and revisions preceded by technical disclosure only (dummy equal to one for technical disclosure and dummy equal to zero for accounting disclosure). No significant change emerges in the results, which are available on request from the authors.

[17] As a robustness test, the same analysis has been conducted by using the entire sample of technical disclosure events reported on the Intel web site without any judgment on the high relevance of the disclosure event. The empirical evidence referred to all the technical disclosure events confirms the one here reported just referred to highly-relevant technical disclosure events. Results are available on request from the authors.

earnings-forecast revisions are induced equally by financial disclosure and technical disclosure.

The information content of financial disclosure, measured by the association between analyst earnings forecasts and price changes depending upon the forecast-release date relative to financial disclosure (as formalised in equation 15), is reported in Table 10. The values for the cumulative returns in the announcement period are respectively 0.882 and 0.889 with and without any financial disclosure preceding the revision, and both values are statistically significant at 1%. This suggests that the correlation between analyst earnings-forecast revisions and contemporaneous stock price changes is the same when forecast revisions are preceded by financial disclosure and when forecasts are not preceded by financial disclosure. Moreover, it indicates that the correlation between stock returns in the announcement period and earnings-forecast revisions is the same when the change in earnings expectations is caused by corporate announcements not directly related to financial information and when the change in earnings expectations is driven by financial disclosure. This remarkable result differs from the one in previous studies (Lys and Sohn, 1990), and warrants further research to find out what other types of corporate disclosure events (e.g. technical disclosure) occur in the sub-sample where no financial releases were issued in the forecast-revision period.

The specific information content of technical disclosure (as formalised in equation 16) is shown in Table 11. In three of the years under observation (from 2005 to 2007), the relationship between analyst earnings-forecast revisions and contemporaneous stock price changes is negative (and large) when forecast revisions are preceded by technical disclosure, whereas it is either positive or null when forecasts are preceded by financial disclosure. These results have several relevant implications. First, the findings of no difference in the magnitude of revisions preceded and revisions not preceded by financial disclosure (equation 15) is due to revisions preceded by no financial disclosure being driven by technical disclosure. Second, analysts' earnings forecasts are especially informative when preceded by technical disclosure, which induces reduction in market prices; financial disclosure alone does not always induce changes in market prices (with the exception of years 2005 and 2006). This means that revisions induced by technical disclosure are a surprise (even if negative) to markets, while revisions induced by financial disclosure tend to be a surprise only in some of the years under observation. Third, revisions not preceded by any disclosure are not statically significant (not different from zero). Finally, the explanatory power of the relationship increases over time, even if not monotonically (adjusted R^2 moves from 15.3% in 2004 to 34.6% in 2007).

5. Conclusions

The empirical findings confirm that other sources of information (different from financial information traditionally assumed to be the drivers of analyst forecasts) are relevant in explaining forecast revisions. Die size, die cost and chip cost, when jointly considered with financial variables expressing the fundamental value of the company, contribute to explain a large part of forecast revisions, which in turn show a good association with future stock price changes on the market. This provides a quantitative empirical support to Miller and O'Leary (2000, p. 3): "non-financial information is of primary importance within the analysts ecosystem for evaluating long-term value creation in the micro-processor industry".

In terms of disclosure, the empirical evidence here indicates that the magnitude of earnings-forecast revisions preceded by financial disclosure is the same as the magnitude of revisions preceded by other corporate disclosure events. Moreover, the correlation between analyst earnings-forecast revisions and contemporaneous stock price changes is negative (and larger) when forecast revisions are preceded by financial disclosure than when forecasts are not preceded by any financial disclosure. By isolating the role of technical disclosure, in most of the years, the contemporaneous change in stock price associated with analyst revisions is negative (and substantially large) when forecast revisions are preceded by technical disclosure, whereas it is either positive or null when forecasts are preceded by financial disclosure.

It is important to note that the empirical evidence reported in this study just refers to a specific company in the microprocessor industry. Nevertheless we believe it may be extended to any industry where there is a substantial amount of non-financial information perceived by the community as a relevant technical indicator, and as a determinant of the performance of the company/industry. The community includes competitors, industry institutional bodies, and the press; while the producer of the non-financial information is usually a technical agent recognised as a key reference point by the community. Financial analysts themselves will then perceive the non-financial information produced by the technical agent as relevant. This phenomenon seems to be observable in other industries, i.e. the management fund industry, where analysts use indexes produced by Morningstar (an independent private research firm) as relevant information in revising their forecasts.

