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"THE ROLE OF INFORMATION ON AFFECTING CAPITAL MARKETS EFFICIENCY: AN ANALYSIS BASED ON INSTANT COMPANY NEWS"

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Firma dello studente

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INTRODUCTION

The capital markets are characterized by the asymmetric information existing between those traders having an advanced knowledge of the fundamental values, the so called informed traders, and those who are uninformed. Exploiting this superior information is not easy and requires a series of choices on the aggressiveness, the size and the type of order to place, in order to have the possibility of making profits from such privileged position. However, the informed trading then causes prices to change and to incorporate such information. This leads to the concept of market efficiency, which has pervaded the capital markets literature since the second half of the last century and, in particular, since Fama (1970)'s paper, which defines efficient a market where *"prices always fully reflect available information"*.

Fama (1970) describes the efficient market theory in terms of fair game model and explains that the market can have different forms of efficiency (week, semi-strong and strong), depending on the level of information (historical prices, public information, and monopolistic information) reflected in the prices. In particular, in his review of the main tests conducted by the past literature, Fama provides large evidence sustaining both the weak form and the semi-strong form of market efficiency, whereas the strong form is defined as only a benchmark to detect the importance of deviations from market efficiency. Fama (1970)'s work, representing the cornerstone of the efficient market hypothesis, has been followed by a continuous debate, with researchers showing arguments clashing with the market efficiency and other providing answers to such criticisms and further developments.

Grossman and Stiglitz (1980) try to *"redefine"* the market efficiency, indicating how available information cannot be perfectly reflected in the prices, otherwise no one has incentive to acquire and analyse information, which is costly. This is only one of the arguments provided by the literature clashing with the market efficiency; indeed, other researchers focus also on the high prices variations, the overreaction and the underreaction to new information, the anomalies and the predictable patterns (e.g. "January effect" and "size effect"), the behavioural criticisms, the internet bubble and the global financial crisis.

Each of these criticisms has been followed by other studies providing different conclusions and sustaining the market efficiency. Among others, Malkiel (2003) underlines how markets are "*far more efficient and far less predictable"* than what is found by the critics.

Many empirical studies have also tried to directly test the market efficiency, examining whether prices rapidly adjust to various types of information, such as corporate announcements or analysts' reports; however, the results are quite variable, depending on the approach and the type of information that is used.

This vast and controversial literature makes it difficult to understand whether markets can be really considered efficient or not. So, in order to contribute to such topic, considering the studies provided by the literature, we propose and implement an empirical approach to test the informational market efficiency. In particular, we focus on the company news alerts provided by *Thomson Reuters Eikon* for some randomly selected companies listed on NYSE and with a high market capitalization, trying to examine the impact of such instant news on prices, trading activity and profitability.

In what follows, we proceed firstly considering the main literature on information and market efficiency and then providing our empirical research. More precisely, in the first chapter we focus on the role played by the information in the capital markets and, in particular, by the informed traders; in the second chapter we examine the concept of informational market efficiency, its development and all the debate characterizing the EMH; in the third and last chapter, considering the studies provided by the literature, we propose our empirical approach and discuss the main outcomes.

1. THE ROLE OF INFORMATION IN THE CAPITAL MARKETS: THE INFORMED TRADING

1.1 GENERAL OVERVIEW

The capital markets are pervaded by the presence of information asymmetry. In *"Trading & Exchanges"* Harris (2004) explains this situation as a condition in which *"traders who know more about values and traders who know more about what other traders intend to do have a great advantage over those who do not"*. Being all trades zero-sum games, the gains made by one side correspond to the losses of the other side; therefore, traders that have a high level of information make profits at the expense of those with a lower level of information. In the extensive literature dealing with information in the capital markets, we can essentially distinguish between two categories of traders: the informed and the uninformed. The first ones are speculators acting on fundamental information of the value of an asset that is not available to the others (Da Silva Rosa, Saverimittu and Walter, 2005), while the second ones are agents trading for liquidity purposes considering only public information and personal convictions (Martins and Paulo, 2014). The achievement of higher level of information is due to uncertainty on future payoff of a security coming from different dimensions, for example: the success of operations in traditional and new speculative lines of business of a firm, the technology that firms develop, the demand for products, the macroeconomic and industrial situation and the development of the firm (Goldstein and Yang, 2014).

The common classification of information is given by public, private or inside information. Informed traders refer to private information, that is the one that a trader obtains through analysis and investigation, or inside information, that is the one that only few specific individuals can obtain (management of a company, investment bankers, corporate officers etc.). Public information is

available to all traders and is the only information that uninformed traders can use for their trades (Hachmeister, 2007).

Before starting with the analysis on informed traders and their impacts on the market, a general understanding about the most important points in the relationship existing between information and capital markets can be helpful.

In *"Information and Capital Markets"* Stiglitz (1981) starts posing the two contrasting views present in the stock market about information. The first one refers to the fact that if prices reflected values, no one would acquire information and no informed market equilibrium can exist. Also, because insiders gain from outsiders, rational outsiders will decide not to trade. The second view is the one by Hirschleifer, for which in a pure exchange economy the incentives to obtain information are strong, because informed individuals can have a profit out of capital gain. In these two hypothesis we have that for one there may be no acquisition of information even in presence of social return, while for the other one there may be some investment in information even in absence of social return.

Stiglitz (1981) argues that both positions are incorrect: the first one because does not identify the role in providing information of the seller of securities, the imperfect conveying of information from informed to uninformed and the possible presence of monopolies of particular individuals on some information; the second one because irrationality and/or non-competitive behaviour are implicitly assumed.

According to Stiglitz (1981), in a competitive contest exists limited incentive for acquiring information of general value and in a limiting case of pure exchange economy the equilibrium is given by no information acquisition and no trade; however, in general cases with different individuals, incentives for obtaining new information are present, but if information is costly, it is imperfectly reflected in prices.

However, in the stock markets trades do take place and the acquisition of information about particular instruments is considerable. Explanations are related to the fact that not all individuals are rational and the endowments of individuals are different so that, even with the same information, trade is desirable (Stiglitz, 1981).

This general part introduces the following paragraphs entering more in detail in the analysis of the informed traders and their strategies, that will help us in the study of our topic: the role of information on affecting market efficiency.

1.2 INFORMED TRADING: INTRINSIC VALUE AND DIFFERENT TYPES OF TRADER

As we said above, informed traders acquire and trade on information about fundamental values, called also intrinsic value (see *Paragraph 1.2.1*). More precisely, they estimate the fundamental values basing on private and public information and they decide to buy when instruments have prices significantly below the estimates and to sell when prices are significantly greater than the estimates they make (Harris, 2004).

Informed traders gain if prices of their purchases rise and those of their sales fall, whereas they lose money if their estimates are not precise or, and this tends to be valid only in the short-term, if their estimates are accurate but prices move away from fundamental values (then in the long run prices tend to revert to fundamental values).

The basic point is the estimation of the intrinsic value, so before trying to understand the different informed trader types and their characteristics, it is useful to describe and analyse more in detail what is the fundamental value.

1.2.1 FUNDAMENTAL VALUE: THE TRUE VALUE OF AN INSTRUMENT

The fundamental value measures the true value of an instrument. It is security value, justified by some factors such as earnings, dividends, assets and management quality (Scott, 2003). The intrinsic value is related to the expectation of the performance of an instrument (Ohanian, 1996) and is given by the expected present value of present and future benefits and costs relative to the instrument (Harris, 2004).

The fundamental value is the central point of fundamental analysis, since it tries to find the value of an individual stock, which is then to be compared with the market value (Scott, 2003); the market value is the trading price of a security at which it could be purchased and sold (Harvey, 2012). The difference between intrinsic and market value is noise; if it is zero, prices are completely informative.

A particular point of view about this difference is given by Black (1986), who considers to be informative those stock prices which are between one-half and twice their intrinsic value.

The intrinsic value is driven by private, or internal, opinions and expectations (Wright, 2016) and because analysts have different views and information, the estimation of the fundamental value of a particular stock is often characterized by a great level of disparity (Scott, 2003).

Informed traders use different ways to estimate fundamental values (see *Paragraph 1.2.2*), with

the same aim of finding the real value of the instruments and so trying to make a profit by buying or selling those instruments.

Therefore, the next step is to describe and explain the different categories of informed traders with their different approaches in the estimation of the intrinsic value.

1.2.2 INFORMED TRADERS: CLASSIFICATION, CHARACTERISTICS AND INTRINSIC VALUE IDENTIFICATION METHODS

Informed traders (as also parasitic traders: order anticipators and bluffers) can be included under the category of speculators which are part of the wider group of profit-motivated traders. Informed traders, depending on their characteristics and on the way by which they identify the fundamental value, can be divided in four different categories: value traders, news traders, information-oriented technical traders and arbitrageurs.

Value traders try to estimate the intrinsic value of an instrument by acquiring the highest possible level of information about economic activity, sales, costs, options of growth, technology development and management quality and applying on such information specific economic models (Harris, 2004). In this way they obtain a better knowledge of values than anyone else to buy/sell instrument they believe to be undervalued/overvalued.[1]

The idea on which value trading is based is the one by Graham and Dodd. The main point is that value traders seek to buy stocks at lower level of the intrinsic value, which is computed discounting future cash flows. So when the price of a stock is lower than the intrinsic value by a margin of safety[2] it is worth to buy (Harvey, 2016).

A value trader clearly needs to be assisted by lots of experts with the aim of finding the best estimates. These experts include financial analysts, actuaries, statisticians, accountants, computer programmers, engineers, economists and so on. This makes clear the great effort required to make this type of trading work; only those traders who know how hard is value trading and stay put can earn superior returns (Harvey, 2016)

Value traders in their estimations have to be really careful: if they are too much optimistic, they may purchase a security even in case of overvaluation; if they are too pessimistic they may sell

[1] This allows them also to play the role of lender of last resort (Harris, 2004), supplying liquidity both directly and indirectly (by the intermediation of dealers) to uninformed traders.

[2] The margin of safety is usually given by the 30% of the fundamental value (Harvey, 2016).

even in presence of undervaluation. Therefore, as a solution, a pyramid-shape organization is adopted, in order to have more levels controlling the operate of the levels below (Harris, 2004).

News Traders, differently from value traders, take their trading decisions according to market news announcements. They try to predict the short-term reactions of the market to a particular news. With their experience and historical data, news traders try to understand if an instrument will increase or decrease because of a particular future news. Essential for a news trader is to be quick to respond but also to be among the first to obtain the news. Since nowadays information remains new only for a fraction of second, engines based on algorithms filter text online assessing its importance in order to eventually execute the trade (Harvey, 2016).

A particular contribution to the analysis of this type of trading is given by Foucault, Hombert and Rosu (2013) in *"News Trading and Speed"*. They start from the fact that information in news is not incorporated into prices immediately, that is there is the possibility to profit from news trading. This finds (non-exclusive) explanations in the fact that news traders could process information in a more efficient way and that they may react faster to news.

The authors consider a model similar to Kyle (1985). In the baseline model the informed investor (the speculator) processes news more efficiently but has no speed advantage in receiving news with respect to dealers; in contrast, then they analyse also the case in which the speculator receives news faster than dealers. Foucault, Hombert and Rosu (2013) find that the optimal trading strategy in these two cases is different. With no speed advantage, the optimal trades of the speculator are determined by the difference between his and dealers' estimate of the asset payoff[3]. Differently, in case of advanced access to news, the news affects his trading over and above its effect on the forecast error of the dealers, so the news becomes a distinct determinant of speculator's strategy; also, with speed advantage, the optimal trading strategy is more sensitive and responsive to news. Therefore, this together with the other results provided by the model underlines how speed can play a crucial role in news trading (Foucault, Hombert and Rosu, 2013).

A particular focus on the analysis of news traders is to be reserved to insider traders.

Doffou (2003) defines insider trading as "*the sale or purchase of securities by corporate insiders, using monopolistic information to their advantage to generate abnormal returns"*. With monopolistic information he refers to non-public information which has the characteristics to be material, privileged and price sensitive. Therefore, insider trading indicates the use of this

[3] That is dealers' forecast error (Foucault, Hombert and Rosu, 2013).

privileged type of information by those who obtain it performing their professional duties (the insiders) or by those who receive it from insiders (Linciano, Macchiati, 2002). So, for example, insider trading on information related to mergers, stock splits or dividends increases is clearly profitable before the announcement of such events.

For a better understanding of insider trading it could be useful to list some pros and cons. Leland (1992) identifies as positive aspect of insider trading the presence of new and useful information in the price; this reduces the risk for decision makers and, as consequence, will increase the asset prices and real investment. Among the cons Leland (1992) underlines: the "unfairness" of the market with the consequent lower investment of outsiders but also the lower level of asset prices and real investment; the reduction of market liquidity; the higher volatility of current stock prices. However, the plurality of studies and analyses characterizing this topic does not seem to have different impact on the policy adopted by different countries, which in general agree on prohibiting insider trading (Linciano, Macchiati, 2002). In particular, the data-set built by Bhattacharya and Daouk (2002) indicates how 87 on 103 countries having a stock market in 1998 have a regulatory on insider trading; among these 87 countries appear all the industrialized countries and the 80% of the developing ones (Linciano, Macchiati, 2002).

The first to regulate insider trading were the US: in 1934 the U.S. Congress decided it was not good for financial markets and since that time it has been regulated in U.S. by the SEC (Doffou, 2003). One of the most important and famous case of illegal insider trading is the one of Texas Gulf Sulphur Company. The company between 1959 and 1963 found and confirmed the possibility of valuable deposits of silver, copper and zinc in an area of Ontario. As Hu and Noe (1997) explain, the company adopted controls not to leak the information to outsiders, while directors, employees and officers of the company bought shares and call options on the company or said other people to buy stocks or options on the company. After the announcement the price grew up, resulting in a large gain for those with that privileged information. Anyhow the SEC in 1965 filed a suit[4] against them and won the case (Hu and Noe, 1997).

Proceeding in our analysis, another type of informed trader is given by the category of *information-oriented technical traders*. When we talk about technical traders[5] we refer to traders taking their investment decisions using a technical analysis. A technical analysis has the aim to forecast the

[4] The charges referred to the violation of Rule 10(b)-5 of the Security and Exchange Act of 1934.
[5] Definition extracted from the "Farlex Financial Dictionary", Farlex Inc. (2012).

future securities prices from past market data, including price and volume (Guo and Xia, 2011). It is reputed the original form of investment analysis[6] and many of its techniques used today to detect hidden relations in stock return have been used for over 60 years (Brock, Lakonishok and LeBaron, 1992).

Technical analysis has been employed for long time by top traders, fund managers and experts, but academics have not agreed on whether it is really useful (Guo and Xia, 2011). It is seen as "*voodoo finance*" among some circles (Lo, Mamaysky and Wang, 2000) and Malkiel (1996) arrives to say that the chart-reading, typical of technical analysis, "*must share a pedestal with alchemy*". Although some studies refer to technical analysis as useless, recent analyses consider these conclusions premature. Indeed, despite its jargon and methodology, it is a good way to discover information from the market prices (Lo, Mamaysky and Wang, 2000). An important direct support to technical analysis, among many others, can be found in Brock, Lakonishok and LeBaron (1992). Their conclusions refer to the fact that returns-generating process of stocks is more complex than proposed by studies with linear models and those hidden patterns could be captured by technical rules[7]: the results of their paper are consistent with the predictive power of technical rules.

