Supply Chain Information in Analyst Reports on Publicly Traded Companies

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ABSTRACT

Analyst reports are an important source of secondary data on companies for understanding a company's performance in the recent past and for getting guidance on its future performance. We therefore analyzed the text of 1028 equity analyst reports of 145 Fortune 500 Global companies (not including services sectors like IT or banking) published between 2009 and 2011 for supply chain related information. We found that nearly three-fifths of these reports contained supply chain information pertaining to inbound, process or outbound aspects of the supply chain of the company. At the report level, there are significant industry effects for supply chain related content in analyst reports. On the other hand, aggregating information at the company level, it appears that analysts focus on a particular supply chain aspect for a company as well as its sector. Furthermore, logistic regression analysis suggests a link between the supply chain information provided when this is positive in orientation and the buy/sell/hold recommendation of the analyst regarding the company's stock.

Keywords: Methodology; secondary data; analyst reports; content analysis; cluster analysis; logistic regression

1. Introduction

Analyst reports on companies provide secondary information based on the information gathered by analysts from diverse sources including the companies' top management. The information in these reports is useful in explaining financial and stock performance in the recent past as well as in guiding investors on the expected future performance as well as stock price. Indeed there is extensive literature analyzing the numerical part of analyst reports and the earnings forecast (e.g. Abdel-khalik & Ajinkya, 1982; Asquith et al., 2005) and stock recommendations (e.g. Beneish, 1991; Elton et al., 1986; Francis and Soffer, 1997; Hirst et al., 1995; Stickel, 1995; Womack, 1996). More recently, there have also been analyses of the textual part of these reports (Asquith et al. 2005; Bradshaw 2002; De Franco et al 2011; Huang et al. 2012) to help understand the company's financial performance.

Researchers have established the link between shareholder value and supply chain initiatives (e.g. Christopher and Ryals, 1999; D'Avanzo et al., 2003; Anderson et al., 2004; Hendricks et al., 2007; Sridharan et al., 2005; Mitra and Singhal, 2008; Randall and Farris, 2009). As such, we expect analysts to discuss the supply chain information of companies from these sectors. However, to our knowledge, no studies have focused on the provision of supply chain related information in the textual parts of the analyst reports. We strive to fill this gap by exploring the nature of supply chain information in the text of analyst reports and by seeking to link it to the analysts/ buy/sell/hold recommendations.

To do so, we gathered the text of 1028 equity analyst reports of Global Fortune 500 companies published between January 2009 and December 2011. Next, we used content analysis to code the textual part of analyst reports to understand the analysts' use of supply chain information particularly by industry sector at the report level. Finally, we used logistic regression to test the link between the analyst's buy/sell/hold recommendation and the nature of the supply chain information.

We found that supply chain issues reported by analysts on the particular aspect of the supply chain – inbound, outbound or process – are much more dependent on the individual company rather than the company's industry sector. The analyst provides this information with a positive or a negative orientation. Logistic regression based analysis suggests a significant positive link between positive supply chain related information and the recommendation issued by analysts. However, we did not find a significant

relationship between supply chain information with a negative interpretation and the recommendation.

Our contribution to the supply chain literature is to introduce analyst reports as a potential useful source of secondary data about companies' supply chains and present some preliminary analysis linking it to buy/sell/hold recommendations. This secondary data is useful in that it targets investors (and therefore top management seeking to increase shareholder value). Being accessible to researchers, this data affords replication of research findings.

The remainder of this paper is organized as follows. Section 2 provides theoretical underpinnings and the prior literature on supply chain management (SCM), shareholder value and analyst reports. Section 3 describes the data collection of analyst reports followed by Section 4 providing our findings in three parts: frequency analysis at the industry level, cluster analysis at the company level and logistic regression to find the link between supply chain information and the analyst's recommendation Section. Section 5 provides a discussion and areas for further research before the conclusion in Section 6.

2. Theory and Prior Literature

This paper builds on agency theory. Agency theory investigates and strives to improve relationships where there is a principal and an agent in which "one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent" (e.g. Jensen and Meckling, 1976, 308p). These type of relationships experience information asymmetry and conflict of interest (Eisenhardt, 1989; Healy et al., 1999).

Managers and shareholders comprise such a relationship. Jensen and Meckling (1976) suggested early on that security analysts held a "socially productive" role in reducing the costs that stem from the agency problem. Security analysts can help reduce the information asymmetry through their analysis and interpretation of the information they receive from senior management as well as from their private information gathering (Frankel et al., 2006).

2.1. Analyst Reports

To help investors understand past performance of a company and possible future performance (and thus shareholder value), analysts prepare reports for investors. An analyst report is a document written about a specific company to disseminate information that is potentially related to future performance, (Asquith et al., 2005). A typical analyst report is structured to include information about a company and the analyst's evaluation of the information (Previt et al, 1994) - see Table 2 for examples of the text information.

A typical equity analyst report contains three quantitative elements: (1) The stock recommendation, (2) the earnings forecast, and (3) the target stock price in the coming months (Asquith et al., 2005). Many analyst reports also contain non-financial assessments of the company (Previt et al, 1994), providing a narrative of various factors such as market share, competitive position, industry and economic conditions, competitors, recent events, suppliers, distribution networks and management strategy (Huang et al., 2012; Kothari et al., 2009; Previt et al, 1994; Roger and Grant, 1997).

Analysts use various information sources in writing these reports, such as financial data disclosed by the company in question, e.g., annual reports, industry and macroeconomic conditions; as well as communication with management of the company of interest (Ramnath et al., 2008). Communication with management is particularly important for analysts and analysts tend to rely heavily on such communication (Previt et al, 1994; Williams, 1996). Roger and Grant (1997) suggest that half the content of a typical report is the result of such communication. For this reason, analysts value the access to managers to increase their own following (Francis and Soffer, 1997; Lang and Lundholm, 1996). Indeed, the quality of the forecasting of share prices and earnings per share by analysts is significantly related to the quality of such communication (Healy et al., 1999; Lang and Lundholm, 1996). Such communication also appears to be sought after by companies since it can be beneficial for the company in terms of share return (Francis et al., 1997) and the increased analyst following has positive impact on the value of the firm in terms of market capitalization (Chung and Jo, 1996).