The key role of the technical analyst seems to characterise many other industries different from the microprocessor one, or rather any industry where there is a strong relationship – through collaboration and coordination – among the firms in the industry, so that a "systemic relationship" can be identified. In essence, the reference is not to firms merely characterised in terms of a product, but to firms that dominate an information sharing process. These are areas, we suggest, deserving of future research.

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Table 1: Descriptive statistics of the analyst earning revisions

Quarter Year	Total number of revisions	Number of analysts	Number of revisions per analyst	Number of revisions per day
1Q2000	97	39	2.49	1.54
2Q2000	91	34	2.68	1.44
3Q2000	157	34	4.62	2.49
4Q2000	116	35	3.31	1.84
2000	461	48	9.60	1.83
1Q2001	120	34	3.53	1.94
2Q2001	88	27	3.26	1.40
3Q2001	78	25	3.12	1.32
4Q2001	105	28	3.75	1.64
2001	391	42	9.31	1.58
1Q2002	69	25	2.76	1.15
2Q2002	97	26	3.73	1.52
3Q2002	79	25	3.16	1.23
4Q2002	140	36	3.89	2.19
2002	385	45	8.56	1.53
1Q2003	106	38	2.79	1.74
2Q2003	96	33	2.91	1.52
3Q2003	190	40	4.75	2.97
4Q2003	170	39	4.36	2.66
2003	562	58	9.69	2.23
1Q2004	133	42	3.17	2.15
2Q2004	117	35	3.34	1.89
3Q2004	150	37	4.05	2.34
4Q2004	146	38	3.84	2.28
2004	546	51	10.71	2.17
1Q2005	147	39	3.77	2.41
2Q2005	163	41	3.98	2.55
3Q2005	143	43	3.33	2.23
4Q2005	112	43	2.60	1.78
2005	565	52	10.87	2.24
1Q2006	201	45	4.47	3.24
2Q2006	133	39	3.41	2.11
3Q2006	106	40	2.65	1.68
4Q2006	108	40	2.70	1.71
2006	548	52	10.54	2.18
1Q2007	77	39	1.97	1.26
2Q2007	81	32	2.53	1.29
3Q2007	131	37	3.54	2.08
4Q2007	90	34	2.65	1.41
2007	379	49	7.73	1.51
Average per year	480	49.6	9.63	1.91

Total number of revisions over the period 2000-2007: 3837; total number of analysts issuing revisions over the period 2000-2005: 134; total number of brokerage and investment firms over the period 2000-2005: 83.