As we have seen, the forecasts made by technical traders are based on recurring price patterns; these price patterns can be caused by uniformed traders or by mistakes made by informed traders. In the first case technical traders act effectively as dealers or order anticipators, in the second case they become informed themselves and we have the so called information-oriented technical traders, who try to find patterns suggesting that prices are different from intrinsic value (Harris, 2004). Depending on the systematic mistakes of informed traders, successful trading opportunities decrease with maturity of the market and traders' experience. Therefore, information-oriented technical trading is quite difficult and rarely considerably profitable.

The last type of informed trader we analyse is the *arbitrageur*. Before trying to understand the mechanism of this informed trading, we start defining the arbitrage and in particular distinguishing among three different types: pure arbitrage, near arbitrage and speculative arbitrage.

In the first case two assets have identical cash flows but different market value; the strategy is given by selling short the asset with the higher price, buying the cheaper one and holding on the differences without future risk exposure. This pure arbitrage is rare and in general may occur in

[6] It dates back to the 1800s. The oldest technique is attributed to Charles Dow.

[7] The authors in the paper consider only two famous technical rules: moving averages and trading-range breaks.

derivatives markets[8] and in fixed income markets[9] (Damodaran, 2012).

Different is the case of near arbitrage: here you have two very similar assets priced differently or assets that are identical and mispriced but without guarantee that the prices will converge; independently from the strategy adopted, the position you decide to take is no longer riskless (Damodaran, 2012).

In the last case, speculative arbitrage[10], investors see assets that are similar and mispriced and they try to take advantage by selling the more expensive asset and buying the cheaper one; if they are right they should get a profit (Damodaran, 2012).

Our aim is not to enter in the detail of each type of arbitrage we have described, but to better understand the general features of this type of informed trader, the arbitrageur, which simultaneously buys and sells instruments that can be considered as similar.

After arbitrageurs have identified inconsistently priced instruments relative to each other, sold the ones they consider the more expensive and bought the ones reputed cheaper, they will get a profit in the case that expensive instruments depreciate and cheaper ones appreciate or in the case that the expensive/cheaper instruments depreciate/appreciate faster than the cheaper/expensive ones (Harris, 2004). What is essential is a good estimation of the differences in value between the instruments[11] but also the simultaneous buying and selling those similar instruments to have a protection against the changes of prices related to common factors. When we talk about *"similar instruments"* we refer to instruments whose value is related to common fundamental factors, that is industry, macroeconomic, physical, social or political variables (Harris, 2004).

An important effect of the arbitrageurs' trading is the enforcement of the so called *"law of one price"*. Indeed, the arbitrageurs try to take advantage from the differential, and the consequent buying and selling tend to eliminate the mispricing (Billingsley,2006). So in case of a correct identification of mispriced instruments, arbitrageurs help to make prices more informative.

We have focused on the different level of information among traders and on the different informed trading approaches, but what about the way to use this advanced information and the possibility to realize superior returns with respect to the less informed traders?

[8] Futures and options.

[9] Mainly in case of default-free government bonds.

[10] It should be clear that the speculative arbitrage for its characteristics is not really an arbitrage, but better a form of pseudo-arbitrage.

[11] Many are the possibilities used by the arbitrageurs for this estimation: statistical, economic or psychological methods.

1.3 How to exploit the informational advantage: some basic choices

1.3.1 Informed trading aggressiveness and size.

A basic decision for an informed trader, in order to use his privileged information in the best way, is to decide how to conduct his trades: aggressively or slowly. This decision, generally speaking, depends on whether the information is or will quickly become known by the other traders (and this implies to trade heavily) or whether it is possible to keep the informational advantage (and this implies to spread the trades) (Cao, 1995).

In Kyle (1985), a single trader with long-lived private information optimally takes advantage from his monopolistic signals over time; more precisely, when trading in continuous time, his private information is leaked out at a constant rate. Differently, in Holden and Subrahmanyam (1992), when two or more traders have the same information, they trade aggressively in order to try to beat the other equally informed, with the consequent quick revelation of their advanced information (Back, Cao and Willard, 2000).

A particularly interesting model is provided by Foster and Viswanathan (1994). They propose a dynamic trading model with two differently informed traders: one having all the private information and the other with only a subset of the information level of the first one.

In this setting the better informed trader is concerned to understand in which way his strategy affects the information acquisition level of the lesser informed trader other than of the market maker and to adopt accordingly the most appropriate strategy to minimize the transfer of information.

In order to reduce the transmission of its own advanced information to the lesser informed trader, the better informed is shown to trade very intensely in the first period on that information endowed by both traders but very little on its additional information. Than only in the later periods, once the common information has been dissipated through trading and the lesser informed has no more a learning advantage relative to the market maker, the trader with the better level of information starts trading on its informational advantage (Foster and Viswanathan, 1994).

A different but absolutely relevant study related to the topic under analysis is the one by Barclay and Warner (1993). Most theoretical and empirical models about the behaviour of informed trading do not focus on the decision about the trade size; but re-examining the data used in many empirical studies (even if they are only related to the insider trading case), it can be seen how informed use essentially medium-size trades[12]. According to Barclay and Warner (1993), an informed, given

[12] Between 500 and 9900 shares.

private signals on a security, has to decide the total share position and whether and in which way to break up trades[13]. The informed will decide the total share position taking into account some risk and portfolio considerations, whose impact may be difficult to be correctly quantified. Traders with valuable private information rarely will use small positions (with consequent small potential profit), while it is more likely to find individual traders that, because of their total wealth constraints and risk aversion, are limited to share positions of medium size or large traders taking large positions without being touch from such considerations. About the second decision relative to the breaking up, the choice of an informed to reach his share position in one or more trades depends on some specific factors. First of all, we have to consider the price concessions. These price concessions, whose components[14] are higher in case of larger trade size, can have a small impact in case that trades are spread over time. But, on the other side, spreading trades delays the desired share position with the possible consequence that in the meanwhile the information could be revealed. It is also to be considered the impact of brokerage commissions with a fixed cost per trade, which reduce the cost of reaching the desired share position when using only one trade.

Essentially it can be said that the share positions of medium size are likely to be acquired with a single trade because the reduction in price concessions arising from breaking up the trade is unlikely to offset the costs we have mentioned. Differently, in the case that the desired share position is large, the price concessions are substantial and there is a breaking up in more trades of medium size (Barclay and Warner, 1993).

The hypothesis of the model (the stealth trading hypothesis) studied by Barclay and Warner (1993) refers to the fact that if trades of privately informed traders are concentrated in medium sizes and the movements of prices are essentially caused by their trades, most of the cumulative change in prices will occur on medium-size trades. The study, using a sample of NYSE tender-offer targets, finds results for the preannouncement period that support this stealth trading hypothesis. In particular, trades of a medium size are the cause of the estimated 92.8% of the cumulative change in prices in the period considered. These results are not consistent with different hypotheses.

Barclay and Warner (1993) provide more generality to the results by investigating the sample securities also for a non-event period long before they experience a systematic unusual behaviour and also using a sample of all NYSE securities; in both cases the results are found to be consistent

[13] The model considers only these two aspects of the stealth trading, ignoring aspects such as the use of limit/market orders or the use of options.

[14] The permanent one that reflects the information revealed by the trade and the temporary one reflecting the compensation for the intermediary providing liquidity.

with the stealth trading hypothesis.

1.3.2 ADVANCED INFORMATION AND ORDER TYPE

As explained by most of the literature, the central point in the decision between limit and market order is the trade-off between transaction costs and execution certainty (Cooney and Sias, 2004). But what are in detail the consequences for an informed trader deriving from choosing one or the other order type?

Deciding to use a market order means that an informed trader can obtain immediate execution but has to bear those transaction costs related to the fact that in this case buy and sell orders are usually executed respectively at ask and bid price. Furthermore, the market order may indicate a higher probability of the presence of an informed trader because of the impatience revealed through this type of order choice; the risk is that this could be then followed by a consequent revision of the prices against the trader.

Differently from market order, a buy/sell limit order generally is executed at the bid/ask price. The risk with limit orders refers to the possibility that information could enter in the price before the informed trader reaches the desired position. In any case, patient limit trades are liquidity providers and are seen as less probable to be informed, so they generally are not followed by an unfavourable revision of the quotes (Cooney and Sias, 2004).

A fundamental study, in order to understand what type of order informed traders use, is proposed by Kaniel and Liu (2006). They show that, in case there is a high probability that information is long-lived, even after incorporating an order's impact on the price, informed traders have a preference for limit orders. They also demonstrate that the probability of using limit orders can be so high that they transmit more information than market orders.

Kaniel and Liu (2006) find that the longer the information horizon, the lower the execution risk of a limit order and consequently this increases the submission of this order type by informed traders. Another point touched by the study is about the level of the mispricing: if it is not so relevant, informed traders continue to prefer limit orders, but in case of a particularly high mispricing the cost of non execution increases, making informed traders more prone to market orders. The last point is about the quantity of uninformed, whose increase is demonstrated by the authors to increase the profitability of market orders more than that of limit orders, with the consequent preference of informed for the market orders (Kaniel and Liu, 2006).

A different analysis is conducted by Cooney and Sias (2004), who consider a third option for

informed traders to execute an order: using a floor broker. By considering the trading crowd, the quoted depth, the limit order book and what learned in the relation with other traders, a floor broker can better evaluate the liquidity of the market than a trader who is off-floor (Cooney and Sias, 2004). A floor broker is also able to reduce the impact of the order on the price by spreading his total order in smaller ones.

Differently from the most models, which ignore the role of floor brokers, Cooney and Sias (2004) show that, despite the high commissions, floor brokers, rather than limit or market orders, because of their distinct advantages account for most informed trading. They also demonstrate that informed floor brokers are sometimes patient in their trading and, resulting from the analysis to be the most informed traders and highly responsible for values movements, it is shown, differently from most trading models, that changes in prices of securities depend not only on initiators but also on patient traders (Cooney and Sias, 2004).

Therefore, the authors take distance from other studies referring to the same topic, introducing the figure of the floor broker, who results, beyond the other findings, to account for a higher volume of informed trading than limit or market orders, that are, as we have seen above, the only options generally considered by the other models.

1.4 DO INFORMED TRADERS REALIZE SUPERIOR RETURNS?

In the previous paragraphs we examined the asymmetric information between informed and uniformed, the intrinsic value, the various types and relative characteristics of informed traders and the basic decisions they take to exploit their superior information. But what about the performance deriving from being informed?

As it can be inferred from the previous paragraphs, the profits of informed traders are related to their capacity in predicting future values and to the effects of their trades on prices (Harris, 2004). According to Figlewski (1982), whether an informed trader can have an expected profit depends on the relation between information he owns and that already inside the price. In particular, it is possible to say that an informed trader can profit if the information he obtains has not been already discounted by the market and can signal to him how the market will move (Figlewski, 1982).

An interesting and complete model is developed by Da Silva Rosa, Saverimuttu and Walter (2005). In the literature it is commonly assumed that informed traders, considering they obtain advanced information from costly searches, can realize superior returns with respect to the uninformed;

nevertheless, before their model, there was no relevant study proving that informed are able to recover the costs of searching information through higher returns.

Therefore, Da Silva Rosa, Saverimuttu and Walter (2005) try to confirm that this general assumption is true, demonstrating that informed traders are compensated for those costs related to the information search.

Because of the lack of data, the other models studied only small groups of investors that are likely to have more information. Differently from these past studies, characterized by the difficulty to understand the level of information of specific traders and so their type (informed or uninformed), Da Silva Rosa, Saverimuttu and Walter (2005) use a panel giving for all firms that are listed on the ASX[15] the daily share ownership records. In this way they can develop some measures to look at the abnormal changes in the share register across various dimensions and evaluate the presence of informed traders in the register.

The results of the model indicate a positive and significant relationship between the abnormal share market performance and the level of informed trading. The study, and it is one of the first, gives evidence to the fact that informed traders can make higher returns and recover the cost for information acquisition[16]. However, beyond the other results, it is to underline that informed are found not to go in and out of the register before abnormal market performance, but as a response to such performance (Da Silva Rosa, Saverimuttu and Walter, 2005).

[15] ASX stands for Australian Stock Exchange, which provided the data used in the model.
[16] Take into account that the findings are not consistent across all measures considered in the model.

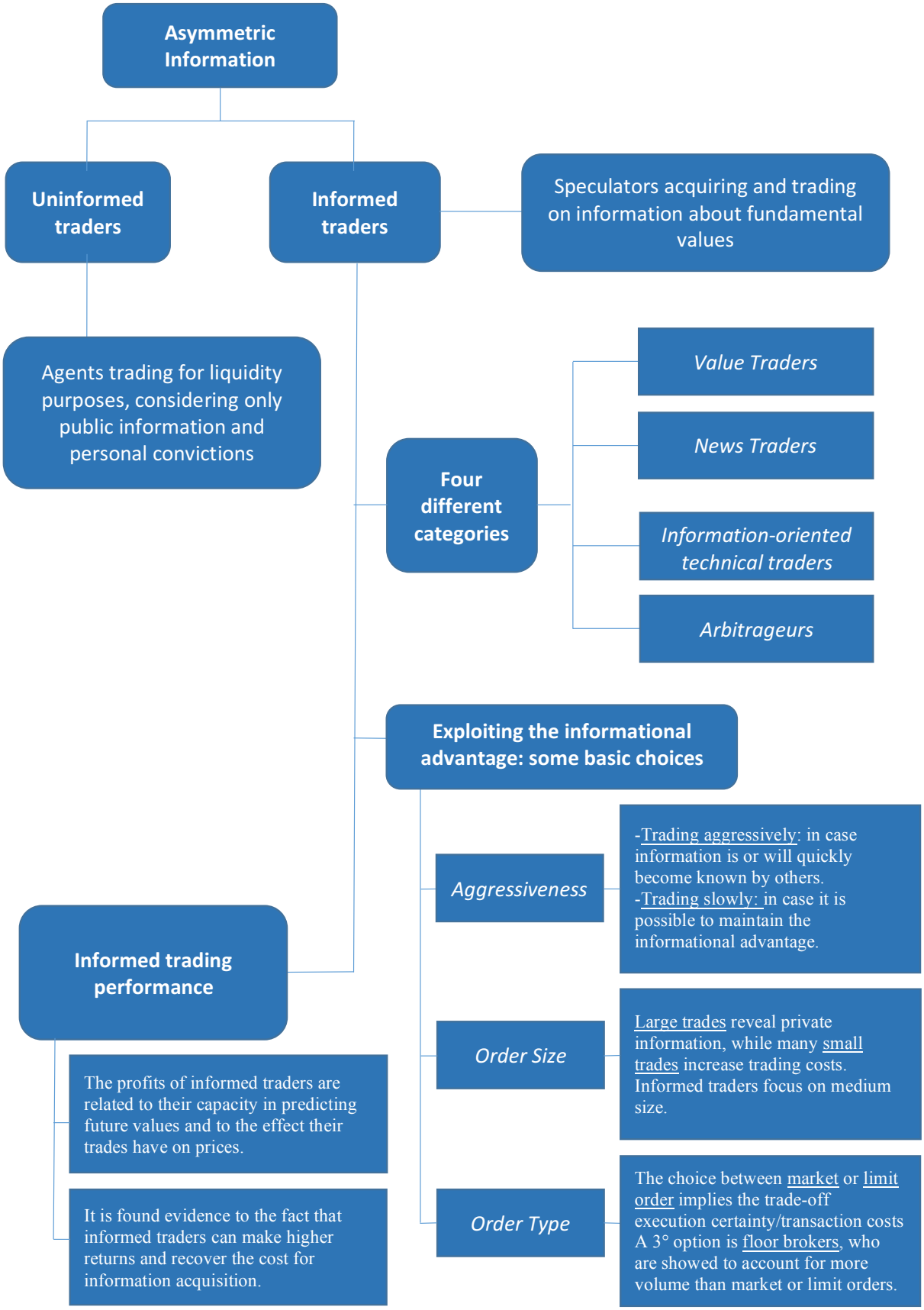

Figure 1.1. The role of information in the capital markets: the informed trading. Summary chart.