Investors use analyst reports for investment decisions and value analysts' ability to evaluate an individual company within the context of the whole industry (Bradshaw, 2011). Empirical evidence suggests that analysts possess knowledge and experience to utilize information better than others (Maine et al., 1997) and investors tend to respond more strongly to the reports by analysts compared to other sources of information (Bonner et al., 2003; Mikhail et al., 2004).

The impact of analyst reports on the shareholder value has been extensively researched using various methods such as event study. Typically, such studies explored the link between the share price and the quantitative elements of analyst reports (e.g. earnings forecasts). Two summary financial measures; earnings forecasts (Abdel-khalik & Ajinkya, 1982; Asquith et al., 2005; Francis and Soffer, 1997; Lys & Sohn, 1990 and Stickel, 1991) and stock recommendations (Beneish, 1991; Elton et al., 1986; Francis and Soffer, 1997; Hirst et al., 1995; Kim et al., 1997; Liu et al., 1990; Stickel, 1995, and Womack, 1996) have been heavily investigated. These studies provide strong evidence of a significant relationship between these quantitative elements of the report and the movement of the stock price, with the exception of Frankel and Lee (1998) and Ali et al., (2003), who have suggested that the market does not fully react to such elements of the reports.

More recently, researchers have noted that investors also pay significant attention to the textual part of these reports (Huang et al., 2012). Studies on this part of analyst reports have established that: (1) the textual part is consistent with the quantitative part (e.g. recommendations and earnings forecasts) and, the textual part is generally used for the justification of analysts decisions (Bradshaw, 2002), and (2) the textual information has a value above and beyond that of the summary financial measures (Asquith et al., 2005; Huang et al., 2012) and that it can increase the volume of shares exchanging hands (De Franco, et al., 2011) and, and more to the point, results in change in share price (Huang et al., 2012). Typically, supply chain related information or analyses would appear on this section of reports. However, Kothari et al., (2009) also point out that the textual part has limited impact on the market.

2.2. Analyst Reports and the Link between Supply Chain Management (SCM) and Shareholder Value

Shareholder value, i.e., the value created for shareholders by the companies in which they invest, can be measured by income-based measures such as return on investment (ROI) and return on assets (ROA) as well as by stock-price-based measures (Christopher and Ryals, 1999). As such, researchers have looked into companies' internal measures based on accounting ratios such as ROI and ROA for comparability (Anderson et al., 2004) and have concluded that supply chain management can improve these measures, due to various factors such as improved cost management, asset utilization and capital efficiency (Christopher and Ryals, 1999; D'Avanzo et al., 2003; Randall and Farris, 2009) (Table 1).

	Supplier Management	Operations and Inventory management	Logistics	IT in supply chain	Customer management in supply chain	Sustainability in supply chain	Other supply chain management
ROA	Tan, et al. (1999) Li et al. (2006) Flynn, *et al*. (2010) Lanier Jr., *et al*. (2010) Cheng (2010) Jayaram and Vickery (1998) Kroes and Ghosh, (2010)	Fullerton, *et al*. (2003) Cannon (2008) Eroglu and Hofer (2011)	Shang and Marlow (2005) Morash, *et al.* (1996)	Akkermans et al. (2003) Li et al. (2006) Dehning, *et al*. (2007)	Tan, et al. (1999) Li et al. (2006) Vickery, *et al*. (2003)	Watson, *et al.* (2004) Gonalez-Benito and Gonzalez-Benito (2005)	Tan, et al. (1999) Randall and Ulrich (2001) Min et al. (2007) Wagner, et al. (2012)
ROS	Kroes and Ghosh, (2010)	Demeter (2003) Fullerton, *et al*. (2003) Eroglu and Hofer (2011)	Morash, *et al*. (1996)	Dehning, *et al*. (2007)	Vickery, *et al*. (2003)		Randall and Ulrich (2001) Sánchez and Pérez (2005) Min et al. (2007) Calantone and Dröge (2006)
ROI	Tan, et al. (1999) Flynn, *et al*. (2010) Cheng (2010)	Ganeshan, *et al*. (2001) Cannon (2008)	Morash, *et al*. (1996) Stock et al. (2000) Shang and Marlow (2005) Schramm-Klein and Morschett (2006)	Wu *et al*. (2006) Bottani and Rizzi (2008)	Tan, et al. (1999) Vickery, *et al*. (2003)	Judge and Douglas (1998)	Tan, et al. (1999) Calantone and Dröge (2006) Sánchez and Pérez (2005) Min et al. (2007)

Table 1: Examples of empirical studies investigating the link between supply chain management and shareholder value

Other studies have used share price as a forward looking measure of shareholder value incorporating a company's future financial performance (Anderson et al., 2004), addressing the concern that accounting-based ratios like ROA or ROI fail to take the time value of money into account (Brealey et al., 2006; Stewart, 1991). Studies using share price movement have investigated various supply chain related issues and initiatives including supply chain disruptions (Hendricks et al., 2009; Hendricks and Singhal, 2005a, 2005b and 2009; Papadakis, 2003), quality management (Corbett et al., 2005; Hendricks and Singhal, 2001), supply chain IT system (Hendricks et al., 2007; Sridharan et al., 2005), supply chain integration (Mitra and Singhal, 2008), and supply chain advertisements (Filbeck, et al., 2005).

Supply chain researchers have thus far not paid much attention to supply chain related information in analyst reports. This is despite the fact that researchers from other domains have shown that the movement of share prices is closely related with the contents of the equity analyst reports including the textual part, which contains supply chain related information (Bradshaw, 2011; Huang et al., 2012; Roger and Grant, 1997).