Table 2: Descriptive statistics of the financial and non-financial variables

Quarter	Δln(NI)	Δln(GM)	Δln(REV)	Δln(Chip cost)	Δln(Die size)	Δln(Die cost)
1Q2000	0.01690	-0.00143	-0.00170	n.a.	n.a.	n.a.
2Q2000	0.01023	0.00181	0.00237	-0.05687	-0.01967	-0.06492
3Q2000	-0.01493	0.00443	0.00318	-0.04021	-0.00779	-0.04075
4Q2000	-0.00914	-0.00191	-0.00021	0.00000	-0.00404	0.00000
2000	0.02309	0.00771	0.00800	n.a.	n.a.	n.a.
1Q2001	-0.10334	-0.07947	-0.01658	0.04189	0.01194	0.06198
2Q2001	-0.06921	0.00000	-0.00336	0.02159	0.01478	0.04979
3Q2001	-0.05044	0.03397	0.00209	0.02584	0.01361	0.04136
4Q2001	0.13474	0.01638	0.00413	0.01175	0.00323	0.02391
2001	-0.12982	-0.03496	-0.01383	0.03539	0.02544	0.08855
1Q2002	0.04715	0.00708	-0.00186	-0.00574	-0.00484	0.00000
2Q2002	-0.05391	-0.00866	-0.00449	0.00577	-0.00331	0.00000
3Q2002	0.03310	0.00252	0.00184	0.01112	0.01916	0.02168
4Q2002	0.03160	-0.02522	0.00613	0.00000	0.00297	-0.01042
2002	0.06264	0.01197	0.00049	0.03031	0.02154	0.05623
1Q2003	-0.00986	0.03442	-0.00373	-0.02248	-0.00597	-0.03401
2Q2003	-0.00153	-0.00176	0.00061	-0.01229	-0.00776	-0.02590
3Q2003	0.04486	0.01975	0.00884	-0.00645	-0.00322	-0.01418
4Q2003	0.01893	-0.14599	0.00691	-0.00665	-0.00493	-0.01505
2003	0.03967	0.01497	0.00695	-0.02942	-0.00395	-0.05978
1Q2004	-0.01562	0.17509	-0.00483	-0.00686	0.00000	0.00000
2Q2004	0.00108	-0.00102	-0.00033	0.00000	-0.00337	-0.01603
3Q2004	0.00566	-0.00080	0.00321	0.00000	-0.00871	-0.01712
4Q2004	0.00746	0.00859	0.00783	0.00691	-0.00917	-0.01836
2004	0.01846	0.00910	0.00735	-0.01655	-0.01625	-0.04934
1Q2005	0.00176	0.00262	-0.00107	0.00000	-0.00382	-0.01978
2Q2005	-0.00455	-0.00472	-0.00135	-0.00686	0.00000	0.00000
3Q2005	-0.00147	0.01030	0.00474	0.00691	0.00383	0.02017
4Q2005	0.01425	0.00226	0.00148	0.00000	0.00744	0.01871
2005	0.00898	0.00979	0.00730	0.00345	-0.01225	-0.03166
1Q2006	-0.03242	-0.00782	-0.00818	0.00014	0.01123	0.02985
2Q2006	-0.05742	-0.01401	-0.00687	0.01064	0.01483	0.03533
3Q2006	-0.02947	-0.02217	0.00549	0.00755	0.01854	0.03507
4Q2006	-0.03338	-0.01707	0.00649	0.01675	0.02020	0.04087
2006	-0.03386	-0.01405	-0.00532	0.00882	0.01631	0.03553
1Q2007	0.01324	-0.00690	-0.00565	0.00020	-0.00091	0.00515
2Q2007	0.02684	-0.00147	-0.00123	-0.00093	-0.00032	0.02145
3Q2007	0.02270	0.01225	0.00942	0.00072	0.00012	0.02520
4Q2007	0.02912	0.01682	0.00371	0.00006	0.00026	-0.04727
2007	0.02101	0.00539	0.00461	0.00002	-0.00019	0.00072
Average 2000-07	0.00127	0.00031	0.00195	0.00457	0.00438	0.00575

Table 3: Earnings-forecast revisions

Quarter	Mean	St. dev.	Median	Min	Max
1Q2000	0.14428	0.15249	0.05000	-0.04000	0.49000
2Q2000	0.04644	0.05532	0.02500	-0.05500	0.22000
3Q2000	0.02693	0.10796	0.00500	-0.13000	0.56000
4Q2000	0.00437	0.09472	-0.01000	-0.16000	0.83000
2000	0.04893	0.11840	0.02500	-0.16000	0.83000
1Q2001	-0.29355	0.21063	-0.22000	-0.93000	-0.01000
2Q2001	-0.08460	0.16617	-0.04000	-1.08000	0.05000
3Q2001	-0.03080	0.09125	-0.01000	-0.63000	0.05000
4Q2001	-0.01620	0.11297	0.01000	-1.07000	0.03000
2001	-0.12041	0.19725	-0.04000	-1.08000	0.05000
1Q2002	0.06812	0.08632	0.03000	-0.09000	0.29000
2Q2002	-0.02977	0.09149	-0.03000	-0.60500	0.22000
3Q2002	-0.01342	0.02982	-0.01000	-0.10000	0.04000
4Q2002	-0.00870	0.03326	0.00000	-0.23000	0.03000
2002	0.00017	0.07251	0.00000	-0.60500	0.29000
1Q2003	0.01880	0.06737	-0.01000	-0.08000	0.20000
2Q2003	0.01670	0.03426	0.01000	-0.16000	0.17000
3Q2003	0.04497	0.03219	0.04000	-0.07000	0.18000
4Q2003	0.01069	0.05418	0.02000	-0.07000	0.29000
2003	0.02500	0.04970	0.02000	-0.16000	0.29000
1Q2004	0.13096	0.21284	0.02000	-0.07000	0.63000
2Q2004	0.00791	0.07936	0.00000	-0.08000	0.48000
3Q2004	-0.02936	0.05031	-0.03000	-0.32500	0.06000
4Q2004	0.02690	0.07536	0.02000	-0.13000	0.61000
2004	0.03184	0.13340	0.01000	-0.32500	0.63000
1Q2005	0.04231	0.06227	0.03000	-0.05000	0.32000
2Q2005	0.04264	0.05464	0.04000	-0.06000	0.36000
3Q2005	0.00238	0.04108	0.01000	-0.07000	0.12000
4Q2005	0.02626	0.09332	0.01000	-0.20000	0.76000
2005	0.02935	0.06534	0.02000	-0.20000	0.76000
1Q2006	-0.10827	0.10065	-0.09000	-0.50000	0.20000
2Q2006	-0.07875	0.08228	-0.07000	-0.46000	0.17000
3Q2006	-0.03237	0.09146	-0.01000	-0.46000	0.11000
4Q2006	0.04325	0.04618	0.05000	-0.17000	0.19000
2006	-0.05762	0.10242	-0.05000	-0.50000	0.20000
1Q2007	0.10227	0.12889	0.05000	-0.09000	0.34000
2Q2007	0.00026	0.08172	-0.02000	-0.12000	0.35000
3Q2007	0.04936	0.06281	0.04000	-0.07000	0.55000
4Q2007	0.05932	0.05745	0.05000	-0.05000	0.36000
2007	0.05227	0.08948	0.03000	-0.12000	0.55000
Average 2000-07	0.00287	0.12240	0.01000	-1.08000	0.83000