2. THE INFORMATIONAL MARKET EFFICIENCY AND THE EFFICIENT MARKET HYPOTHESIS DEBATE

2.1 GENERAL OVERVIEW

The informed trading with all its aspects and peculiarities has constituted the first step in the analysis we have been conducting. In the following paragraphs we will try to analyse in deep the concept and the main literature on the market efficiency.

The efficiency we are considering is the so called informational market efficiency, that is the condition for which the relevant information is reflected in the prices (Dimson and Mussavian, 2000). More precisely, the capital market efficiency indicates the degree at which the instrument prices accurately incorporate the current information that is present in the market place (Harvey, 2012).

Whether securities rapidly adjust in order to fully reflect such information has been the focus of the most important academic researches in the last decades; nevertheless, this question is one of the most controversial areas among investment studies (Reilly and Brown, 2011). The literature is characterized by a continuous debate on the Efficient Market Hypothesis (EMH), starting in particular with the Nobel Prize Eugene Fama in 1970 and proceeding still nowadays with models sustaining or clashing with the EMH.

Thus, in what follows our aim will be to analyse the impact of the informed trading on the security prices and, therefore, the concept of efficiency and its first developments prior to the study conducted by Fama (1970). Subsequently, we will pass through his work and the three different forms of market efficiency, weak, semi-strong and strong, in order to conclude with the last part centred on the most relevant studies and theories characterizing the EMH debate.

2.2 INFORMED TRADERS AND INFORMATIONAL MARKET EFFICIENCY

2.2.1 THE INFORMED TRADING IMPACT ON SECURITY PRICES

As reported above, the informational market efficiency is related to the information content of the security prices. Therefore, the first question to answer is how these prices can be informative.
Harris (2004) explains that this can happen when traders have a good knowledge of intrinsic values, but generally these are not common knowledge, or when there is the presence of informed traders collecting and trading on all available information. This last case is exactly what commonly happens; in fact, informed traders cause prices to change and move accordingly to their information[17].
More in detail, as explained by Jones and Netter (2008), investment analysts search for stocks that are undervalued or overvalued, which constitute profit opportunities and make investors interested in trading. In this way, such trading causes the market to become efficient and stock prices to represent the present value of the future cash flows, that is the fundamental value.
However, Jones and Netter (2008), recovering Fama (1991), underline how the level of market efficiency is related to low transaction costs, comprehending both costs of trading and information acquisition. Informed traders have to cover their expenses for obtaining and using such information, other than their other costs. But some information could be too expensive or it could be that it does not pay to buy and trade on certain type of information; the clear consequence is that prices do not incorporate all the available information, but only that information which traders can acquire and from which they can obtain a profit (Harris, 2004).

2.2.2 THE INFORMATIONAL MARKET EFFICIENCY: THE CONCEPT AND ITS DEVELOPMENT

We have analysed the general meaning of the market efficiency and its dependence from the information reflected in the security prices by informed trading. But what is the precise meaning and development across time of such market efficiency?
Many studies usually connect the first remote point of the long process conducting to the concept of the market efficiency with the *"Liber de Ludo Aleae"* by Girolamo Cardano (1564), who states as the fundamental principle of gambling the presence of equal conditions and describes the

[17] See also *Paragraphs 1.3.1 and 1.3.2*.

decision to depart from it as foolishness or unjustness[18] (Sewell, 2011).

However, we do not consider all the subsequent steps along history, but we proceed directly with the one who is commonly considered the anticipator of the market efficiency concept, Louis Bachelier.

Louis Bachelier (1900)[19] in his "*Theorie de la Speculation"* explains that the market prices incorporate events of the past, present and future (discounted), but these events generally do not present apparent connection with price changes. Bachelier (1900) also shows that commodity prices are characterized by a random fluctuation (Dimson and Mussavian, 2000); this is then followed by Cowels (1933), indicating how forecasters of the stock market cannot forecast.

Another work of particular relevance is the one by Williams (1938). He states that real worth and market price are to be distinguished and not confused; in particular, Williams was identified by Graham as the inventor of the process to determine the fundamental value of a stock (Lutolf-Carroll and Pirnes, 2009). Indeed, in his work Williams explains how the value of a stock is given by the discounted value of the sum of the dividends, that is the so called dividend discount valuation method (Price, 2010).

However, before the 1950s there was not so much attention for stock returns and their economic meaning. Jones and Netter (2008) identify some main reasons: many saw stock markets little more than casinos according to Keynes's view about the speculative nature of stock prices; during the Great Depression and soon after the World War II a lot of economists were in favour of investments directed by the Government; lastly, the necessity of large amount of capital is something related to modern corporations.

The attention for the researches on such topic grew up only from the 1950s with the new possibilities given by the computing power (Jones and Netter, 2008).

Even if there was evidence that stock price changes were random, there were some cases showing prices following predictable paths (Dimson and Mussavian, 2000). For instance, Cowels (1960) revisits and corrects an error in averaging made with Jones in a precedent work (1937), where they found significant evidence of correlation in averaged stock prices time series; but he comes up

[18] It is foolishness if you depart from equal conditions in favour of your opponents, unjustness if it is in your favour (Cardano, 1564).

[19] Bachelier's theory remained unknown until 1950s. As Samuelson explains in the preface of *"Louis Bachelier's Theory of Speculation"* by Davis and Etheridge (2006), discovery (or rediscovery) of this theory dates back to the middle of the last century thanks to lots of postcards sent by Jimmie Savage, asking if anyone knew Bachelier and its work. Samuelson, apparently the only one to respond, found Bachelier's original thesis and spread it to the early theorists (Davis and Etheridge, 2006).

again with results of mixed temporal dependence (Sewell, 2011). Working (1960) and Alexander (1961) explain that, using time-averaged prices, autocorrelation may be introduced into returns series. However, there seems to be a random fluctuation of returns, once series of returns are based on end-of-period prices (Dimson and Mussavian, 2000).

For the purpose of our analysis the most relevant works started with Eugene Fama and Paul Samuelson. In *"The Behaviour of Stock-Market Prices"*, Fama (1965) begins with the old question about the meaningful of using past prices of common stocks to make predictions on future prices. As reported in his work, answers to such question are given by chartist theories[20] and by the theory of random walks[21]. In particular, Fama (1965) concentrates the attention on the random walk model, supporting its validity and belittling chart reading. This study is of particular relevance also for the reason that for the first time Fama defines an efficient market; he writes: *"A situation where successive price changes are independent is consistent with the existence of an efficient market for securities, that is, a market where, given the available information, actual prices at every point in time represent very good estimates of intrinsic values"* (Fama, 1965).

As indicated above, a central role is also played by Paul Samuelson. In particular, he provides a *"Proof That Properly Anticipated Prices Fluctuate Randomly*" (Samuelson, 1965) and concentrates on the martingale property (Read, 2012).

However, all these models are the steps conducting to the main research on the topic under analysis. Indeed, Eugene Fama published in the 1970 his work from the title *"Efficient Capital Markets: A Review of Theory and Empirical Work"*.

Now we do not enter more in detail on the contents of the paper, that will be the subject of the next paragraph, but we want only to conclude giving the precise definition of efficiency that Fama provides. In the introduction to his paper he writes: *"A market in which prices always "fully reflect" available information is called efficient"* (Fama, 1970).

[20] They assume that the behaviour of past prices is full of information about the future behaviour (Fama, 1965).

[21] The theory states that the successive changes of prices are independent, identical distributed random variables; so the future behaviour is not predictable from the past (Fama, 1965).

2.3 THE EFFICIENT MARKET HYPOTHESIS AND THE THREE FORMS OF EFFICIENCY

The Efficient Market Hypothesis (EMH) states that the prices of securities reflect in an accurate way the cash flows expected in the future and that those prices are based on all the information that are available to the investors (Petty *et al.*, 2015).

Apart from this formal definition, in order to better understand the idea of EMH, it is usually used the following fanciful illustration: two investors are walking, when one says that at the side of the road there is a $10 note; the other investor does not stop, answering that if it was really there, another person would have already pick it up (Price, 2010).

The term "Efficient Market Hypothesis" and the distinction between weak and strong forms were first developed by Roberts in 1967 (Sewell, 2011). Then Eugene Fama in 1970 decided to review and organize the theory and the empirical works on the efficient markets; in particular, it is to underline that the early academic works before Fama were full of empirical analysis, but not of theory about such topic.

Fama (1970) describes the theory of the efficient market in terms of a fair game model, arguing that all the available information is inside the market prices and so the expected returns are consistent with the risk (Reilly and Brown, 2011). He also distinguishes the EMH in three different hypotheses according to the type of information considered: the weak, the semi-strong and the strong form of EMH.

As mentioned above, in this paragraph we will concentrate our attention to this essential work conducted by Fama (1970) from the title *"Efficient Capital Markets: A Review of Theory and Empirical Work"*, and only subsequently we will pass to his and other developments constituting the continuous debate on the topic considered.

2.3.1 EUGENE FAMA'S CONTRIBUTION: THE EFFICIENT CAPITAL MARKETS REVIEW

"The ideal is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make production-investment decisions, and investors can choose among the securities that represent ownership of firms' activities under the assumption that security prices at any time "fully reflect" all available information. A market in which prices always "fully reflect" available information is called efficient" (Fama, 1970).

This extract from the first part of Fama's work is the unavoidable starting point for the analysis of his study. In what follows we will proceed keeping the same order he uses in his review: firstly,

some theory and, subsequently, the empirical work.

As discussed by Fama (1970), in order to have a testable model, it is essential to give a more exact meaning to the term *"fully reflect"*. Generally, the only base assumption of most of the works is that "*the conditions of market equilibrium can (somehow) be stated in terms of expected returns"*[22]. Conditional on a set of information, the security equilibrium expected return depends on the risk, which is differently defined depending on the theory considered.

All the *"expected return theories"* are described by[23]:

$$\mathbb{E}\left(\tilde{p}_{j,t+1}|\phi_t\right) = \left[1 + \mathbb{E}\left(\tilde{r}_{j,t+1}|\phi_t\right)\right]p_{jt} \qquad (2.1)$$

The conditional expectation indicates that, whatever expected return model is used, in the determination of the equilibrium expected returns the information set ϕ_t is fully considered.

It is also important to note that the tests based on the assumption about the use of expected returns to state the market equilibrium conditions depend not only on the market efficiency, but also on the validity of such assumption; however, this is necessary to have the possibility to conduct an empirical work on the market efficiency.

The described situation, with the assumptions about the use of expected returns and about the formation of equilibrium expected returns based on ϕ_t, results in the impossibility of trading on $\phi_t$with an excess of expected profits or returns with respect to the equilibrium expected profits or returns.

$$\text{If } z_{j,t+1} = r_{j,t+1} - \mathbb{E}\left(\tilde{r}_{j,t+1}|\phi_t\right) \text{ then } \mathbb{E}\left(\tilde{z}_{j,t+1}|\phi_t\right) = 0$$

Therefore, the sequence $\{z_{jt}\}$ is said to be a *"fair game"* with respect to the sequence $\{\phi_t\}$.[24]

If it is considered a trading system as $\alpha(\phi_t) = [\alpha_1(\phi_t), \alpha_2(\phi_t), \ldots, \alpha_n(\phi_t)]$, that is based on ϕ_t and gives the amount of funds at *t* to invest in each of the *n* securities, it generates in *t+1* an excess market value V_{t+1}.

$$V_{t+1} = \sum_{j=1}^{n} \alpha_j(\phi_t)\left[r_{j,t+1} - \mathbb{E}\left(\tilde{r}_{j,t+1}|\phi_t\right)\right] \qquad (2.2)$$

As above, according to the *"fair game"* property, it is possible to see that $\mathbb{E}\left(\tilde{V}_{j,t+1}|\phi_t\right) = 0$.

[22] This statement is always extracted from the work written by Fama (1970) that we are analysing.

[23] *P* and *r* indicate respectively the price and return of a security, indicated by *j*, at a certain time. ϕ_t stands for an assumed set of information fully reflected in *p* at *t*. The tildes in $\tilde{p}_{j,t+1}$ and in $\tilde{r}_{j,t+1}$ say that they are r.v. at *t*.

[24] Equivalently, the same can be done with the prices instead of the returns.

Fama (1970), after this part on the *"fair game"* or expected return model, proceeds his work focusing on two special cases: firstly, the submartingale model and then the random walk model.
Assuming in (2.1) that for all t and ϕ_t $\mathbb{E}(\tilde{p}_{j,t+1}|\phi_t) \geq p_{jt}$ or[25] $\mathbb{E}(\tilde{r}_{j,t+1}|\phi_t) \geq 0$ means that the sequence $\{p_{jt}\}$ follows a submartingale with respect to the sequence $\{\phi_t\}$. In the case that the expressions hold as equalities, the price sequence $\{p_{jt}\}$ follows a martingale.
An important consequence of a submartingale in prices is that *"one security and cash"* trading systems[26] based only on ϕ_t cannot obtain expected profits that are higher than a strategy given by always buying and holding during the future period considered.
As mentioned above, Fama (1970) in the first part of his work focuses his attention also on some theory about the random walk model.
Fama (1970) argues that the statement that *"the current price fully reflects available information"* was assumed, in the early works from the literature, to imply independent successive price changes and usually also identically distributed. Such combination forms the random walk model, that is[27]:

$$f(r_{j,t+1}|\phi_t) = f(r_{j,t+1}) \qquad (2.3)$$

However, this is more than what is said by (2.1). Indeed, the random walk model can be considered an extension[28] of the general fair game model, which just makes the assumption about the use of expected returns to state market equilibrium conditions and says little about the process that generates returns.
After the theoretical part, Fama (1970) concentrates on the empirical literature about adjustment of prices to the three types of relevant information subsets. Therefore, the empirical work is divided in the following three categories: weak form tests, in which the subset of information is only given by historical prices; semi-strong form tests, which refer to all information that is obviously publicly available; strong form tests, which concentrate on whether given investors or groups hold a monopolistic connection with any information that is relevant in the formation of the security price.
All the empirical works on efficiency[29] can be considered within the general *"fair game"* or

[25] The two expressions are equivalent.
[26] We speak of systems concentrating on individual securities and giving the cases in which holding a security, selling short or holding cash.
[27] The expression indicates identical conditional and marginal probability distribution of an independent r.v. Remember also that *f* is the same for all t.
[28] In the random walk model the statement about the economic environment is more detailed.
[29] Remember that the early literature refers in particular to the random walk model. As Fama (1970) underlines, most of the empirical evidence of the literature on the random walk model can be interpreted as tests of the more general fair game models.

expected return model and much of the evidence bears on the special submartingale model seen before.