Due to analysts' influence on the perception of investors as regards future stock price, understanding the way they use supply chain related information can provide a 'communication' dimension to top management wishing to manage shareholder value, in this case, specifically from a supply chain perspective. However, there is a gap in the literature in that no studies, to our knowledge, have focused on what kind of supply chain related information the analysts report and its link to their recommendations.

Our literature review therefore shows that while there is extensive research on the relationship between analyst reports and shareholder value, only a small subset of this research focuses on the text in the reports. More importantly, there is a gap in the literature in that, at least to our knowledge, there is no study that examines the implications of supply chain related information in analyst reports on shareholder value.

3. Methodology

3.1. Data Collection of Equity Analyst Reports

We downloaded quarterly analyst reports from 2009 to 2011 of companies on the 2009 Fortune Global 500 list from Bloomberg. We chose to have a sample from diverse sectors with significant supply chains such as aerospace, motor vehicles and parts, electronics, and retail. As such, we did not include Fortune Global 500 companies from service-related sectors such as the financial, banking, insurance and IT service sectors. For the companies in the selected sectors, we created a list of all the reports from the 1st quarter of 2009 to the 4th quarter of 2011. Where more than one report from different analysts were available, we randomly selected a report if it had textual analysis (some reports have primarily quantitative analysis). Typical examples of the textual parts of the reports containing supply chain related information can be seen in Table 2.

Company Date of issue	Financial institution Analyst(s)	Textual part containing supply chain related information
ABB (1Q/2009)	Anand Rathi S. Kumar M. Madhurendra	We believe that pricing pressure due to lower raw material c osts and mounting competition, especially from Korea and C hina, led to the poor performance. The company has failed t o enter the EHV segment (765kV) due to lack of domestic m anufacturing and the higher cost of subcontracting equipmen t to its foreign facilities.
Hyundai Moto r (3Q/2010)	Daewoo Securities M. Yun Y. Park K. Kim	We forecast HMC's net profit in 2011 to increase by another 9.6% to W5.6tr on the back of: 1) new capacity at the Russian and Czech plants, 2) improved efficiency at the plants that are currently operating at full capacity, 3) improved export sales mix and 4) the continued benefits of the integrated platform.
Nokia (2Q/2011)	Pohjola Bank Hannu Rauhala	Nokia expects D&S sales to fall and profitability to weaken in Q2. This was attributed to the natural catastrophe in Japan and its impacts on component deliveries, an old product mi x and lack of inexpensive dual-SIM devices in the product m ix.
Flextronics (Q1/2011)	J.P.Morgan Steven J. O'Brien	We have increasing confidence in the longer-term topline gr owth plan as OEM customers become more reliant on FLEX 's design capabilities, its broad multi-product manufacturing know-how, and its supply chain management expertise.

Table 2: Sample text from some analyst reports

The reports in our sample are from the period between Q1 2009 and Q4 2011 so do not represent only a period of financial crises or recovery. Indeed, the movement of the FTSE 100 market shows both ups and downs during this period (Figure 1). Also our sample is

from the Global Fortune 500 and the economic cycles in the different countries represented are not all correlated.

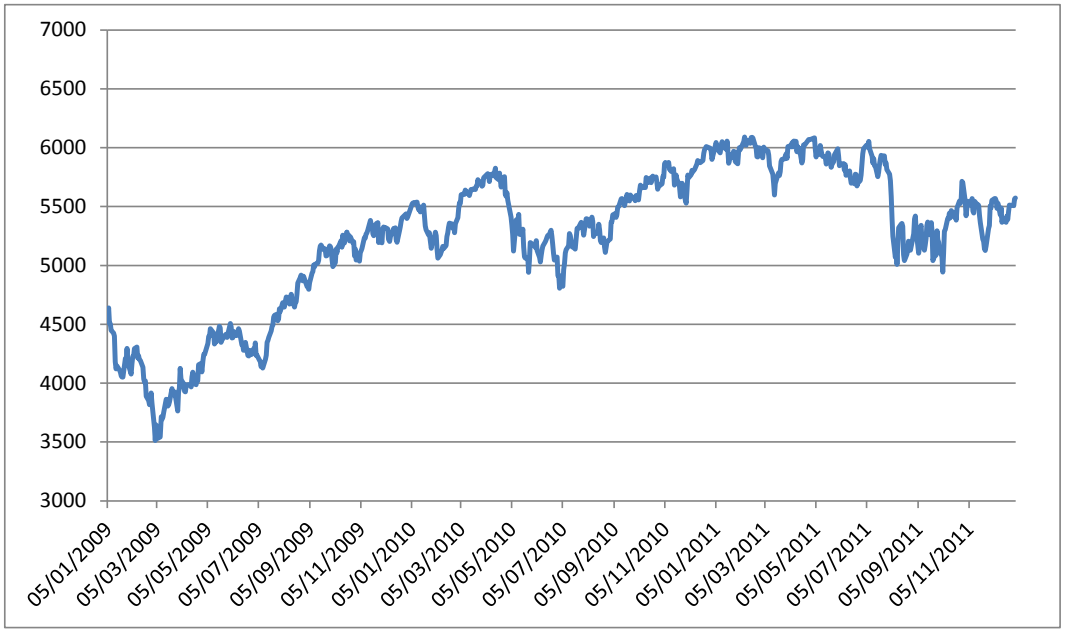

Figure 1: The monthly movement of FTSE 100 between 2009 and 2011 (Source: Datastream)

In the end, we had 1028 analyst reports of 145 Fortune Global 500 companies. We grouped the resulting sample using the industry classification used by Fortune magazine although we merged similar sectors that did not have sufficient number of reports to allow comparison of sectors, for example, the reports from the retail and the wholesale sector were merged into one industry group. As a result, we had nine industry sectors with each sector having 16 companies on an average and about 114 reports. The industry groups as well as the number of companies and reports in each group are provided in Table 3. Moreover, reports were not available for all companies in the sample for all quarters. For the individual companies we had, on an average, about seven reports per company over the twelve quarters.