Total number of revisions over the period 2000-2007: 3837; total number of analysts issuing revisions over the period 2000-2007: 134.

Table 4: Information content of analyst forecasts in the revision and announcement period

Equation (3)	Constant (γ_0)	R^{RP} (γ_1)	RM^{RP} (γ_2)	R^{AP} (γ_3)	RM^{AP} (γ_4)	Adj. R^2 [F test that all u_i=0]
Predicted sign		+	-	+	-	
Annual and quarterly forecast revisions						
Mean	0.006***	0.158***	-0.007	0.446***	-0.844***	8.16%
Std. Error	0.002	0.018	0.026	0.041	0.106	[Prob > F=0.80]
t-statistic	2.80	8.84	-0.28	10.81	-7.94	
Annual forecast revisions						
Mean	0.008**	0.227***	-0.014	0.588***	-1.112***	8.85%
Std. Error	0.003	0.032	0.046	0.073	0.185	[Prob > F=0.57]
t-statistic	2.19	7.14	-0.31	8.03	-6.01	
Quarterly forecast revisions						
Mean	0.003**	0.083***	0.000	0.295***	-0.529***	15.08%
Std. Error	0.001	0.113	0.016	0.262	0.069	[Prob > F=0.99]
t-statistic	2.35	7.35	0.02	11.29	-7.66	

, * means statistically significant at the 5% and 1% respectively.

Table 5: Analyst informativeness

Year	Trading days	Number of days with revisions	AI Benchmark	AI
1Q 2000	63	19	0.015873	0.019727
2Q 2000	63	21	0.015873	0.018909
3Q 2000	63	25	0.015873	0.018417
4Q 2000	63	21	0.015873	0.018879
2000	252	86	0.003968	0.004709
1Q 2001	62	21	0.016129	0.017658
2Q 2001	63	22	0.015873	0.015251
3Q 2001	59	15	0.016949	0.020205
4Q 2001	64	25	0.015625	0.020481
2001	248	83	0.004032	0.004526
1Q 2002	60	13	0.016667	0.017388
2Q 2002	64	13	0.015625	0.024951
3Q 2002	64	19	0.015625	0.014064
4Q 2002	64	22	0.015625	0.021268
2002	252	67	0.003968	0.004918
1Q 2003	61	21	0.016393	0.015851
2Q 2003	63	19	0.015873	0.016605
3Q 2003	64	18	0.015625	0.021595
4Q 2003	64	22	0.015625	0.020005
2003	252	80	0.003968	0.004509
1Q 2004	62	24	0.016129	0.017786
2Q 2004	62	17	0.016129	0.017351
3Q 2004	64	20	0.015625	0.022536
4Q 2004	64	20	0.015625	0.02254
2004	252	81	0.003968	0.005132
1Q 2005	61	19	0.016393	0.016719
2Q 2005	64	24	0.015625	0.017865
3Q 2005	64	27	0.015625	0.019509
4Q 2005	63	28	0.015873	0.017133
2005	252	98	0.003968	0.004518
1Q 2006	62	29	0.016129	0.020136
2Q 2006	63	27	0.015873	0.019092
3Q 2006	63	26	0.015873	0.020199
4Q 2006	63	22	0.015873	0.016560
2006	251	104	0.003984	0.004869
1Q 2007	61	14	0.016393	0.026760
2Q 2007	63	15	0.015873	0.022996
3Q 2007	63	23	0.015873	0.018491
4Q 2007	64	19	0.015625	0.020390
2007	251	71	0.003984	0.005393
MEAN 2000-2007	251.25	83.75	0.003980	0.004822
ST DEV 2000-2007	1.39	12.44	0.000022	0.000322
MEDIAN 2000-2007	252	82	0.003968	0.004789
MIN 2000-2007	248	67	0.003968	0.004509
MAX 2000-2007	252	104	0.004032	0.005393