Now, without entering much in detail on the empirical studies, we will pass trough the main conclusions reached by Fama, considering the three categories in which the empirical work is divided.

The tests about the weak form constitute the largest part in the literature. Fama (1970) finds fair to conclude that there is strong support to the EMH given by the results of these tests and, even if the evidence for dependence of successive price changes or returns is significant, part of it is consistent with the *"fair game"* model and the other part is not such to see the market as inefficient.

Also the tests of the semi-strong form support the market efficiency. As reported by Fama, the work on *"The Adjustment of Stock Prices to New Information"* by Fama, Fisher, Jensen and Roll (1969) explains that the information in stock splits about the firm's payment of the dividends in the future is, on average, fully incorporated in the price at the time of the split. Other researchers come to similar conclusion considering firm's annual earnings announcements and common stock's new issues and large block secondary issues.

The last category of tests refers to the strong form of efficient markets model, in which all available information are considered to be fully reflected in the prices. Therefore, this is essentially only a benchmark to evaluate the importance of deviations from the market efficiency. Only two are the groups that are seen by researches to hold monopolistic access to information: specialists on major security exchanges and corporate insiders.

Fama (1970) concludes his work stating that, apart from the results discussed, not all questions are closed and still much remains to study; so much so that Fama himself will deal with works and reviews further developing this subject in response to the new researches following this 1970 paper (see *Paragraph 2.4.2*).

2.4 THE CONTINUOUS DEBATE ON THE EFFICIENT MARKET HYPOTHESIS

Many are the developments on the market efficiency that came after Fama's work described above. All these studies present different analyses, which result in a continuous debate on the Efficient Market Hypothesis. Our aim is not to pass through all these developments, but to consider the main topics analysed by the literature, trying to explain which are the criticisms and the main arguments clashing with the EMH, but also which are the main developments sustaining it and the answers to the criticisms.

2.4.1 ARGUMENTS AND ANOMALIES CLASHING WITH EMH

Among the researches showing elements of distance from the EMH we can begin with the one by Grossman (1976), who provides a model explaining that diverse information is perfectly aggregated by *"informationally efficient price systems"*, but in this case there is no private incentive to obtain information; if the acquisition of information is costly and there is no noise in the price system, no one gains from collecting information and, therefore, no one collects it. Then in this situation there will be someone having the incentive to acquire costly information, but, when these individuals will become a lot, the price of equilibrium will aggregate their information and they will stop collecting it again.

The most famous work on such topic is the one by Grossman and Stiglitz (1980), which is clearly summarized by its title: *"On the Impossibility of Informationally Efficient Markets"*. As they explain, the available information cannot be perfectly reflected in prices, otherwise no one has incentive to acquire and analyse information, which is costly. Therefore, a sensible model must leave some incentive for collecting information (Sewell, 2011).

Proceeding with the main arguments that are opposed to the EMH, we have to consider the debate on the volatility of stock market. Shiller[30], with his variance bounds tests, shows that aggregate stock market prices variations are too high to be explained by the subsequent changes in dividends payments (Marsh and Merton, 1986). Considering the assumption that, over time, expected real return on the market is essentially constant, Shiller arrives to state that the large stock prices variation, founded in his tests, determines evidence against the EMH. He also confirms this result in case that the expected real return on the market does not remain constant over time but changes (Marsh and Merton, 1986). However, many other studies, after Shiller's work, provided results

[30] In a series of papers between 1981 and 1982.

different from his conclusions. As reported by Lo (2007), apart from the questions related to the statistical inference, there may be many reasons for the variance bounds empirical violation; as indicated by the literature, it could be explained by violation of the efficient market hypothesis, or it could be a symptom of the smooth of dividends, or it could be referred to investors' risk adversity. Lo (2007) also highlights that these results, provided by the literature, underline a particular aspect, namely, that tests of the efficient market hypothesis are tests of joint hypothesis; this means that any test on the statement that *"prices fully reflect all available information"*[31] must refer to information content of the prices and the mechanism by which information is reflected in the prices. Apart from the high stock prices variations, some studies developed many other aspects that can indicate deviations from market efficiency. For instance, as reported by Lo (2007), some researches, concentrating their attention on the reaction of some investors to new information, show that sometimes they do not react in proper proportion and they overreact or underreact.

However, proceeding in the field of arguments clashing with the EMH, most of the criticisms concern the anomalies and the predictable patterns studied by a vast literature from 1970s.

We can start with the calendar effects and in particular with the *"January effect"*. Such effect indicates that the mean raw returns of securities in January is higher than in the other months of the year (Patel, 2016); more precisely, this effect is referred to small companies and involves the first two or three weeks of January. The January effect is clearly not consistent with the market efficiency theory; however, the growing literature sustains that it does not exist anymore in stock returns (Patel, 2016). Apart from this, many others are the effects referring to the seasonality that are discussed by the literature, for instance: the weak-of-the-month, the day-of-the-week and the hour-of-the-day effects (Dimson and Mussavian, 2000).

Another type of predictable patterns is connected to valuation parameters; indeed, some researches claim that dividend yield of the stock market and price-earnings multiple have considerable predicting power (Malkiel, 2003). For example, for the dividend yield, it is showed that investors can earn a higher rate of return if they buy a market basket of equities with a relatively high initial dividend yield and a future low rate of return in case of a low initial dividend yield[32].

It is also possible to identify other predictable patterns which refer to the characteristics of the firms and the valuation parameters; in particular, it is necessary to consider the studies on the size effect, the value stocks and the equity risk premium puzzle (Malkiel, 2003).

[31] From the statement used by Fama (1970) to define an efficient market.

[32] The study refers to an analysis conducted on the Standard & Poor's 500 Stock Index.

The size effect is well explained by Banz (1981), who analyses the monthly returns of shares listed on the NYSE from 1931 to 1975, finding that the fifty smallest stocks performed better than the fifty largest ones on a risk-adjusted basis (Dimson and Mussavian, 2000). However, as reported by Schwert (2003), this effect has been much smaller after it was discovered.

Other studies concentrate their attention on the "value" stocks, showing that they have higher returns than "growth" stocks. In particular, many researches indicate that higher rates of return seem to be provided by stocks with low price-earnings multiples, that are called "value" stocks, rather than by those with low price-to-earnings ratios[33] (Malkiel, 2003).

As mentioned above, we have another type of regularity belonging to the class under analysis; we are talking about the so called equity risk premium puzzle. It is identified by Mehra and Prescott (1985), who show that the historical US equity premium is grater than it should be according to the standard neoclassical paradigm of financial economics (Mehra, 2008).

The literature presents a lot of other predictable patterns; for example, Malkiel (2003), before giving its explanations on this subject (see *Paragraph 2.4.2*), in his review of the main regularities provided by the literature, recalls also the short-term momentum and the long-run return reversals. Indeed, some studies show that in the short-run (days or weeks) it is possible to identify some positive serial correlation of stock returns, while others identify a negative serial correlation for longer holding periods.

In the 1990s, as reported by Shiller (2003), much of the attention of the academic research started focusing more on human psychology and its relation with financial markets. In this way it was developed the so called *Behavioural Finance* and its arguments against the market efficiency. Indeed, important criticisms to the EMH refer precisely to the human behaviour of the investors, which, because of loss aversion, overconfidence, overreaction, psychological accounting, miscalibration of probabilities, herding, regret and many other reasons, results to be often *"irrational"*, *"predictable"* and *"financially ruinous"* (Lo, 2007).

We conclude this paragraph on the main criticisms and anomalies developed by the literature along years with a recent and particularly strong event indicated by many as the main argument against the EMH: the global financial crisis. Jeremy Grantham writes: *"The incredibly inaccurate efficient market theory [caused] a lethally dangerous combination of asset bubbles, lax controls, pernicious*

[33] In addition, some studies claim that also the price-to-book-value ratio can constitute a good predictor of future returns.

incentives and wickedly complicated instruments [that] led to our current plight"[34] (Siegel, 2009). Gantham is not the only one to see the EMH as the responsible of the financial crisis; similar conclusions are made by Justin Fox and many others. The main explanation they give for this charge refers to the fact that, believing that prices fully reflect all available information, regulators and investors did not verify what was the true value of publicly traded securities and so they did not identify an asset price bubble (Ball, 2009). However, as Siegel (2009) reports in an article of *The Wall Street Journal, "Our crisis wasn't due to blind faith in the efficient market hypothesis"*. Similarly, Ball (2009) writes: *"Despite the theory's undoubted limitations, the claim that it is responsible for the current worldwide crisis seems wildly exaggerated"*.

The financial crisis is only the last example belonging to the group of the important events along history that provoked criticisms to the EMH. We remember, among others, also the Internet Bubble of the late 1990s, which is indicated by behavioralists as evidence of markets irrationality. However, as explained by Malkiel (2003), the stock market in that occasion may have temporarily failed as efficient allocator, but "*bubble periods are the exception rather than the rule"*.

In this part we have focused on the main findings against the EMH that were developed after Fama's work. But what are the main answers to the EMH criticisms and the further developments sustaining the efficiency?

2.4.2 DEVELOPMENTS SUSTAINING THE EMH AND ANSWERS TO THE CRITICISMS

The academic research focused on the market efficiency is completely divided: each of the criticisms seen above is followed, as already partially explained, by other studies providing different conclusions and sustaining such efficiency. This results in a continuous debate along years between supporters and critics of the EMH.

The most relevant development and answer to part of the criticisms is given by Fama himself in *"Efficient Capital Markets: II"*. As first thing, Fama (1991), considering the work by Grossman and Stiglitz (1980), underlines that the extreme version[35] of EMH is false (and it constitutes only a benchmark), because the costs of information and trading are positive and not zero. Apart from such costs, Fama (1991) indicates the joint-hypothesis problem as a more serious question for the inferences about efficiency, because the market efficiency can be only tested jointly with an asset-

[34] These words refer to Grantham's quarterly letter of January 2009 and were then reported by Siegel (2009) in an article of *The Wall Street Journal*.

[35] Namely, that all information is fully reflected into prices.

pricing model. Nevertheless, he sustains that empirical work on market efficiency and asset-pricing models remains unequivocally interesting and really useful.

As discussed in the *Paragraph 2.3.1*, the three categories in which Fama (1970) divides his previous work are the weak, semi-strong and strong form tests. Differently, here Fama (1991) changes such subdivision in: *tests for return predictability*, *event studies* and *tests for private information*.

With this new distinction, the first category considers not only the forecast power of past returns, but also the works on returns forecasts through variables like dividend yields and interest rates, the cross-sectional predictability of returns[36], the seasonal effects and the question on the high volatility of security prices.

As explained by Fama (1991), the new results provided by the literature show that the security returns can be predicted from past returns, but also from dividend yields and many terms-structure variables. Fama (1991) points out that the new works refuse the good early *"efficient constant expected returns model"* and enter into the joint-hypothesis problem. Moreover, the apparent returns predictability could be spurious and, for example, represent the result of the chance conditions of the specific sample. We do not go more in detail, but in this review on studies included in the first category, what emerges is Fama's explicit disagreement on the efficiency implication of these new studies on the predictability of returns; however, as he explains, they give the possibility to know better the returns behaviour.

For what concerns the second and the third category, they change only in their title, but not in their coverage. Of particular relevance in this last part is that Fama (1991) indicates event studies, since they are really close to separating equilibrium pricing and market efficiency, as the most direct evidence (mostly supportive) on efficiency.

Subsequently, in another work entitled *"Market Efficiency, Long-Term Returns and Behavioural Finance"*, Fama (1998) tries to answer to some researches finding inefficiency about long-term returns, in particular, long-term underreaction and overreaction to information. The clear answer of Fama (1998) is that from these researches market efficiency cannot be rejected. Indeed, apparent overreaction is as frequent as underreaction and it is consistent with market efficiency. Moreover, as he indicates, two behavioural models, provided by some other researchers[37] and accommodating overreaction and underreaction, explain well such anomalies; however, they show problems with

[36]Therefore, tests of the asset-pricing models and the anomalies are considered (Fama, 1991).
[37] He refers to the studies of Barberis et al. and Daniel et al.

other anomalies. Indeed, with long-term pre-event returns they both predict reversals for the post-event, while reversals and continuations should be about equally frequent, an argument that is indicated by Fama (1998) as more consistent with market efficiency. We do not go deeper, but it is necessary to underline that all these long-term anomalies considered tend to vanish with the technique that is used, so that Fama (1998) indicates such apparent anomalies as *"methodological illusions"*.

As we have previously explained, many others are the authors answering directly to the main criticisms and supporting EMH. In addition to Ball, Siegel and many others, who oppose to the main criticisms, we can also mention Roll (1994), who shows in practice that it is hard to make a profit from market inefficiencies (Sewell, 2011).

However, among the main supporters it is necessary and unavoidable to include Burton G. Malkiel[38], who in 2003 provides a review and an answer to the main arguments clashing with the efficiency in his work *"The Efficient Market Hypothesis and Its Critics"*.

With respect to what is said by many critical researchers, Malkiel (2003) indicated the stock markets to be "*far more efficient and far less predictable"*. In particular, he writes: *"The evidence is overwhelming that whatever anomalous behaviour of stock prices may exist, it does not create a portfolio trading opportunity that enables investors to earn extraordinary risk adjusted returns"* (Malkiel, 2003).

[38] He is also the author of the famous book, first published in 1973, entitled *"A Random Walk Down Wall Street",* whose main concept is clearly summarized by the following words: *"The market prices stocks so efficiently that a blindfolded chimpanzee throwing darts at the Wall Street Journal can select a portfolio that performs as well as those managed by the experts"* (Malkiel, 2007).