Industries	No. of companies	No. of Reports
Aerospace and Defence	9	66
Computer, Communications Equipment and Semiconductor	16	123
Consumer Products, Food and Beverage	18	144
Electronics, Electrical Equipment	15	136
Metal	15	107
Motor Vehicles and Parts	25	147
Pharmaceuticals	9	70
Retail and Wholesale	23	160
Machinery and Petroleum Refining	15	75
Total	145	1028

Table 3: Number of analyst reports by industry group in our sample

3.2. Data Preparation with Content Analysis and Coding

Content analysis refers to "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use", (Krippendorff, 2004; p.18). Content analysis has been widely used in areas of management research such as marketing (e.g. Howard and Kerin, 2006); yet has only started to gather interest in operations and supply chain management research more recently (Montabon, et al., 2007; Tangpong, 2011). Researchers have also used content analysis to convert or code textual information in analyst reports to quantitative information for further analysis (e.g.Rogers, and Grant, 1997; Asquith, et al., 2005; Kothari, et al., 2009; De Franco, et al., 2011; Huang, et al., 2012).

For our sample, we coded different supply chain aspects of analyst reports manually even though there is content-analysis software available. Manual coding allows for achieving semantic validity and analyzing highly sophisticated textual data such as an analyst reports. Although content analysis software can process large volumes of data at high speed, computers only recognize character strings, therefore, they cannot process text reliably unless the text is predictable and repeated and can miss out meanings in the texts (Krippendorff, 2004).

A human coder, on the other hand, could introduce individual bias into coded data set (Tangpong, 2011), and using multiple coders can overcome this issue providing that there is high level of agreement between coders (Weber, 1990). Therefore, two or more researchers should carry out the manual coding of text independently. In our case, we used two independent teams of coders, where each team consisted of two coders. Moreover, in order to ensure that the coders have the necessary cognitive abilities and backgrounds (Krippendorff, 2004), the four coders were selected from a pool of post-

graduate students who had successfully completed SCM and finance modules. This ensured that they were efficient at detecting meanings in the texts of analyst reports which were heavily populated with management and finance terms. As the next few sections explain, we followed 'content analytic approach to measurement development' by Tangpong (2011) for coding the text.

3.2.1. Determining the Recording Unit and the Content Categories

The first step in coding textual data is determining the *recording unit* (Tangpong, 2011). We opted for the recording unit to be a *paragraph* because the meanings of texts can be lost in alternative coding units such as phrases or words. For example, it is not uncommon for someone who comes across the phrase 'raw material' in a report to assume that the discussion of the report is related to the commodity price, yet it could equally be about inventory management.

Next, we developed content *categories*. These are the backbone of any text analysis and contain the definition of the constructs of interest (Tangpong, 2011). Krippendorff (2004) notes that content analyses would benefit from building content categories from scratch since this could better reflect the content of the text at hand. In order to create a content category, two teams of two independent coders read 100 randomly selected reports from the sample and extracted paragraphs referring to the company's supply chain and operations and supply chain events related to the company. The various SCM factors and issues mentioned in these reports were grouped into the following three categories: *inbound*, *process* and *outbound.* The *inbound* category includes SCM factors related to the procurement of material and components as well as issues related to suppliers. The *process* category encompasses the operations of a company and includes two frequently mentioned SCM fields: inventory and capacity. The last category, *outbound*, covers the distribution aspect of the company.

3.2.2. Developing and Testing Coding Rules

Next, we developed detailed coding rules containing specific instructions for assigning an individual recording unit to a content category as shown in Table 5. Coding rules also establish whether coders are consistent with the variable definition therefore ensuring reliability (Tangpong, 2011). Coding rules were developed in two phases. First, once we developed an initial version of the coding rules using the extracts from the 100 reports used for step 1, we tested the reliability of the rules using the methods suggested by Weber (1990). Then two independent teams of four coders coded the next batch of 100 reports and we compared the results. During this process, significant efforts were made to ensure

the two teams had a shared understanding of the rules. When a single paragraph contains more than one SCM factor, we coded the paragraph under all the pertinent coding categories.

The finalized coding rules contained detailed instructions about coding a paragraph into the content categories created during Step 1. Since coding was done manually rather than by software, we did not use a dictionary with keywords and phrases. We also interpreted the nature of the information provided: if the SCM factor identified in a paragraph was described in a positive light (e.g. …better margins due to the decrease in the distribution cost side of the company), it was coded as 1 and in contrast, if it was discussed in a negative light (e.g., increasing uncertainty for the company's earnings due to the raising raw material cost), it was coded as -1 (Table 4 and Table 5). This would have been difficult with computer coding. SCM factors not mentioned in an analyst report were coded as zero. We also incorporated emphasis: SCM issues that were discussed several times, but as distinct narratives rather than repetitions of certain words were coded as +2 or -2. For example, if "over-capacity" was mentioned twice in independent contexts, the "process" variable for that report was coded as -2.

Company (Recommendation) Date of issue	Textual part containing supply chain related information	Supply cha in factor
Intel Hold (14/Jan/11)	We believe Intel needs to lower utilization rates and inventory (Phase 2 of the downturn), as its inventory days increased roughly 11 days QoQ from 83 days in 3Q10 to 94 days in 4Q10, the second-highest level in fifteen years.	Process (Negative)
Posco Buy (09/July/10)	We forecast POSCO.'s 2Q10 sales and operating profit at W8,410.1bn and W1,777.9bn in line with market expectations of W8,118.7bn and W1,759.2bn, respectively. The 22.9% QoQ rise in operating profit will be attributable to: 1) price hikes in May, and 2) input of low-priced raw materials.	Inbound (Positive)
Sainsbury Sell (11/May/11)	"Trading intensity" or "sales density" fell on average from £20.42 to£ 20.04 or 1% meaning the core business fell materially more than that given the positive momentum of the large raft of space added in the last 2 years. Given Sainsbury continues to have more "unprofitable" space than peers and therefore headline better LFL's but a weaker profit outlook, recent negative momentum in guidance is understandable but mis-understood, we believe, at present.	Outbound (Positive)

