Information demand and stock market volatility

Nikolaos Vlastakis [a], Raphael N. Markellos [b,*]

[a] *Essex Business School, University of Essex, Wivenhoe Park, Colchester, Essex CO4 3SQ, UK*
[b] *Norwich Business School, University of East Anglia, Norwich NR4 7TJ, UK*

ABSTRACT

We study information demand and supply at the firm and market level using data for 30 of the largest stocks traded on NYSE and NASDAQ. Demand is approximated in a novel manner from weekly internet search volume time series drawn from the recently released Google Trends database. Our paper makes contributions in four main directions. First, although information demand and supply tend to be positively correlated, their dynamic interactions do not allow conclusive inferences about the information discovery process. Second, demand for information at the market level is significantly positively related to historical and implied measures of volatility and to trading volume, even after controlling for market return and information supply. Third, information demand increases significantly during periods of higher returns. Fourth, analysis of the expected variance risk premium confirms for the first time empirically the hypothesis that investors demand more information as their level of risk aversion increases.

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1. Introduction

Information is the most valuable and highly sought asset in financial markets. Unsurprisingly, a voluminous literature examines the intricacies between announcements, news and market activity. Probably due to data limitations, previous research efforts concentrate solely on exploring the role of supply of financial information. This is only one side of the story since the importance of demand for information is theoretically well established (see, for example, Kihlstrom, 1974; Grossman and Stiglitz, 1980; Radner and Stiglitz, 1984; Allen, 1990). In the present paper we exploit a new dataset to proxy intertemporal information demand on the basis of internet search volumes. This approach recognizes the fact that the internet has nowadays revolutionized the production, intermediation, dissemination and consumption of information in the financial industry (see Barber and Odean, 2001; Antweiler and Frank, 2004; Rubin and Rubin, 2010). Our dataset allows us to investigate for the first time the effects of information demand at the individual stock and at the overall market level, respectively. By controlling for information supply and by looking into both contemporaneous and dynamic relationships, we are able to shed light on issues related to the information formation and discovery pro-

cess. Finally, by associating our novel proxy with the expected variance risk premium we can evaluate the validity of a longstanding hypothesis according to which demand for information is positively related to the level of risk aversion.

Our empirical application focuses on 30 of the largest stocks traded on the New York Stock Exchange (NYSE) and NASDAQ. Proxies of idiosyncratic information demand for each stock are built on the basis of measures of the popularity of the company name as a keyword in the most popular internet search engine. Accordingly, information demand for the overall market is proxied using S&P 500 as the search keyword. In order to control for the known effects of information supply, we also take into account the number of firm-specific news stories along with the total number of news stories reported by the Reuters NewsScope service. Information demand for the stocks in our sample is shown to vary stochastically along a deterministic trend with seasonal regularities. Demand and supply tend to be positively correlated at the contemporaneous level while their dynamic relationship is characterized by causalities running in both directions. Overall, our results demonstrate that variations in information demand have a significant effect at the individual stock and overall market level in terms of historical volatility and trading volume. This effect is robust even after controlling for variations in the supply of information and in the market return. Market information demand has a consistently positive effect on all measures of market activity. However, the effect of idiosyncratic information on risk is mixed in direction and strength

* Corresponding author. Tel.: +44 (0)1603 59 7395.
  E-mail addresses: nvlast@essex.ac.uk (N. Vlastakis), R.Markellos@uea.ac.uk (R.N. Markellos).

and diminishes if an implied measure of volatility derived from options market data is used to represent market activity. Our analysis also suggests that the effect of information demand on market activity becomes stronger in "high return" market states. Finally, we analyze expected variance risk premia for the S&P 500 and confirm the hypothesis which postulates that information demand increases along with the level of risk aversion in the market.

The next section reviews the relevant literature and outlines the theoretical and methodological background. Section 3 discusses the datasets for measuring information demand and supply and offers a preliminary descriptive analysis. This section also presents the results of our empirical application. The final section concludes the paper.

2. Background and theoretical framework

2.1. Information supply

The link between information flow and financial markets is well known to financial economists (see, for example, Fama et al., 1969; French and Roll, 1986). The widespread hypothesis is that measures of market activity – such as return volatility and trading volume – are directly related to the rate of arrival of information in the market. A relevant strand in the literature stems from the so-called "Mixture of Distributions Hypothesis" (Clark, 1973; Epps and Epps, 1973; Tauchen and Pitts, 1983; inter alia) (MDH henceforth). The MDH provides an explanation to the observed link between volatility and trading volume by imposing a joint dependence of both volume and returns on a latent information process. A direct consequence of the MDH is that the observed patterns in market activity, such as volatility persistence, are a reflection of similar patterns in information flow.