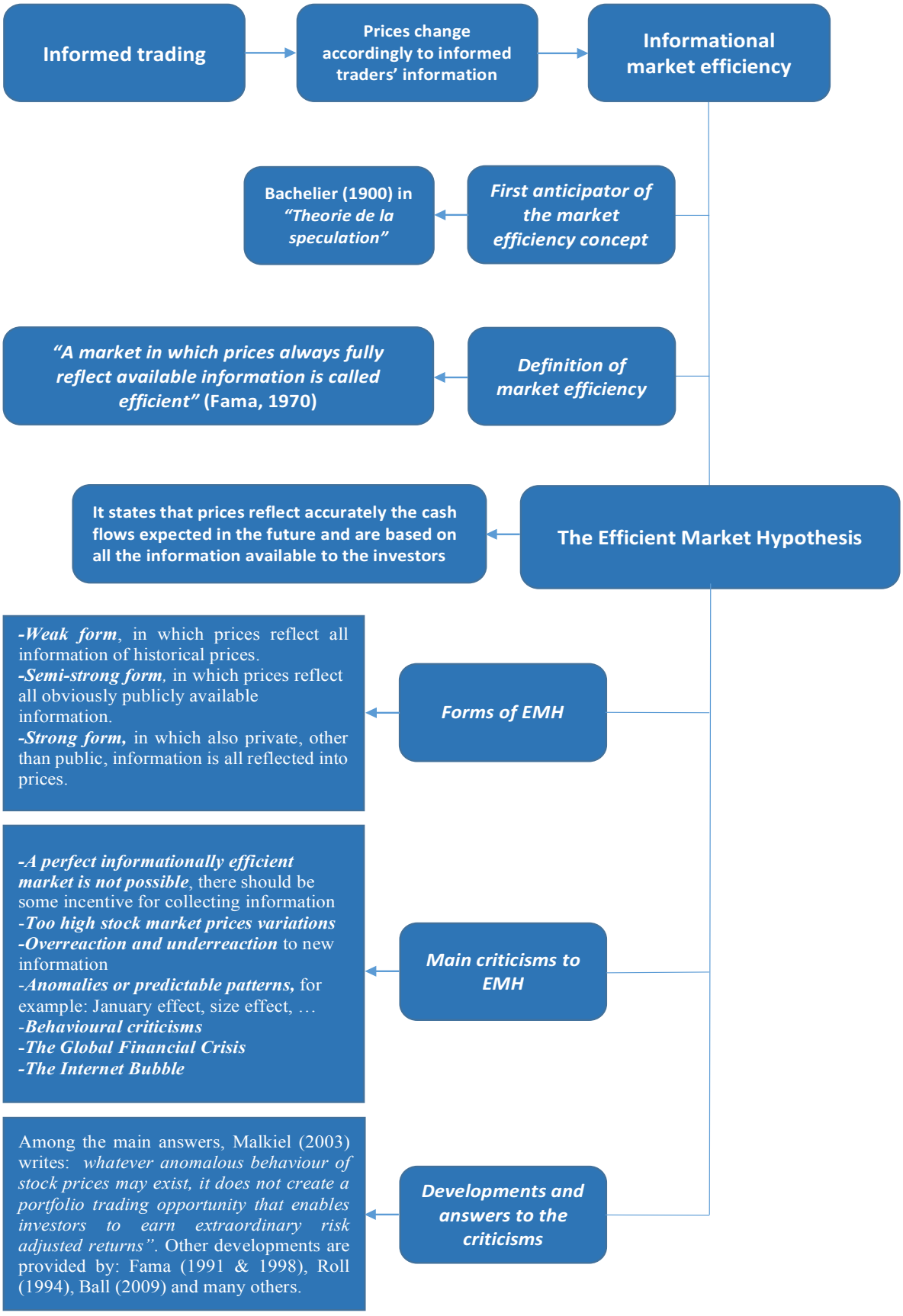

Figure 2.1. The informational market efficiency and the EMH debate. Summary chart.

3.INFORMATION AND MARKET EFFICIENCY: AN ANALYSIS BASED ON INSTANT COMPANY NEWS

3.1 GENERAL OVERVIEW

The aim of this work is to understand what is the role of information on affecting market efficiency. However, trying to find a unique common answer on the informational efficiency of the markets is quite difficult given the vast and controversial literature on such topic.

In particular, many are the studies that, with different results, have tried to examine whether prices rapidly adjust to new information. Among the first analyses, we find the work of Fama, Fisher, Jensen and Roll (1969), that we have already mentioned. They examine the process of adjustment of stock prices to information implicit in a stock split with results supporting a quick adjustment of prices and so the market efficiency.

Along years many other analyses have tried to understand the effects of different types of news; they have focused, for example, on the impact of corporate announcements or analysts' reports with the aim to identify the time required by prices to incorporate such information. Fama (2016), during a recent debate on the market efficiency, said: *"there are all kinds of test with respect to the response of prices to specific kind of information, in which the hypothesis that prices adjust quickly to information looks very good; there are others where it looks less good. So, it's a model, it's not entirely always true, but it's a good working model for most practical uses"*.[39]

Among the studies about the response to the arrival of new information, Busse and Green (2002) consider the Morning Call and the Midday Call segment on CNBC giving opinions of analysts and informing on developments affecting individual stocks and all the market. For the stocks that are

[39] These words were pronounced by Fama (2016) during a debate with Richard H. Thaler for a *Chicago Booth Review*'s video entitled *"Are Market Efficient?"*. The full video is available at: *http://review.chicagobooth.edu/economics/2016/video/are-markets-efficient.*

discussed by the CNBC call segments during the period considered, they examine the effects on prices and trading. Their results underline that stocks associated to positive reports show a significant price impact starting some seconds after the initial mention and lasting about one minute; in the case of stocks associated to negative reports, the effect is found to be longer, with prices adjusting for fifteen minutes. They find also that the trading intensity doubles in the minute following the news, with a significant increase of buyer/seller-initiated trades, and that there is evidence of small but significant profits for those trades executed within fifteen seconds after the first positive mention of the Midday Call. The authors conclude that, even if all available information is not instantaneously reflected in the prices, the market is efficient enough that making profits from largely disseminated information is not possible, apart in case of almost immediate trades.

In this chapter we propose our approach in analysing the informational market efficiency and provide the relative results.

Our model is based on collecting all relevant instant company news at the time of the first release, without waiting for any report happening at a given time or focusing on a certain type of news. In order to construct our sample of data, we consider companies listed on NYSE with a high level of market capitalization and the relative alerts from the company news section provided by *Thomson Reuters Eikon*, which represent the instant headlines of market-moving news released even before the publication of the entire stories. Using these news alerts, we analyse the impact of such information both on stock prices and trading with the aim to test whether the market can be considered efficient, and to what degree (weak, strong, semi-strong).

3.2 THE DATA SAMPLE AND THE METHODOLOGIES

3.2.1 THE DATA SAMPLE

We consider the stocks that are listed on the New York Stock Exchange (NYSE) and we randomly select 25 companies from those in the first third for market capitalization. In *Table 3.1*, it is possible to find the list of the 25 companies, their sector (according to *Thomson Reuters Business Classification*) and their market capitalization.

Symbol	Company	Sector	Market Cap. ($)
JNJ	Johnson & Johnson	Pharmaceuticals (NEC)	312.833.943.402,72
PG	Procter & Gamble	Personal Products (NEC)	225.773.489.249,88
VZ	Verizon Communication Inc	Integr.Telecommunications Services (NEC)	210.476.610.941,76
LLY	Eli Lilly and Co	Pharmaceuticals (NEC)	74.704.176.724,10
LOW	Lowe's Companies Inc	Home Improv. Prod. & Serv. Retailers (NEC)	63.985.956.501,12
GD	General Dynamics Corp	Aerospace & Defense (NEC)	52.907.226.617,00
SYK	Stryker Corp	Medical Devices & Implants	43.709.749.042,14
PX	Praxair Inc	Commodity Chemicals (NEC)	34.982.982.516,78
DE	Deere & Co	Heavy Machinery & Vehicles (NEC)	31.615.224.505,45
BHI	Baker Hughes Inc	Oil Related Services and Equipment (NEC)	27.371.685.307,98
SRE	Sempra Energy	Multiline Utilities	25.168.636.932,45
CAH	Cardinal Health Inc	Drug Retailers (NEC)	23.194.987.495,94
UAL	United Continental Holdings Inc	Airlines (NEC)	23.142.810.424,02
LB	L Brands Inc	Apparel & Accessories Retailers (NEC)	20.646.013.308,60
AMP	Ameriprise Financial Inc	Investment Manag. & Fund Operators (NEC)	17.848.332.294,57
NBL	Noble Energy Inc	Oil & Gas Exploration and Production (NEC)	17.527.536.911,48
CAG	Conagra Brands Inc	Food Processing (NEC)	16.521.427.119,36
FE	FirstEnergy Corp	Electric Utilities (NEC)	13.335.830.479,02
DVA	DaVita Inc	Healthcare Facilities & Services (NEC)	12.594.120.000,00
OKE	ONEOK Inc	Natural Gas Utilities (NEC)	12.075.540.256,56
COH	Coach Inc	Handbags & Luggage Retailers	10.580.982.195,12
KSU	Kansas City Southern	Ground Freight & Logistics (NEC)	9.113.021.918,47
AJG	Arthur J Gallagher & Co	Insurance Brokers	8.946.586.052,92
PVH	PVH Corp	Apparel & Accessories (NEC)	7.928.159.314,80
OGE	OGE Energy Corp	Electric Utilities (NEC)	6.640.123.386,75

Table 3.1. The sample of the 25 companies. The table shows the randomly selected companies from those listed on NYSE and with a high market capitalization; all data in the table are extracted from Thomson Reuters Eikon.

The period of analysis is the interval between 1st November 2016 and 13th December 2016; we extract, for each of the 25 companies, all the alerts from the company news section provided by *Thomson Reuters Eikon*[40]; such alerts represent the instant headlines of market-moving news even before the arrival of the full stories.

For each news alert, we look at the time of its release. If it is included, for example, between 14:33:01 and 14:34:00, 14:34:00 is called t=0, and we say that the news is released in the interval corresponding to t=0, which indicates the minute before (59''). Therefore, in general, with "interval t" we refer to the minute between t-1 and t, whereas with "t" we refer to that exact point in time.

It is also necessary to specify that we take into account only the news within the trading day; more precisely, we consider the news in the interval between twenty minutes after the opening of the trading day and twenty minutes before the closing of the trading day, in order to have the possibility to compute our analyses both before and after the release of the information.

For each news, we extract, from t=-21 to t=20, the closing stock prices per minute from *Thomson Reuters Eikon* and we compute the returns and the cumulative returns. We also extract, from interval t=-2 to interval t=4, the traded volumes, the number of trades and the number and the relative prices of buyer-initiated and seller-initiated transactions. These extractions are made considering the values for each singular transaction occurring in each minute around the release of the instant company news.

We then distinguish between positive and negative news. The approach we use to understand the impact of the information is based on the price change following its release. In particular, if the closing price at t=5 is higher with respect to t=0, we consider that the relative news has a positive impact; if the price is lower, a negative impact[41]. In this way, the 148 instant news alerts are distinguished in 81 positive and 67 negative. This distinction between positive and negative information will be maintained for all the subsequent analyses[42].

[40] *Thomson Reuters Eikon* is a database providing all types of information, exclusive news, analytics and other data on the financial markets.

[41] If the price remains unchanged, we consider whether the return in interval t=5 is increasing or decreasing.

[42] Some descriptive statistics of the data are available in *Table A, B, C* and *D* reported in the *Annex.*

3.2.2 THE METHODOLOGIES

In our model, for the types of tests that are implemented, we partially follow Busse and Green (2002), in order to examine the impact of the new information both on stock prices and trading.

In relation to the stock prices reaction, we consider all the cross sectional returns[43] both for positive and negative news. Then, in order to verify the time required by prices to adjust, we test, in each interval *t*, whether the average return is significantly different from zero. However, we are using intraday returns (our research is always conducted with data per minute), which cannot be considered to be normally distributed; so, we adopt the nonparametric bootstrap technique[44], in order to conduct the *t*-tests and present the relative results.

Always in relation to the stock prices reaction, we consider a similar approach also for the cumulative returns, in order to analyse the magnitude of the impact both before and after the release of the information.

After this first part on the response of the stock prices to the news alerts, we concentrate our attention to examine the impacts of such news on the trading activity.

Therefore, for each interval of time considered, we study the statistical differences both in the intensity of trading and in the order imbalances using a two-sample one-tailed Kolmogorov-Smirnov test, which allows to verify whether the values of a sample are stochastically smaller/larger than those corresponding to the sample of comparison[45]. In particular, these two directional hypotheses are tested using the following statistics (formulas 3.1 and 3.2):

$$D^{+} = max_{x}\{F(x) - G(x)\} \qquad (3.1)$$

$$D^{-} = min_{x}\{F(x) - G(x)\} \qquad (3.2)$$

where F(x) and G(x) indicate the empirical distribution functions of the samples to be compared.

In order to analyse the intensity of trading, we consider the volume and the number of trades per minute. Then, both for positive and negative news, we apply the two-sample one-tailed Kolmogorov-Smirnov test, in order to understand whether the volumes and the number of trades of a certain interval are larger than those of the period of comparison.

[43] We define the return as the percentage change per minute between two successive closing stock prices.

[44] In implementing the bootstrap, we choose a high number of replications (equal to 1000), in order to obtain accurate results. This number of replications will remain the same each time we use the bootstrap technique.

[45] As period to which compare each interval of time, starting from the release of the information, we choose the two minutes before the news, that is the period constituted by interval t=-2 and t=-1.

A similar analysis is then conducted for the "order imbalances", that we measure by calculating the following ratio:

$$(number\ of\ buys - number\ of\ sells)/(number\ of\ buys + number\ of\ sells) \qquad (3.3)$$

In case of positive information, we apply the Kolmogorov-Smirnov test to verify whether the values corresponding to each interval of time are larger than those of the period of comparison, whereas, in case of negative information, we test whether the values are smaller.

As reported by the formula 3.3, in order to measure the order imbalances in each interval *t* surrounding the news announcement, we need to know the number of buyer and seller-initiated trades. Hence we exploit the tick rule and we consider the trades indicated by *Thomson Reuters Eikon* as occurring on an uptick or on a downtick[46].

In the last section of the analysis we try to understand whether there could be any possibility of making significant[47] profits in case of trades occurring around the news release. In particular, being necessary to know the buy and sell prices, we consider the average price per minute of buyer and seller-initiated transactions in correspondence to each news alert, relying on the same trades classification used for the order imbalances.

[46] Transactions occurring on a zero-uptick or on a zero down-downtick are also included.

[47] In order to apply the *t*-tests and verify whether average returns are significant, we consider the same bootstrap approach discussed before.

3.3 THE REACTION OF THE STOCK PRICES TO THE INSTANT COMPANY NEWS

In this first part we try to understand the behaviour of the stock prices in the intervals surrounding the instant company news. More precisely, we try to identify the time that the prices require to adjust and the magnitude of the prices reaction. This will give us the possibility to understand if prices *"fully reflect available information"* and so make the first considerations on the informational market efficiency.

3.3.1 THE TIME REQIRED BY THE STOCK PRICES TO INCORPORATE THE INSTANT NEWS

In *Paragraph 3.2.1* we described the process we adopt to construct our sample of data; in particular, for this first part of analysis we use, distinguishing between positive and negative news, all the returns in relation to the company news from interval t=-20 to interval t=20[48].