Table 4: Examples of interpretation of 'positive' or 'negative' tone of the different types of supply chain information

SCM Factors	Sub-factor(s)	Coding	Examples of related keywords
Inbound (components, raw materials and supplier related)	Price (change and volatility) of raw materials/components	+1	Decreases, stable, low
		-1	Increases, unstable, high
	Procurement management	+1	Efficient, improves
		-1	Inefficient, deteriorates
	Availability of raw materials/ components	+1	Good, improves
		-1	Lack of, deteriorates
	Issues related to supplier(s)	+1	Technology, robust
		-1	Quality issues, weak
Process (inventory and capacity related)	Inventory level	+1	Decreases, low, improves
		-1	Increases, high, deteriorates
	Inventory management	+1	Efficient, improves
		-1	Inefficient, deteriorates
	Capacity level	+1	Sufficient, expansion investment
		-1	Lack of, decreases
	Capacity utilization/management	+1	High, efficient, new technology/system
		-1	Inefficient, low, over
Outbound (distribution)	Distribution network	+1	Efficient, sufficient, robust to risk, stores
		-1	Inefficient, insufficient, lacks, risky, stores

Table 5: Examples of the coding rules under the different categories

To ensure reliability, the two independent coding teams met periodically to compare the coding output and assess inter-coder reliability. If any inconsistencies in coding were detected, the teams exchanged their rationale for assigning a certain paragraph to a particular SCM factors and reconciled the inconsistencies.

4. Analysis and Findings

We carried out three types of analyses: *First*, we carried out frequency analyses to investigate the use of different supply chain related information in analyst reports of companies in various industries. We also compared the use of information with a more positive tone to that with a negative tone in these industries. *Second*, we used cluster analysis with the company as unit of analysis to determine whether companies could be grouped according to the mention of different supply chain related information in the reports. *Finally*, we tested the relation between supply chain content and the analyst's recommendation using logistic regression.

4.1. Frequency Analysis

Content analysis and coding show that there are some industry effects for supply chain related content in analyst reports (Table 6). Over 58% of the reports (598/1028) in our sample had supply chain related information (Table 6). More than 60% of the reports for

(1) metals, (2) motor vehicles and parts and (3), consumer products, food and beverage industry groups had supply chain related content. However, less than 23% of the reports for aerospace and defense sector and for the pharmaceutical sector contained supply chain related information (Table 6). We investigated further to see whether the supply chain related information that appeared in the reports was *positive* or *negative*. Overall, more positive supply chain related information than negative appeared in the reports (Table 6).

Industry Group	% of reports with SC information	% of reports with positive information	% of reports with negative information
Metals	82.2%	58.9%	61.7%
Motor Vehicles and Parts	63.3%	42.9%	39.5%
Consumer Products, Food and Beverage*	61.1%	38.9%	48.6%
Electronics, Electrical Equipment	61.0%	36.8%	40.4%
Retail and Wholesale**	59.4%	51.9%	20.0%
Computer, Communications Equipment and Semiconductor	56.9%	36.6%	31.7%
Pharmaceuticals	22.9%	15.7%	12.9%
Aerospace and Defence	22.7%	7.6%	16.7%
Machinery and Petroleum Refining**	66.7%	50.7%	25.3%
All industries combined**	58.2%	40.3%	34.9%

*** The difference between % of reports with negative and % of reports with positive is significant at 0.01 level
** The difference between % of reports with negative and % of reports with positive is significant at 0.05 level
* The difference between % of reports with negative and % of reports with positive is significant at 0.1 level

Table 6: The percentage of the reports that have 1) supply chain related information, 2) positive supply chain related information, and 3) negative supply chain related information. Note: The sum of the positive and the negative can be greater than the overall percentage as a single report can have both positive and negative information about supply chain.

We disaggregated these results further (Table 7) and found that on average, 34% of the reports mentioned inbound related supply chain factors, 34% mentioned process related supply chain factors, and, finally, 15% mentioned outbound related factors. Companies disclose input prices (as cost of goods sold) and inventory data annually or even quarterly, which is perhaps why such data is prominent in analyst reports. We also partitioned these frequencies further by industry sector to get a more granular picture.

	Inbound		Process		Outbound	
	Overall	Positive Negative	Overall	Positive Negative	Overall	Positive Negative
Aerospace and defence	9.1%	1.5%* 7.6%*	12.1%	4.5% 9.1%	3.0%	1.5% 1.5%
Computer, Communications Equipment and Semiconductors***	34.1%	14.6% 22.0%	34.1%	22.8%** 12.2%**	10.6%	8.2%** 2.4%**
Consumer Products, Food and Beverage***	43.1%	18.8%*** 37.5%***	27.1%	18.1% 15.3%	17.4%	9.0% 8.3%
Electronics, Electrical Equipment***	36.8%	15.4%*** 28.7%***	37.5%	21.3% 19.9%	12.5%	8.1% 7.4%
Metals***	68.2%	32.7%*** 52.3%***	56.1%	42.1%** 29.0%**	8.4%	7.5%** 0.9%**
Motor Vehicles and Parts***	35.4%	18.4% 23.8%	45.6%	30.6%** 19.7%**	8.2%	6.1% 2.7%
Pharmaceuticals*	11.4%	4.3% 8.6%	14.3%	10.0% 10.0%	2.9%	2.9% 0%
Retail and Wholesale*	25.6%	19.4%** 10%**	28.1%	25.6%*** 6.3%***	36.9%	30.6%*** 8.1%***
Machinery and Petroleum Refining **	21.3%	16.0% 8.0%	38.7%	29.3%*** 10.7%***	21.3%	12.0% 9.3%
All industries combined***	34.0%	17.0%*** 23.7%***	34.1%	23.9%*** 15.1%***	15.1%	10.9%*** 5.0%***

*** Significant at 0.01 level
** Significant at 0.05 level
* Significant at 0.1 level

Table 7: The percentage of the reports that have supply chain related factors by industry sectors, highest being shaded

It is observed that inbound related factors are more frequently mentioned in analyst reports for companies from the consumer products, food and beverage (43%) and metal (68%) industry groups. *Process*-related factors, such as capacity and inventory, are the most frequently mentioned for the companies from metals (56%), motor vehicles and parts (46%), machinery and petroleum refining (39%) electronics, and electrical equipment industry (38%). *Outbound*-related supply chain information is the most frequently mentioned supply chain factor (37%) for the companies from the retail and wholesale industry group. Further research is needed to understand why certain factors are more important to which industry sector. In any case, our results indicate that different aspects of the supply chain – inbound, process or outbound – may be of greater interest in some sectors than others.