Table 6: Unexpected analyst forecast and Analyst informativeness (2000-2007)

Portfolio	N. obs	UAF Mean	AI mean	T-stat for test of differences in means across AI portfolios
1	202	0.000455	0.003783	
2	200	0.001582	0.003956	(Port2-Port.1) 0.00113***
3	200	0.005954	0.005093	(Port3-Portf2) 0.00437***

__Table 7 : Regression Analysis: quarterly determinants of earnings-forecast revisions (2000-2007)__

	Parameters	A (Equation 7)	B (Equation 8)	C1 (Equation 9)	C2 (Equation 10)	C3 (Equation 11)	D1 (Equation 12)	D2 (Equation 13)	D3 (Equation 14)
β_0	CONSTANT	0.003 (0.011)	-0.001 (0.009)	0.003 (0.010)	0.006 (0.011)	0.006 (0.010)	-0.001 (0.009)	0.002 (0.009)	0.002 (0.009)
$\beta_1 P_{jt}$	Δ(lnNI)	0.935*** (0.271)	0.481* (0.268)	0.706*** (0.255)	0.759*** (0.280)	0.674** (0.265)	0.348 (0.245)	0.311 (0.265)	0.325 (0.204)
	Δ(lnGM)		0.733*** (0.208)				0.653*** (0.188)	0.714*** (0.196)	0.683*** (0.189)
	Δ(lnREV)		4.987*** (2.019)				4.442** (1.819)	5.057** (1.901)	4.295** (1.846)
	Δ(ln Chip cost)			-1.778*** (0.617)			-1.415*** (0.511)		
	Δ(ln Die size)				-2.192* (1.240)			-2.080** (0.984)	
	Δ(ln Die cost)					-1.006** (0.377)			-0.817** (0.309)
Diagnostic tests	R	0.540	0.751	0.673	0.602	0.660	0.814	0.792	0.810
	R^2	0.291	0.564	0.453	0.362	0.435	0.663	0.627	0.656
	Adjusted R^2	0.267	0.515	0.414	0.317	0.395	0.611	0.570	0.603

*, **, *** means statistically significant at the 10%, 5% and 1% respectively. Standard deviation in ( ).

Table 8: Financial disclosure and analyst earnings-forecast revisions

	Revisions with at least one financial disclosure between consecutive forecasts			**Revisions with no financial disclosure between consecutive forecasts**		
	Number of total revisions = 3022 Number of analysts = 133 Number of revisions per analyst = 22.72			Number of total revisions = 815 Number of analysts = 90 Number of revisions per analyst = 9.06		
	Days[a]	ΔFEPS[b]	|ΔFEPS|[c]	Days[a]	ΔFEPS[b]	|ΔFEPS|[c]
Mean	63	0.00994	0.13045	36	-0.00076	0.13381
Median	47	0.01449	0.07317	37	0.01216	0.07246
Std. Error	71	0.20336	0.15625	20	0.20161	0.15074

[a]Paired sample t-test Days = 31.77***; [b]Paired sample t-test ΔFEPS = -0.00784; [c]Paired sample t-test |ΔFEPS| = 0.01123.

Table 9: Financial and technical disclosure and analyst earnings-forecast revisions (July 2004-December 2007)