As we explained before, for each interval *t*, we implement the bootstrap approach to execute the *t*-test and find the *p*-value, in order to understand whether the average return is significantly different from zero. The results are reported in *Table 3.2*, which distinguishes between positive and negative instant company news and provides the average return and the significance at ten, five and one percent level for each interval considered.

In order to discuss the results obtained, we focus on the period around the release of the information, observing the prices reaction both before and after the announcement.

For what concerns the positive news, the adjustment begins already in the first minute after the release; indeed, in correspondence to the interval t=1, the table shows positive average return and high significance. Other significant responses can be found some minuets later and, in particular, for the intervals t=4 and t=5. However, the effect does not stop and, as it can be seen in the table, the adjustment continues with significant impacts until t=15. Therefore, the prices start reflecting the positive instant news immediately after the release, but the whole process, lasting for fifteen minutes, seems to be quite slow.

In relation to the periods before the announcement, apart in interval t=-6, there are no other significant price changes and so no other significant signals of traders' forecasts and reactions to the upcoming positive news.

[48] We remind that the returns are computed using the closing stock prices for each minute; this means that, for example, the return in interval t=0 refers to the return occurring between t=-1 and t=0.

	Positive Instant News		Negative Instant News	
Interval (t)	**Average Return**	**Significance**	**Average Return**	**Significance**
-20	0,0379%		0,0099%	
-19	0,0182%		0,0095%	
-18	-0,0032%		0,0151%	
-17	0,0084%		-0,0055%	
-16	-0,0035%		0,0053%	
-15	-0,0271%		0,0325%	**
-14	0,0059%		-0,0089%	
-13	-0,0069%		0,0254%	**
-12	-0,0122%		0,0211%	**
-11	-0,0131%		-0,0094%	
-10	0,0256%		-0,0026%	
-9	-0,0024%		-0,0079%	
-8	-0,0493%		-0,0080%	
-7	-0,0211%		0,0146%	
-6	0,0417%	**	0,0136%	
-5	0,0049%		0,0316%	**
-4	0,0160%		-0,0110%	
-3	0,0045%		0,0152%	
-2	0,0275%		0,0166%	
-1	-0,0061%		0,0146%	
0	-0,0031%		0,0363%	**
1	0,0441%	***	-0,0382%	**
2	0,0323%		-0,0328%	***
3	0,0162%		-0,0268%	*
4	0,0561%	***	-0,0417%	***
5	0,0450%	**	-0,0143%	
6	0,0282%	*	0,0142%	
7	-0,0227%	*	-0,0002%	
8	-0,0267%		0,0066%	
9	0,0077%		-0,0080%	
10	0,0220%		-0,0065%	
11	-0,0384%	***	-0,0007%	
12	-0,0069%		0,0158%	
13	0,0187%	**	0,0041%	
14	0,0030%		0,0097%	
15	0,0279%	***	0,0177%	*
16	0,0079%		-0,0030%	
17	0,0057%		-0,0164%	
18	-0,0041%		-0,0092%	
19	0,0118%		-0,0055%	
20	0,0077%		0,0024%	

*Table 3.2. The time required by the stock prices to incorporate the instant news. The table provides the average returns and the significance from interval t=-20 until interval t=20. The significance at ten, five and one percent level is respectively indicated by *, ** and ***.*

For what concerns the negative information, the table shows that the intervals after the news alerts until t=4 are characterized by negative and significant average returns, whereas in the following minutes, apart in interval t=15 (significant at ten percent level), there is no further significant prices reaction. Therefore, in four minutes the news effect seems to end and the information to be incorporated in the prices.

Considering the period before the negative announcements, the table indicates some interesting results, with some positive and significant intervals; however, we will better discuss this point in the second part of the following paragraph, where, using the cumulative returns, the trend of the stock prices will be more clear.

If we compare the effects of positive and negative news, in both cases the reaction of the stock prices is instantaneous, with the first significant response in the first minute; however, the adjustment to negative news seems to require less time than in case of positive news, with a faster process lasting eleven minutes less.

3.3.2 THE MAGNITUDE OF THE STOCK PRICES REACTION

After having considered the stock returns around the release of the instant news, we examine the cumulative returns, in order to understand what is the magnitude of the stock prices reaction.

In correspondence to each time *t*, we consider the cumulative return, distinguishing always between positive and negative news. Using these data, we implement again the bootstrap technique for the *t*-tests, finding the *p*-values and so determining whether the cumulative average returns are significantly different from zero. The results are reported in *Table 3.3,* which provides, for each *t*, the cumulative average return, computed starting from the closing prices at t=-21, and the significance at ten, five and one percent level.

For what concerns the positive instant company news, the cumulative average return starts increasing after the news release and from t=4 it is significantly different from zero.

The results are really different for what concerns the negative news. The table shows significant cumulative average returns around t=0 and, in particular, it is to observe the presence of an interesting increase before the release of the negative new information and a rapidly decrease after its announcement.

	Positive Instant News		Negative Instant News	
Time (t)	**Cum. Average Return**	**Significance**	**Cum. Average Return**	**Significance**
-21	0,0000%		0,0000%	
-20	0,0379%		0,0099%	
-19	0,0563%		0,0195%	
-18	0,0531%		0,0346%	
-17	0,0615%		0,0290%	
-16	0,0578%		0,0344%	
-15	0,0303%		0,0671%	
-14	0,0364%		0,0581%	
-13	0,0294%		0,0836%	*
-12	0,0172%		0,1048%	**
-11	0,0040%		0,0954%	*
-10	0,0298%		0,0928%	*
-9	0,0275%		0,0850%	
-8	-0,0210%		0,0770%	
-7	-0,0417%		0,0915%	*
-6	-0,0005%		0,1053%	*
-5	0,0043%		0,1371%	**
-4	0,0207%		0,1261%	*
-3	0,0254%		0,1413%	**
-2	0,0532%		0,1579%	**
-1	0,0473%		0,1724%	***
0	0,0431%		0,2090%	***
1	0,0870%		0,1705%	**
2	0,1190%		0,1375%	**
3	0,1357%		0,1107%	
4	0,1921%	*	0,0689%	
5	0,2370%	**	0,0544%	
6	0,2649%	**	0,0688%	
7	0,2423%	**	0,0686%	
8	0,2154%	**	0,0751%	
9	0,2229%	**	0,0669%	
10	0,2448%	**	0,0603%	
11	0,2057%	**	0,0596%	
12	0,1985%	**	0,0756%	
13	0,2172%	**	0,0797%	
14	0,2205%	**	0,0894%	
15	0,2485%	**	0,1070%	
16	0,2566%	**	0,1040%	
17	0,2624%	**	0,0874%	
18	0,2582%	**	0,0782%	
19	0,2701%	**	0,0727%	
20	0,2778%	***	0,0750%	

*Table 3.3. The magnitude of the stock prices reaction. The table shows the cumulative average return and the significance at each time t, starting from t=-21 until t=20. The significance at ten, five and one percent level is respectively indicated by *, ** and ***.*

In order to provide a better explanation of the results, we plot the cumulative average return both for positive and negative instant news.

We start with the positive information and, considering both the values reported in *Table 3.3* and the trend shown in *Figure 3.1*, we try to understand the magnitude of the stock prices reaction.

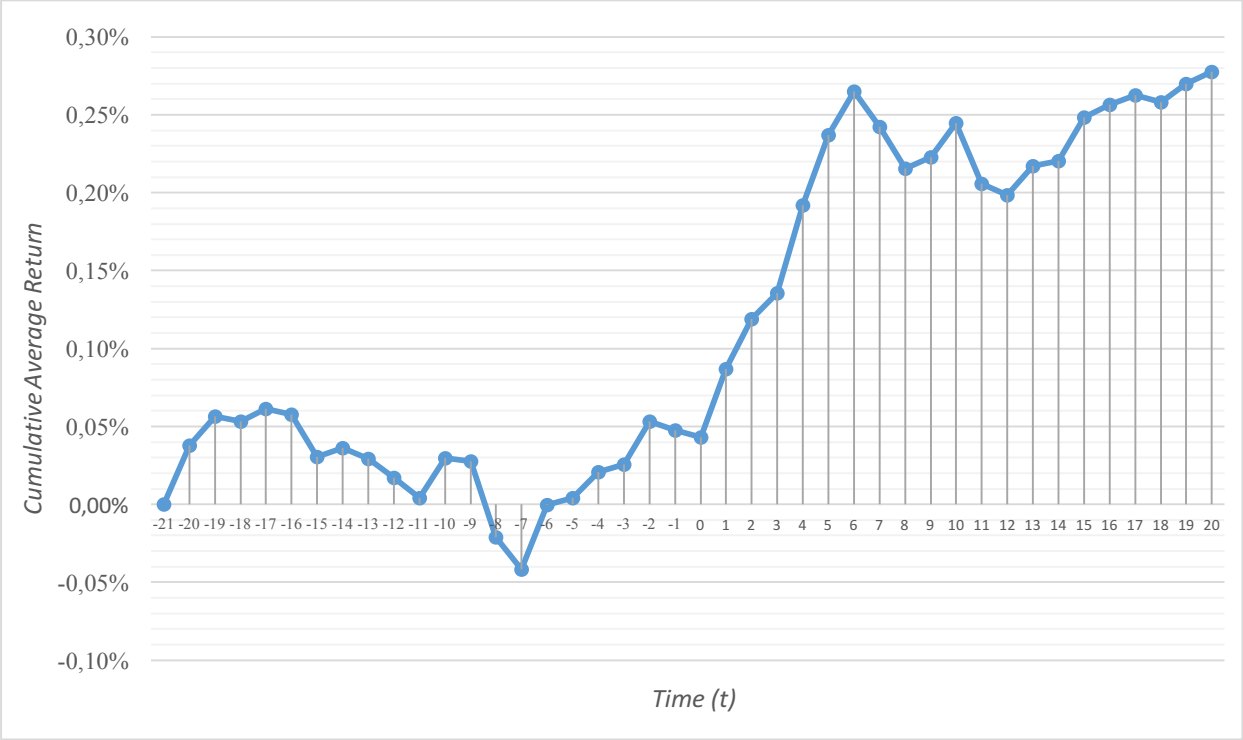

Figure 3.1. The positive news alerts and the trend of the cumulative average return. The chart represents the behaviour of the cumulative average return in correspondence to the positive instant news, starting from t=-21 until t=20.

The chart shows essentially what we have also previously anticipated, that is a high response of prices starting from the release of the information. In particular, it can be seen how much prices increase, with a cumulative average return that goes from 0,04% in correspondence of t=0 to 0,26% in t=6. Then the prices stop their growth, but continue to adjust in the following minutes, with a trend characterized by successive downgrades and upgrades.

For what concerns the significance of these results, reported in the previous table, it can be observed that from t=4 the cumulative average return remains significant, and, in particular, from t=5 it is significant at a five percent level (one percent level in t=20).

If we consider the period preceding the release of the positive instant company news, we can see that the prices show successive small increases and decreases, with the cumulate average return

remaining on the range between -0,04% (in t=-7) and 0,06% (in t=-17). However, the tests indicate no significant results before the release of the new information.

For what concerns the values in correspondence to the negative news, the trend followed by the cumulative average return is reported below in *Figure 3.2*.

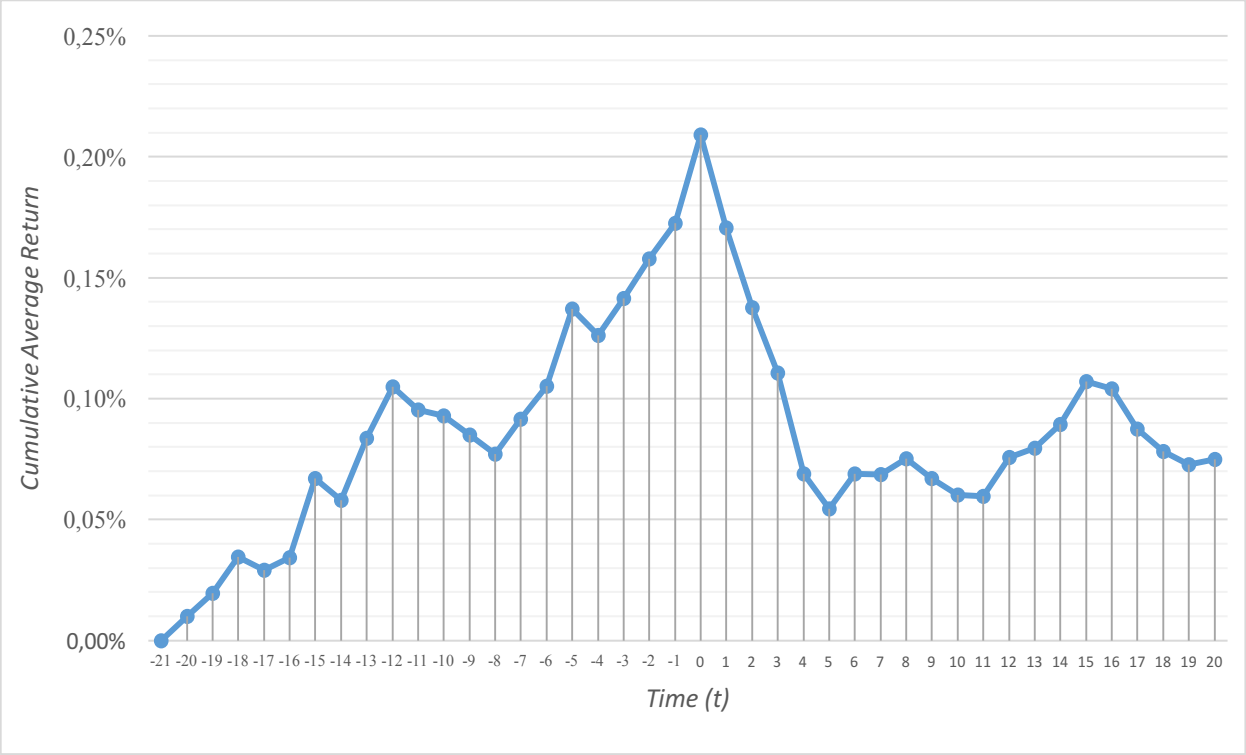

Figure 3.2. The negative news alerts and the trend of the cumulative average return. The chart represents the behaviour of the cumulative average return in correspondence to the negative instant news, starting from t=-21 until t=20.

It can be observed that the chart is characterized by an increasing trend followed by a rapidly decrease after having reached its peak at t=0. Regarding the behaviour after the release of the negative instant news, it is consistent with the sentiment of such information; indeed, the cumulative average return goes from 0,21% in t=0 to 0,05% in t=5. Particularly interesting is that the values around the time of the release, and mainly before, are positive and significant. This is related to the fact that prices continue to increase before the announcements of the news even if the information that will be released is negative. Therefore, if the trend is consistent with the sentiment of the news after t=0, this is not valid for the period before. Such increase could be explained with the fact that traders lack forecasts on such upcoming news, which is completely reflected in the prices only after its release.