Regarding inbound related supply chain information across all companies, more reports (24%) contain negative information than the positive (17%), while for the process and outbound the opposite was true. Within the group for inbound related information, this pattern of more negative than positive information was quite consistent across industries

except for the retail and wholesale industry (overall, supply chain related information for the retail and wholesale industry has appeared in a more positive light in the reports). For process-related information, the results from the different industries overwhelmingly supported the focus on more positive information, with the exception of aerospace and defense; and pharmaceuticals, where analyst reports contained very little supply chain related information to start with. The same was also true for outbound-related information with the only exception being pharmaceuticals, which in this category shows a higher ratio of positive to negative information.

4.2. Cluster Analysis for Patterns at Company Level

We conducted cluster analysis at the company level to identify any patterns of how analysts perceive the supply chain related information about individual companies. First, we converted multiple reports about a company into a single data point of the percentage of the company's reports containing overall inbound, process and outbound related supply chain information. For each company therefore, we had three variables. After removing companies whose reports did not contain any supply chain related information, we had supply chain information for 137 companies of the original 145 companies in our sample. Then, we investigated what type of supply chain related information was reported by analysts.

We used cluster analysis because it is frequently used for exploratory purposes and for empirical classification (Hair *et al.*, 2010; Punj & Stewart, 1983). We used Punj and Stewart's (1983) two-stage clustering method, which involves conducting a hierarchical cluster analysis to obtain the number of clusters and the initial seed points (Stage 1) and using the output of the previous stage to do non-hierarchical partitioning (Stage 2). This is because non-hierarchical clustering methods are known to be less susceptible to outliers and inclusion of irrelevant variables as long as seed-points are provided before partitioning (Punj and Stewart, 1983). In our case, the results of the cluster analyses over two stages suggested the following four-cluster solution of companies. Table 8 presents the average percentage of the total reports of a company in a group containing specific supply chain related information.

I. *Base group* (52 companies): The first group is the largest and represented the companies where there was some mention of all three different types of supply chain related information but only occasionally (e.g., on average, only 13.0% of the reports of a company in this group containing process-related information). This suggests that

analysts do not frequently use supply chain related information of these companies as a basis for justifying quantitative parts of their reports, e.g. recommendations, nor consider that providing investors with such information may be necessary.

II. *Process-focused group* (39 companies): The second group represented those where a significant amount of the analyst's attention was on their internal processes and their effectiveness in inventory and capacity management was emphasized in the analyst reports. On average, more than half of the reports of a company in this group contain process-related information, which is the highest among four groups. On the other hand, the appearance of supply chain information on inbound and outbound factors are among the lowest (inbound, 16.5% and outbound, 7.0%).

III. *Inbound-focused group* (29 companies): The third group represented the companies receiving great amount of analysts' attention primarily on the supply side and secondarily on the process-related aspects of their supply chains. On average, more than three quarter of the reports of a company from this group contained mention of inbound supply chain related factors, the highest among four groups. The emphasis for the process is similar to the companies in cluster II. This suggests that analysts believe supply chain related information for these companies is essential for producing their recommendations, target price and earning forecast and investors also want such information.

IV: *Outbound-focused group* (17 companies): The last group is the smallest in terms of the membership and represented those companies where analyst reports mentioned supply and distribution related information significantly more than processes or on inbound related information. On average, 68.0% of the reports from a company from this group contain outbound supply chain related information. This figure is significantly higher than the mean value for the other groups at 8.4%

. The inbound aspects of their supply chain also attracts analysts' attention.

	I: Base	II: Process Focused	III: Inbound Focused	IV: Outbound Focused
Inbound***	23.9%	16.5%	76.7%	45.0%
Process***	13.0%	56.0%	55.4%	28.9%
Outbound***	10.4%	7.0%	6.9%	68.0%
Number of companies	52	39	29	17

*** Significant at 0.01 level
** Significant at 0.05 level
* Significant at 0.1 level

Table 8: Mean values of the percentages of the total reports with specific type of information (inbound/process/outbound) for each cluster, highest percentage shaded for each cluster

The results of the cluster analyses suggested that analysts tend to perceive supply chain related information at company level at different parts of the supply chain depending on the company. However, this pattern does not lend itself to all industry sectors (Table 9). For example, with regard to the metal industry group, the majority of the companies belong to 'inbound-focused group' which focuses issues like raw material price, however, this pattern is weaker in other groups (Table 9). This might suggest that analysts tend to consider the company level supply chain factors as well as the industry level factors.