Since information is not directly observable, any attempt to empirically study its effect on financial markets requires the use of some proxy for information flow. For example, Mitchel and Mulherin (1994) derive a metric of information flow by using the number of macroeconomic and firm-specific news announcements released by Dow Jones and Company on the Broadtape and in the Wall Street Journal. They find that the flow of information displays patterns by time of day, day of the week and month of the year, respectively, in line with the behavior of asset prices. They also find evidence of a statistically significant relation between information and volume, but a weak relation to volatility. In a related study, Berry and Howe (1994) study the number of news announcements in the Reuters North American Wire. In line with Mitchel and Mulherin (1994) they find seasonal patterns in the arrival of news. They also document a significant difference in the flow of news between trading and non-trading hours and argue that this may explain the differences in volatility observed by French and Roll (1986). Ederington and Lee (1993) find a strong link between scheduled macroeconomic announcements and the volatility of interest rate and exchange rate futures, respectively.

A distinction sometimes made in the literature is between market-wide and firm-specific information. Thompson et al. (1987) study the properties of firm-specific news reported in the Wall Street Journal Index for 1983 and report that news coverage varies with respect to firm size, industry, day of the week and month of the year, respectively. They also find that several firm-specific news categories have a statistically significant impact on stock returns. More recently, Ryan and Taffler (2004) study a sample of the largest 350 firms listed on the London Stock Exchange and present evidence that firm-specific information releases are a highly significant determinant of both individual stock price changes and trading volume activity. Some researchers derive a general measure of information flow that incorporates both firm-specific and market-wide information (eg., see Mitchel and Mulherin, 1994; Berry and Howe, 1994).

Little attention is devoted in the literature on measuring the separate impact of idiosyncratic and market-wide information on individual stock activity. Bessembinder et al. (1996) examine the relationship between trading volume and proxies of idiosyncratic and market information using data on portfolios of firms which differed in terms of market capitalization. They show that firm-specific information has a positive impact on trading activity for all firms, but that the effect is stronger for small firms. Moreover, they report that market-wide information has a significant impact on larger firms, but a negligible impact on small firms. Notwithstanding, the authors do not employ explicit measures of information flow based on news announcements or some other similar information variable, but rather use indirect proxies. Specifically, they use the volatility of returns to a diversified portfolio to approximate market information, and absolute deviations of individual firm returns from market-model expected returns as a measure of idiosyncratic information. The adoption of these variables has the additional disadvantage of inhibiting the examination of the relationship between information flow and volatility, as it is explicitly assumed that such a relationship exists.

Since simple measures of information supply cannot capture the actual impact of news or announcements for investors, some studies attempt to control for the importance of information. For example, Mitchel and Mulherin (1994) consider measures such as the number of topics covered by an announcement, the size of New York Times headlines, and the occurrence of monthly macroeconomic announcements. Klibanoff et al. (1998) control for news salience which is proxied by the appearance of a news item on the front page of The New York Times. Ryan and Taffler (2004) first identify major market reactions and then study the news behind these reactions. Although their approach produces satisfactory results, focusing only on events that produce large reactions excludes a large amount of information and potentially overstates the effect of news on stock returns.

2.2. Information demand

In a famous seminal paper, Grossman and Stiglitz (1980) analyze a noisy rational expectations equilibrium. They show that equilibrium occurs when prices reflect only a portion of the information held by informed investors, which they call an "equilibrium degree of disequilibrium", so that perfect informational efficiency can never exist. This conclusion is based upon the rationale that as the percentage of informed investors increases, prices become more informative, thus the incentives to acquire information are decreasing (information substitutability). Another implication is that the demand for information, the percentage of informed traders, increases with the magnitude of noise. Veldkamp (2006) revisits the Grossman and Stiglitz (1980) model and instead of treating information as exogenous to the market, she replaces constant information price with an endogenous price which is set in a market characterized by increasing returns. The model features competitive information suppliers in a complementary market for information. Veldkamp shows that the inclusion of endogenous information in the Grossman and Stiglitz model has an important implication: increasing the number of informed investors increases the returns to information, since the price of information is a decreasing function of the quantity, thus information becomes a strategic complement. Moreover, she suggests that payoff volatility increases information demand, whereas information increases asset prices.

Moscarini and Smith (2002) study "internet conditions" by concentrating on settings where information has high demand but is available at a very small price. They derive an analytical formula