	2004				**2005**			
	Revisions with at least one highly-relevant technical disclosure[i]		**Revisions with at least one financial disclosure[ii]**		**Revisions with at least one highly-relevant technical disclosure[i]**		**Revisions with at least one financial disclosure[ii]**	
	Days	ΔFEPS[a]	Days	ΔFEPS[a]	Days	ΔFEPS[b]	Days	ΔFEPS[b]
Mean	8.02837	-0.01705	0.98295	0.01262	9.53202	0.04789	1.04061	0.04058
Median	8.00000	-0.03333	1.00000	0.01724	10.00000	0.03571	1.00000	0.03571
Std. Error	1.55813	0.14362	0.19927	0.13272	2.08882	0.11177	0.29131	0.09634
	2006				**2007**			
	Revisions with at least one highly-relevant technical disclosure[i]		**Revisions with at least one financial disclosure[ii]**		**Revisions with at least one highly-relevant technical disclosure[i]**		**Revisions with at least one financial disclosure[ii]**	
	Days	ΔFEPS[c]	Days	ΔFEPS[c]	Days	ΔFEPS[d]	Days	ΔFEPS[d]
Mean	10.88750	-0.14523	1.27715	-0.06945	8.32624	0.12788	1.02713	0.11261
Median	13.00000	-0.12857	1.00000	-0.08140	9.00000	0.06452	1.00000	0.05085
Std. Error	2.82172	0.16338	0.40121	0.24736	2.43339	0.19539	0.48643	0.18832

[i] Number of total revisions (2004-2007) = 825; Number of analysts (2004-2007) = 70; Revisions per analyst (2004-2007) = 11.79; [ii] Number of total revisions (2004-2007) = 1074; Number of analysts (2004-2007) = 67; Revisions per analyst (2004-2007) = 16.03; [a] Independent sample t-test ΔFEPS (2004) = -0.02967*; [b] Independent sample t-test ΔFEPS (2005) = 0.00732; [c] Independent sample t-test ΔFEPS (2006) = -0.07578***; [d] Independent sample t-test ΔFEPS (2007) = 0.01527.

Table 10: Information content of analyst forecasts depending upon financial disclosure

Equation (15)	Constant (γ_0)	R^{RP} (γ_1)	RM^{RP} (γ_2)	R^{AP}*D_1 (γ_{31})	R^{AP}*D_2 (γ_{32})	RM^{AP} (γ_4)	Adj R^2
Predicted sign		+	-	+	+	-	
Mean	0.013***	0.218***	0.201***	0.882***	0.889***	-1.331***	12.1%
Std. Error	0.003	0.028	0.038	0.069	0.112	0.165	
t-statistic	3.969	7.777	5.286	12.728	7.411	-8.083	

D_1 = Dummy variable equal to one if financial disclosure occurred in the forecast-revision period, zero otherwise; D_2 = Dummy variable equal to one if no financial release occurred in the forecast-revision period, zero otherwise. **, *** means statistically significant at the 5% and 1% respectively.

Table 11: Information content of analyst forecasts depending upon financial and technical disclosure (July 2004-December 2007)

Equation (16)	Constant (γ_0)	R^{RP} (γ_1)	RM^{RP} (γ_2)	R^{AP}*D_1 (γ_{31})	R^{AP}*D_2 (γ_{32})	R^{AP}*D_3 (γ_{33})	RM^{AP} (γ_4)	Adj R^2
Predicted sign		+	-	+	+	0	-	
2004								
Mean	0.008	-0.269	1.181***	-0.729	2.147***	-1.438	-0.648	15.3%
Std. Error	0.024	0.188	0.374	0.722	0.734	1.404	1.945	
t-statistic	0.355	-1.434	3.157	-1.009	2.925	-1.024	0.333	
2005								
Mean	0.041***	-0.106	0.803***	0.708***	-1.828***	-1.306	1.407	10.7%
Std. Error	0.005	0.069	0.137	0.263	0.459	0.847	0.947	
t-statistic	7.933	-1.534	5.865	2.692	-3.981	-1.542	1.486	
2006								
Mean	-0.008	1.026***	-0.819***	4.367***	-3.028***	-0.309	0.227	35.0%
Std. Error	0.009	0.088	0.150	0.542	0.534	0.310	0.763	
t-statistic	-0.887	11.632	-5.472	8.063	-5.666	-0.994	0.298	
2007								
Mean	0.015	0.884***	0.441**	0.507	-1.922**	-0.993	3.876***	34.6%
Std. Error	0.014	0.177	0.208	0.509	0.819	1.073	1.320	
t-statistic	1.038	4.987	2.121	0.996	-2.384	-0.925	2.937	

D_1 = Dummy variable equal to one if financial disclosure occurred in the last four days of the forecast-revision period, zero otherwise; D_2 = Dummy variable equal to one if technical disclosure occurred in between the last two weeks and last five days of the forecast-revision period, zero otherwise; D_3 = Dummy variable equal to one if no disclosure occurred in the forecast-revision period, zero otherwise. **, *** means statistically significant at the 5% and 1% respectively.