Cluster	I: Base	II: Process-focused	III: Inbound-focused	IV: Outbound-focused
Aerospace and Defence	5 (83.3%)	1 (16.7%)	0 (0.0%)	0 (0.0%)
Computer, Communications Equipment and Semiconductor	6 (37.5%)	5 (31.3%)	4 (25.0%)	1 (6.3%)
Consumer Products, Food and Beverage	9 (50.0%)	2 (11.1%)	4 (22.2%)	3 (16.7%)
Electronics, Electrical Equipment	5 (29.4%)	8 (47.1%)	2 (17.6%)	1 (5.9%)
Metals	3 (20.0%)	2 (13.3%)	10 (66.7%)	0 (0.0%)
Motor Vehicles and Parts	9 (37.5%)	9 (37.5%)	4 (16.7%)	2 (8.3%)
Machinery and Petroleum Refining	4 (28.6%)	6 (42.9%)	3 (21.4%)	1 (7.1%)
Pharmaceuticals	5 (71.4%)	2 (28.6%)	0 (0.0%)	0 (0.0%)
Retail and Wholesale	6 (30.0%)	4 (20.0%)	2 (5.0%)	9 (45.0%)

Table 9: Industry distribution across the four-cluster classification of companies

4.3. Logistic Regression to Test the Link between SCM Information and Analyst Recommendations

We used logistic regression to see if there was a link between supply chain related information in the reports and the recommendations made by the analysts. To do so, first,

we discarded the reports with no supply chain related information and conducted the analyses on the remaining 589 reports. The reason for this is that we want to limit the scope of the analyses for those with supply chain related information only.

Then we consolidated the three positive supply chain related variables (input/process/output) for each report into a single variable ("Positive SC Information" and then did the same for all the three negative variables, aggregating them into another variable ("Negative SC information").

We conducted a multinomial logistic analysis using a dependent variable consisting of *buy*, coded as 0, *sell* coded as 1, and *hold* coded as 2 in order to test whether there was a link between the type of supply chain information (positive or negative) and the analysts' recommendation (Table 10). The model fitting criteria -2LL (log likelihood) for the intercept-only model was 0.158. Adding the independent variables (the positive and negative supply chain information) decreased the -2LL (log likelihood) to 0.133 (significant at 0.05). This suggests that the model with the independent variables – 'Positive SC information' and 'Negative SC information' – explains a significant amount of the original variability and provides better fit than the intercept-only model.

Effect	Model Fitting Criteria		Likelihood Ratio Tests	
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Buy/sell/hold recommendation				
Intercept	29.936	0.000	0	0.000
Positive SC information	37.353	7.417	2	0.025
Negative SC information	67.983	30.046	4	0.000

Table 10: Likelihood ratio test for the multinomial logistic model with dependent variable 'buy/sell/hold' (0/1/2)

Goodness-of-fit statistics, Pearson ($p = 0.394$) and deviance ($p = 0.527$) suggest that the model is a good fit to the data (Field, 2009). Pseudo R^2 values were low (Cox and Snell = 0.024 and Nagelkerke = 0.028), however, it did not cause a concern since low Pseudo-R^2 values in logistic regression are common and they are more useful in evaluation of competing models rather than assessing goodness-of-fit (Hosmer and Lemeshow, 2000).

The likelihood statistics indicate which independent variables significantly enable us to predict the outcome (Field, 2009). Table 11 indicates that 'Positive SC information' has a significant main effect on the recommendation issued by analysts. However, the

'Negative SC information' was not significant, suggesting that it may not have had an impact on the type of recommendation made by the analysts.

Given that our dependent variable is the multinomial *buy*/*sell*/*hold* recommendation, we further investigated how the type of supply chain information (positive or negative) was linked to the incremental odds of the *sell* versus *buy* recommendation as well as to the *hold*-versus-*buy* recommendation. We chose the *buy* recommendation the reference category, as this suggests creation of shareholder value. The results show that positive supply chain information is linked significantly to incremental odds for the two decisions. As in the previous model, negative supply chain-related content is not linked to either (Table 11).

Recommendations	*B (SE)*	95% Confidence Interval for Odds Ratio		
		Lower	Odd Ratio	Upper
Sell recommendation versus *buy* recommendation				
Intercept	-2.380(0.000)***			
Positive SC information	0.793(0.059)*	0.970	0.653	5.029
Negative SC information	0.425(0.318)	0.665	1.204	3.517
Hold recommendation versus *buy* recommendation				
Intercept	-0.639(0.000)***			
Positive SC information	0.518(0.022)**	0.803	0.733	2.614
Negative SC information	0.216(0.331)	1.241	1.011	1.916

Table 11: Multinomial logistic regression results. Note: R^2 = 0.017 (Cox and Snell), 0.020 (Nagelkerke). $\chi^2(2)$ =16.834, p < 0.1. p < 0.05, ** p < 0.01, *** p < 0.001.*

As a final step, we calculated the conditional probability of the analysts issuing a certain recommendation *given* that the supply chain-related content was positive. This helps shed further light on how positive information is tied to the *buy*/*sell*/*hold* recommendation. We did not do this analysis for negative information because we have already seen that this orientation is not linked significantly. The results show that, given the condition that an analyst report contains positive supply chain information, the conditional probabilities for buy, sell, and hold recommendations were 47.82%, 9.78% and 42.39% respectively (Table 12). This means positive supply chain information is linked to *buy* and *hold* recommendations.

Recommendation	$P(Y = j \mid x) = \frac{e^{g_j(x)}}{\sum_{k=1}^{n} e^{g_j(x)}}$	Conditional probability
Buy	$P(\text{Sell} \mid x) = \frac{e^{-1.782}}{e^{-1.782} + e^{-0.437} + e^{0}}$ $P(\text{Buy} \mid x) = \frac{e^{0}}{e^{-1.782} + e^{-0.437} + e^{0}}$	47.82%
Sell	$P(\text{Hold} \mid x) = \frac{e^{-0.437}}{e^{-1.782} + e^{-0.437} + e^{0}}$ $P(\text{Sell} \mid x) = \frac{e^{-1.782}}{e^{-1.782} + e^{-0.437} + e^{0}}$	9.78%
Hold	$P(\text{Buy} \mid x) = \frac{e^{0}}{e^{-1.782} + e^{-0.437} + e^{0}}$ $P(\text{Hold} \mid x) = \frac{e^{-0.437}}{e^{-1.782} + e^{-0.437} + e^{0}}$	42.39%

Table 12: Conditional probability of a recommendation positive supply chain information in the report.

Overall these results suggest supply chain related information is related to the type of recommendations issued by the analysts. In particular, it is positive supply chain related content that appears to matter in the sense it is linked to the recommendation of an equity analyst. The results are broadly in line with the findings by Easterwood & Nutt (1999) that analysts react more to positive news than to negative news.