3.3.3 General remarks and comparisons

The results of this first part of analysis indicate that the stock prices require some minutes to incorporate the information provided by the alerts of the market-moving news. In particular, the prices start reacting in the first minute after the arrival of the information, but the adjustment continues for the first four minutes in case of negative news, while fifteen minutes are required with positive news. We also find that the magnitude of the response reached in the first minutes after the release is particularly large and consistent with the sentiment of the news.

Given these results, we can state that the stock prices do not "fully reflect available information" immediately after the release, even if the process of prices adjustment starts instantaneously.

From a general point of view, our results can be considered in line with those given by the most part of the literature, which indicates that prices require within five to fifteen minutes to reflect new information; however, these studies follow very different approaches with many differences in their results. Among others, for the purpose of comparison, we can mention the works conducted by Patell and Wolfson (1984), Kim, Lin and Slovin (1997) and Busse and Green (2002).

Patell and Wolfson (1984) focus on the effects on prices in case of earnings and dividends announcements and identify the first price changes in the first few minutes, with a full adjustment lasting from five to ten minutes.

Completely different is the study of Kim, Lin and Slovin (1997), who analyse the impact of buy recommendations that are released to important clients before the opening of the market. They find that stocks incorporate the information within five to fifteen minutes after the opening of the trading day. They also consider the effects of public news; however, prices are found to remain unchanged.

Busse and Green (2002) observe that positive news featured on the CNBC call segments is incorporated in prices within one minute, while negative news requires more time, about fifteen minutes.

The results of these studies present some clear differences from those provided by our analysis; the main reason of such differences consists in the different approaches and sources of information that are used. In particular, we focus on the impact of the news alerts, which allow us to analyse, how prices react immediately after the arrival of all types of instant market-moving information, that is without concentrating on a release occurring at a certain time (Busse and Green, 2002) or on a particular type of news (Patell and Wolfson, 1984; Kim, Lin and Slovin, 1997). After this first part on the prices adjustment, we proceed our research trying to understand what are the effects of the instant news on the trading activity and on the possibility of making profits.

3.4 THE INSTANT COMPANY NEWS AND THE EFFECTS ON THE TRADING ACTIVITY

We have analysed the significant price changes following the instant news alerts provided by *Thomson Reuters Eikon*; we consider it is also important to examine what is the impact of such information on the traders' activity. In particular, in this paragraph we focus on the volumes, the number of trades and the order imbalances, trying to identify whether the news release causes significant increases both in the trading intensity and in the level of buyer/seller-initiated transactions.

3.4.1 THE TRADING VOLUMES AND THE NUMBER OF TRADES

As first step, in order to study whether there is an increase in the trading intensity in correspondence to the news release, we consider the trading volumes per minute both before and after the information and, more precisely, from interval t=-2 to interval t=4.

We apply the two-sample Kolmogorov-Smirnov test, which allows to test the equality of distributions. In particular, we consider the one-tailed test, in order to understand whether the volumes in each interval are larger than those in the period constituted by interval t=-2 and t=-1, that is in the two minutes before the news release.

We compute all the corresponding *p*-values and we report the significance at ten, five and one percent level in *Table 3.4*, which provides also the median trading volume for each interval considered, whose trend is then reported in *Figure 3.3*.

	Positive Instant News		**Negative Instant News**	
Interval (t)	**Median**	**Sig. (K-S test)**	**Median**	**Sig. (K-S test)**
-2 to -1	10023,5		10562,5	
0	12028,0		12335,0	
1	9546,0		12335,0	
2	7358,0		13859,0	*
3	10962,0		13396,0	
4	9858,0		13380,0	

*Table 3.4. The trading volumes. The table provides the median trading volume for each interval t and the results of the two-sample one-tailed Kolmogorov-Smirnov test. The significance at ten, five and one percent level is respectively indicated by *, ** and ***.*

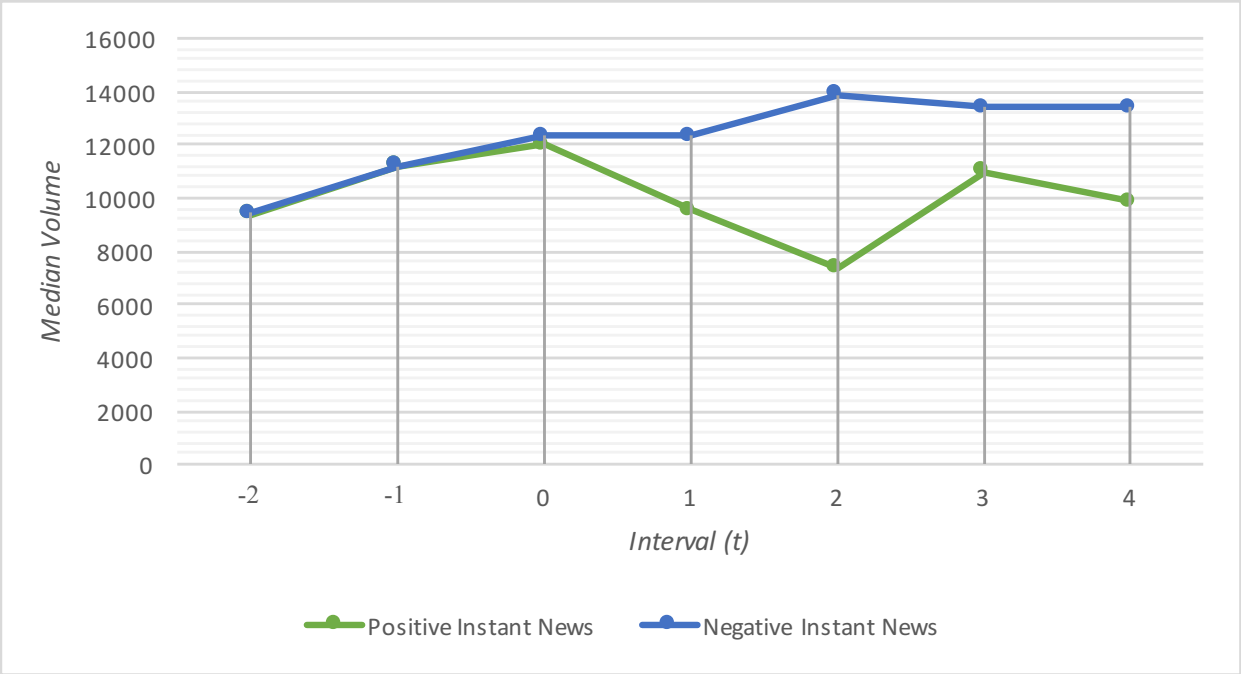

Figure 3.3. The trend followed by the median volume. The chart shows the behaviour of the median volume from interval t=-2 until interval t=4 in case of positive and negative news.

The median volume tends to increase in the periods before t=0 both in case of positive and negative news alerts; however, using the two-sample one-tailed Kolmogorov-Smirnov test, the increase corresponding to the interval of the release is found to be not significant.

For what concerns the period after the announcement of the new information, the behaviour of the median volumes is particularly different for the two groups of news.

In case of negative news, the value remains equal to 12335 until t=1 and rises up to 13859 in interval t=2, which is found to be the only significant increase in relation to the intervals before the news. Completely different is the behaviour after the positive instant news, which is characterized by a decrease of the median volume until t=2, before recovering in interval t=3, but the test shows no significant growth with respect to the period of comparison.

In general, as it can also be seen in *Table 3.4*, the results of the Kolmogorov-Smirnov test show no significant upgrade of the trading volumes with respect to the two minutes before the release. Therefore, it is possible to state that such results indicate that the volumes traded after the news alerts are not particularly affected by the new information.

As second step, always in order to study the effects on the trading intensity, we consider the number of trades per minute both before and after the news alerts. Below (*Table 3.5*) we report the results of the test and the behaviour of the median number of trades.

	Positive Instant News		Negative Instant News	
Interval (t)	**Median**	**Sig. (K-S test)**	**Median**	**Sig. (K-S test)**
-2 to -1	83,5		89,0	
0	104,0		118,0	
1	96,0		102,0	
2	74,0		115,0	
3	96,0		107,0	
4	99,0		107,0	

*Table 3.5. The number of trades. The table provides the median number of trades for each interval t and the results of the two-sample one-tailed Kolmogorov-Smirnov test. The significance at ten, five and one percent level is respectively indicated by *, ** and ***.*

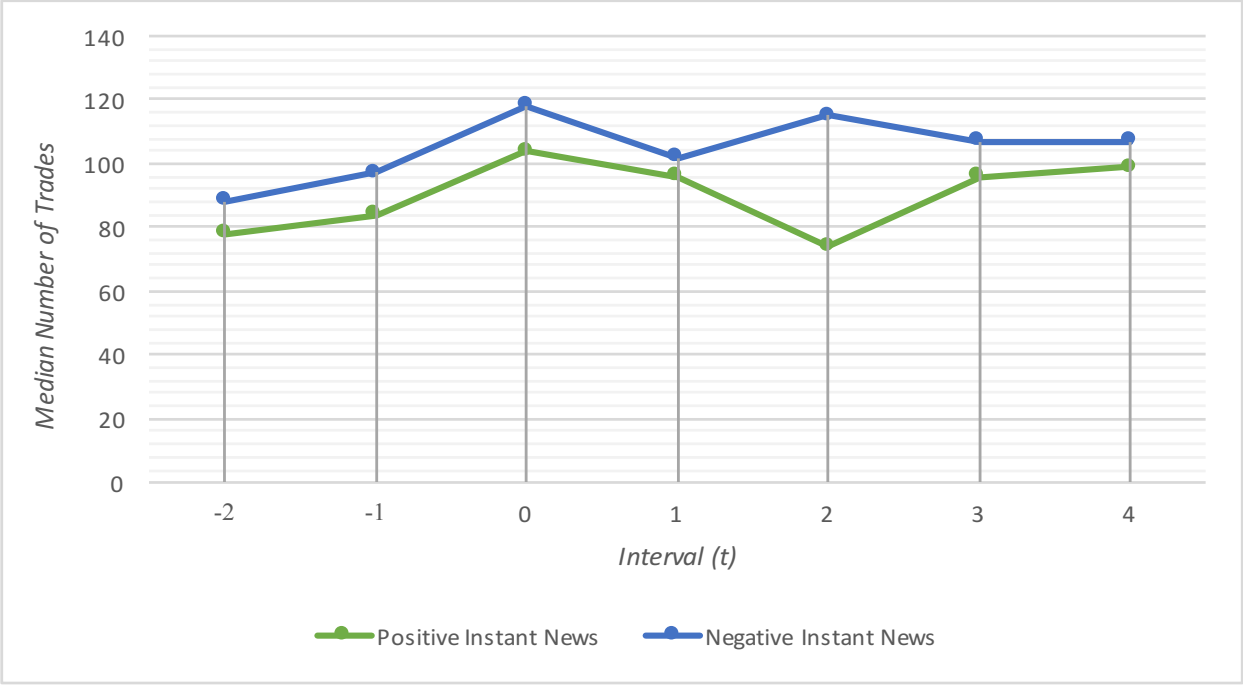

Figure 3.4. The trend followed by the median number of trades. The chart shows the behaviour of the median number of trades from interval t=-2 until interval t=4 in case of positive and negative news.

As it can be observed in *Table 3.5* and in *Figure 3.4,* the median number of trades tends to grow up with respect to the period of comparison. The increase is particularly relevant in correspondence to the interval of the release t=0, where, with respect to the two minutes before the news, the median passes from 83,5 to 104 in case of positive information and from 89 to 118 in case of negative information. After t=0 the behaviour of the median number of trades decreases and then recovers, but the values remain always higher than in the minutes before the release, with the only exception in correspondence to the interval t=2 in case of positive news. However, as reported in *Table 3.5,* using the Kolmogorov-Smirnov test, this general upgrade of the number of trades is found to be not significant.

Therefore, the results both for the volume and the number of trades seem to indicate that the two groups of news have some positive impact on the trading intensity, but the effect cannot be considered significant[49].

These tests on the volume and the number of trades examine whether there is an impact on the trading intensity, but without providing information on the direction of the submitted market orders. For instance, as reported by Chordia, Roll and Subrahmanyam (2002), the volume alone conceals important aspects of trading; indeed, there could be differences in the number of shares purchased and sold and analysing the changes of volumes does not provide such information. So, in order to examine whether the trades are placed in accordance to the information reported by the news alerts, we need to consider also the order imbalances in the minutes surrounding the news release.

3.4.2 THE ORDER IMBALANCES

An order imbalance can be defined as an excess of buy or sell orders and, as specified in *Paragraph 3.2.2*, such imbalance can be measured dividing the difference between the number of buyer-initiated and seller-initiated trades with their sum. The limit cases, given by 1 and -1, imply that all trades are respectively buyer-initiated and seller-initiated.

Considering the order imbalances computed for the intervals of time around the news release, starting from interval t=-2 until t=4, we apply again the two-sample one-tailed Kolmogorov Smirnov test. In particular, in case of positive news, we test the hypothesis that the order imbalances

[49] We also analysed the trading size and we obtained similar results. Indeed, no significant increase was found in case of positive information, whereas, in case of negative information, only one significant increase (at ten percent level) was found in correspondence to interval t=3.

in each interval of time are larger than those in correspondence to the period including interval t=-2 and t=-1; whereas, in case of negative news, we test whether the values in each interval of time are smaller than those constituting the group of comparison.

For each interval considered, we report in *Table 3.6* the results of the tests with a significance at ten, five and one percent level and the median order imbalance, whose trend can be observed in *Figure 3.5*.