5. Discussion and Future Work

In this paper, we investigated the supply chain information in equity analyst reports to understand its characteristics (section 4.1 and section 4.2) and its link with what analysts recommend regarding buying/selling/holding the shares (section 4.3), and thus what this signals about shareholder value.

Upon characterizing the supply chain information in equity analyst reports, we find that equity analysts do use and provide supply chain related information for the most part section 4.1). True, we restricted ourselves to sectors that have supply chains, excluding sectors like banking. Still, we found that nearly three out of every five reports had supply chain related information. This itself is a useful finding and we could argue that it reflects the importance of the supply chain to any company's shareholders, senior management and therefore to analysts, who then incorporate relevant supply chain information in their reports.

Recall that our underlying theory is agency theory, whereby shareholders are at a disadvantage as regards managers' actual behavior. In this view, analysts exist to reduce the information gap by providing analyst reports. Indeed, shareholders are far removed from the details of a company's supply chain and how in the past the supply chain impacted on profits or might do so in the future.

Our finding then that three-fifths of reports of companies have information on their supply chains, suggests that supply chain issues are a part of the information asymmetry and significant enough to be included in the reports. Moreover, by aggregating this information at the company level, we found that among the 145 companies in our sample of 1028 reports, nearly 95% (137 companies) had at least one report containing supply chain related information in 12 quarter periods between 2009 and 2011.

The next set of findings (section 4.2) was about the detailed nature of the information as regards the specific aspect of the supply chain – inbound, process, and outbound. Our cluster analysis at the company level using variables that reflect each specific supply chain aspect show that analysts seems to focus for the most part on a particular aspect of the supply chain when it comes to a company. A particular company may belong to a cluster for which analysts appear to focus on the inbound side of the supply chain. This makes sense: for a particular metals company, the inbound side may be important while for a retailer, outbound issues may be more important. This might suggest that analysts tend to consider the company level supply chain factors as well as the industry level factors.

However, we also saw that the analysts' view is not totally sector-specific so entire sectors of companies in our sample do not belong to the same cluster. This means that analysts are discerning about specific company issues – one retailer may have persistent issues on the inbound side while another may have notable strengths on the outbound side. If so, analysts are certainly aiming to provide value to shareholders by providing supply chain information specific to the company.

Next (section 4.3), we tried to link the interpretation of the supply chain information – whether positive or negative – to the analyst's recommendation by way of *buy*/*sell*/*hold*. Our logistic-regression analysis suggested that positive supply chain related information is significantly linked to analysts' recommendations. This suggests that equity analysts believe supply chain related information is important to justify their recommendations either directly or by linking that information to earnings forecasts or target stock price and linking these to their recommendation. It may well be that analysts use the supply

chain information they gather from a company's managers (e.g., via the 'analyst call') or from the press or other third party sources to make their recommendations.

However, there is much further work to be done on this issue. Recall that our findings highlight the significance of positive information. It is not clear why negative information is not equally or possibly more useful. One could argue that an analyst could use negative information to inform a sell or hold recommendation. Moreover, further work is needed to study the frequency analysis at the report level, company level and eventually across sectors, to answer questions that arise about why a report focuses on a particular aspect of a company's supply chain. For example, the majority of the reports from the metal industry referred to supply chain related factors, while only around a quarter of the aerospace and defense reports did so. The supply chain information could be specific to the time at which the report was written, it could be specific to the company in terms of its supply chain strengths and weaknesses, or it could be important for a particular sector. A more systematic study is required with analysis of many more reports as well as through interaction with analysts to shed light on what might be an important determinant of shareholder value from an analyst's viewpoint: (a) timing, (b) a company's supply chain competence in handling inbound, process and outbound aspects of its supply chain, and (c) the particular sector to which the company belongs.

The orientation of the information – positive or negative – raises similar questions and the need for further research on the findings from frequency analysis. We observe such patterns as that the information is generally negative for inbound information but positive for both process and outbound information. We could speculate that supply chain risk is generally associated with suppliers so negative information may be linked to the inbound side. Alternatively, the sharp commodity price rise between 2009 and 2011 (Inamura et al., 2011) could be a reason why analysts viewed inbound issues with a negative orientation in the reports in our sample. As such further work is needed.

6. Conclusion

We used content analysis to code text from 1028 equity analyst reports of Global Fortune 500 companies with supply chains, published between Q1-2009 and Q4-2011. We used descriptive statistics and cluster analysis to explore the kind of supply chain related information mentioned in these reports from a manager-investor communication viewpoint. Subsequently we used logistic regression to investigate links between the

supply chain related information, including its orientation (positive or negative) with the buy/sell/hold recommendation of the analyst.

Considering the impact of analyst reports on the stock price (Abdel-khalik & Ajinkya, 1982; Asquith et al., 2005; Francis and Soffer, 1997; Lys & Sohn, 1990 and Stickel, 1991) and how investors value such reports (Bradshaw, 2011; Bonner et al., 2003; Chen et al., 2005; Maine et al., 1997; Mikhail et al., 2004), our findings suggest a new way of approaching shareholder value from the viewpoint of information asymmetry between shareholders and managers, with the gap being closed by analysts. Analysts are important communicators to investors of shareholder value being created (and expected to be created) by the company. Managerial implications of this work then relate to the type of information managers can provide to their shareholders via the analysts. Clearly, analysts do care about the company's supply chain capabilities.

Analyst reports about companies are an important source of secondary data that researchers can exploit to better understand the link between supply chain initiatives or supply chain performance to company performance as measured by income or stock price. In addition, analyst reports also provide the analyst's forecast of income and stock price as well as his or her recommendation to buy, sell or hold the stock. In a world where much attention is focused on what to do with 'big data', we find a valuable source of secondary data that has potential for theory building and implications for managers.

Acknowledgements: The authors would like to thank two anonymous reviewers for their thoughtful comments.