	Positive Instant News		**Negative Instant News**	
Interval (t)	**Median**	**Sig. (K-S test)**	**Median**	**Sig. (K-S test)**
-2 to -1	-0,007576		0,013514	
0	0,000000		0,076923	
1	0,118483	***	-0,073892	
2	0,060345	*	0,000000	
3	0,028986	**	-0,025391	
4	0,092127	**	-0,104167	***

*Table 3.6. The order imbalances. The table provides the median order imbalance for each interval t and the results of the two-sample one-tailed Kolmogorov-Smirnov test. The significance at ten, five and one percent level is respectively indicated by *, ** and ***.*

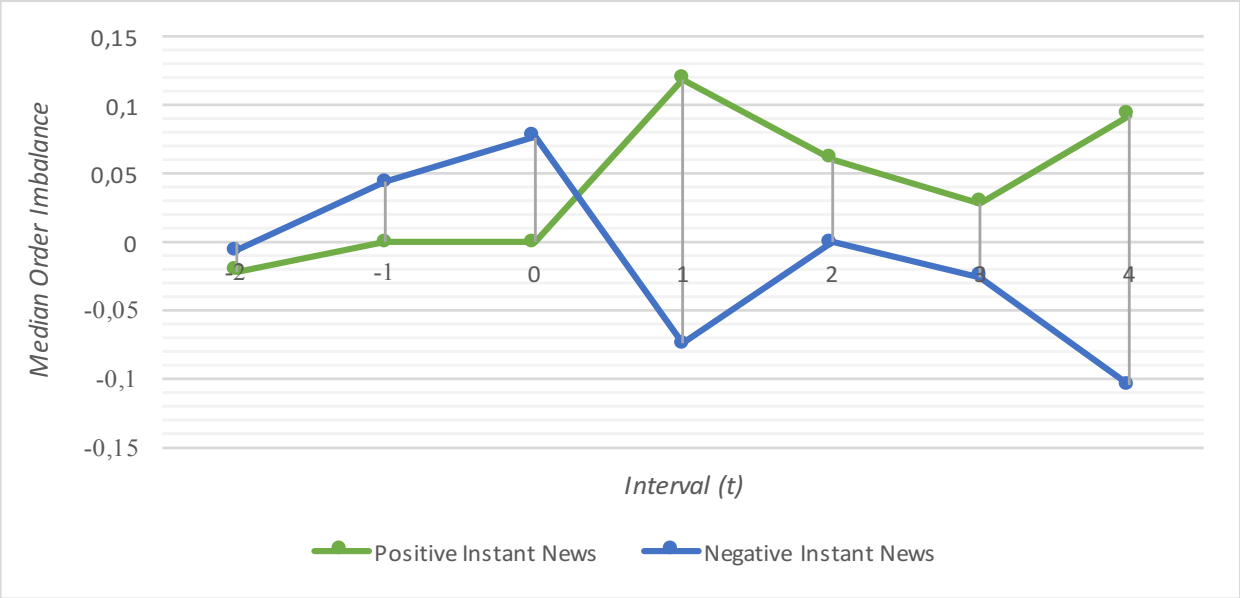

Figure 3.5. The trend followed by the median order imbalance. The chart provides the trend of the median order imbalance computed from interval t=-2 until t=4 for both types of news.

Observing the behaviour of the median order imbalance, particular attention is to be reserved to the first minute following the news. Indeed, according to the sentiment of the information, the median order imbalance starts increasing in case of positive news, passing from 0 to 0,12, and decreasing in case of negative news, passing from 0,08 to -0,07. Then, the effects seem to diminish after t=1 and restart in interval t=4, where the median imbalances return to similar values as in the first minute after the release.

However, looking at the results of the Kolmogorov-Smirnov test in *Table 3.6,* we can see that the order imbalances are not always characterized by a significant increase/decrease with respect to the period of comparison.

In case of positive news, significant shifts in the direction of the information are found for all the minutes after the announcement; in particular, the first minute shows a significant increase at one percent level, but also the third and fourth minute show high significance (at five percent level).

Instead, considering the group of negative instant news, the results are quite different; indeed, the only significant decrease (at one percent level), with respect to the period of comparison, is found in correspondence to the interval t=4.

These results imply that the news alerts are followed by significant changes in the order imbalances and such changes occur in accordance to the sentiment of the new information. However, the reaction seems to be faster in case of positive news announcements, which are followed by significant changes immediately after the release.

Comparing these results with those for the trading intensity of the previous section, it is possible to conclude that the news alerts do not have particularly significant effects on the trading volume, the number of trades and the trading size, but they tend to significantly change the types of orders, increasing the number of buyer-initiated or seller-initiated transactions depending on the direction of the new information. This means that, after the release, traders tend to place orders which reflect the content of the alerts; but, is it profitable to trade on such information?

3.5 PROFITABILITY BY TRADING ON THE NEWS ALERTS

In the previous paragraphs we examined how the stock prices and the behaviour of traders are affected by the instant information. However, we cannot refrain from assessing also whether there could be any possibility of making profits by trading in the period surrounding the news release.
We now take into account only the positive news and we study whether purchasing in each minute between interval t=-2 and t=3 and selling in each minute from the first interval after the announcement until interval t=4 can lead to any profit. As buy price, we consider, in correspondence to each news, the average price per minute of the buyer-initiated transactions; whereas, as sell price, we consider the average price per minute of the seller-initiated transactions. Using these data, we compute the returns and the average returns for each buy and sell combination. Then, in order to test whether the average returns are significant, we implement the bootstrap technique and execute the *t*-tests, finding the relative *p*-values. *Table 3.7* reports the results of the test and the average trading profits, whose behaviour is shown in *Figure 3.6.*

		Profitability			
		Selling Interval			
		t=1	t=2	t=3	t=4
Purchasing Interval	t=-2	0,0140%	0,0529%	0,0778%**	0,1052%***
	t=-1	0,0043%	0,0441%	0,0680%**	0,0954%***
	t=0	0,0051%	0,0448%**	0,0688%***	0,0962%***
	t=1		0,0260%	0,0500%**	0,0775%***
	t=2			0,0124%	0,0399%*
	t=3				0,0072%

*Table 3.7. Instant news and profitability. The table provides the average profitability from interval t=1 until t=4, depending on the purchasing interval t. The significance at ten, five and one percent level is respectively marked by *, ** and ***.*

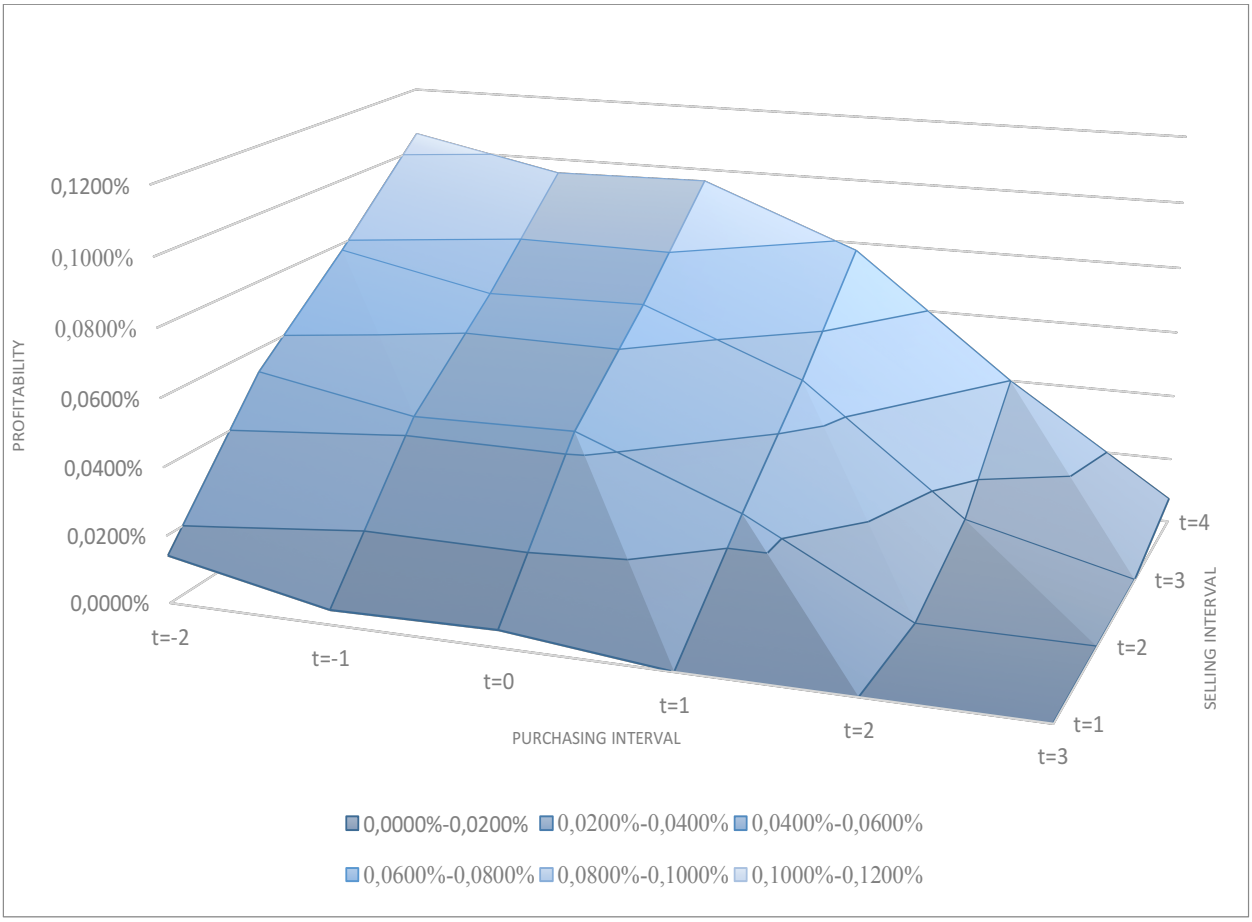

Figure 3.6. The trend followed by the average profitability. The chart provides the behaviour of the average profitability for each combination of purchasing and selling interval of time.

The first relevant remark is the absence of negative profits for each of the combinations considered, even if not all the results of such combinations are found to be significant.

If we consider as purchasing intervals the minutes before the release, the table shows quite large profits and high significance in case of choosing as selling intervals t=3 and t=4. However, for the purpose of our research, we are interested to understand whether there is any possibility of making profits by trading on the news alerts. Therefore, if we consider the case of purchasing in the same minute of the news release, significant trading profits (at five and one percent level) are found starting from the selling interval t=2. However, also purchasing in the two minutes after the news announcement is profitable and, in particular, high and significant average returns are found in case of buying in the first minute after the news release and selling in the third or in the fourth interval. If we compare our results with those of Busse and Green (2002), we note that they find the possibility to obtain a statistically significant return only in case of purchasing until fifteen seconds

after the announcement, that is much less than what we have found (two minutes). However, it is necessary to specify that they use a different approach both for the type of news and for the computation (for instance, they only analyse, as selling time, the first two minutes after the report with respect to our four minutes). Lastly, it is also to consider that, because of their high variability, we do not account for all the possible trading costs that can be involved in the computation, but they can play a role in decreasing the time of the profitable purchasing interval.

Apart from the trading costs, our results indicate that trading on the news alerts can give some possibility of making significant profits. This confirms what we found in the first part of our analysis, where the time required by prices to incorporate the news alerts was the proof of a market that cannot be properly defined semi-strong efficient, in the sense that the prices do not fully reflect all available information as soon as it becomes public.

CONCLUSIONS

The role of information and its impact on the market efficiency has been a controversial topic in the capital markets literature, with a continuous debate between supporters and critics of the EMH since Fama (1970)'s work.

Many empirical researches, with various results, have provided different models in order to analyse the effects of the release of new information and, in particular, to examine the time required by prices to adjust to some types of news, such as earnings and dividends announcements, buy recommendations and analysts' reports (Patell and Wolfson, 1984; Kim, Lin and Slovin, 1997; Busse and Green, 2002).

Considering the models provided by the literature, in this work we proposed a different approach to examine the prices and trading response to new information and, in particular, we implemented an analysis per minute that allowed us to consider the reactions to all the news at the time of their first release. Therefore, in order to conduct our research, for some randomly selected companies listed on NYSE and with a high market capitalization, we focused on the news alerts within the trading day provided by *Thomson Reuters Eikon*, which represent the headlines of market-moving news even before the release of the full stories.

As first step of our analysis, we focused on the behaviour of the stock prices in the minutes surrounding such news alerts and, in particular, we tried to identify the time required by the prices to adjust and the magnitude of the prices reaction.

The evidence suggests that the process of the stock prices adjustment starts in the first minute after the news release, but lasts four minutes in case of negative news and fifteen minutes in case of positive news. We also showed that the magnitude of the prices response reached in the first minutes after the announcement is large and consistent with the sentiment of the new information. Therefore, for what concerns the prices reaction, it is possible to assert that, even if the adjustment starts instantaneously, prices do not fully incorporate new information as soon as it becomes public, but trough a gradual process.

Comparing these results with those found in other researches is not easy given the various approaches and sources of information that are used; however, even if with some differences, it is possible to state that our results are in line with those provided by the most part of the literature, which identifies the prices adjustment within five to fifteen minutes.

After the analysis on the reaction of stock prices to the news alerts, we tried to understand whether such information has some effects also on the trading activity. In particular, we examined the trading intensity and the order imbalances, trying to detect the presence of significant changes.

For what concerns the trading intensity, we considered the volume and the number of trades, verifying whether the values in each minute, starting from the news announcement, significantly increase with respect to the minutes before the news. However, both for the volume and the number of trades we did not find a significant increase.

The trading intensity identifies the general reaction of traders to the news announcements, but it does not indicate whether there is any significant change in the number of shares purchased and sold. Therefore, this led us to focus on the order imbalances, and we obtained remarkable results. Indeed, the news alerts were found to be followed by significant changes in the order imbalances, with a significant increase in the number of buyer-initiated or seller-initiated transactions, depending on the direction of the news announcement. In particular, the reaction to the alerts seems to be faster in case of positive information, with a significant increase of the buy orders immediately after the news release.

Given the results obtained, in the last part of the analysis we tried to identify whether there could be any possibility of making significant profits by trading on these news alerts. In order to answer to this question, we examined whether purchasing in the intervals surrounding the positive new information and selling in the following minutes could lead to significant profits.

The evidence obtained suggests that not only those who are aware of the news before its announcement can obtain significant average returns, but, and this is the main result, also those trading on its announcement. More precisely, purchasing until the second minute after the news release can lead to significant profits, with particularly high and significant returns in case of buying in the minute of the release or in the first following minute and selling respectively from the second or the third minute.

As a final point, in this empirical research we tested the informational market efficiency considering the effects on the stock prices, the trading activity and the profitability in the case of the arrival of the company news alerts. This type of information is instantaneously released and so

at the time of the announcement it is not obviously public and already interpreted by the market, as instead it could happen, for example, in case of analysts' reports or buy recommendations. Therefore, recovering the classification provided by Fama (1970), we can conclude that the market seems to be not properly semi-strong efficient, since the news alerts are not reflected in the prices as soon as they become public, but through a gradual process, leading to the possibility of making significant profits by trading on such news in the first minutes after the release.

ANNEX

	Positive Instant News				Negative Instant News			
Time (t)	**Mean**	**Std.Dev.**	**Min**	**Max**	**Mean**	**Std.Dev.**	**Min**	**Max**
-21	72,5713	28,8261	33,7550	177,9634	81,4252	35,8044	30,4400	176,1800
-20	72,5903	28,8277	33,7000	177,9900	81,4359	35,8188	30,4750	176,1400
-19	72,5919	28,8163	33,7200	178,1900	81,4425	35,8224	30,4771	176,2450
-18	72,5879	28,8083	33,7200	178,1200	81,4479	35,7939	30,4536	176,2450
-17	72,5963	28,8184	33,7342	178,1400	81,4361	35,7652	30,4601	176,0500
-16	72,5947	28,8153	33,7500	178,0500	81,4385	35,7585	30,4500	176,2100
-15	72,5800	28,8264	33,7700	178,0800	81,4672	35,7845	30,4450	176,2100
-14	72,5858	28,8335	33,8200	178,0200	81,4631	35,7922	30,4500	176,3500
-13	72,5851	28,8475	33,8000	178,0400	81,4807	35,7903	30,4450	176,6100
-12	72,5791	28,8524	33,7850	178,0300	81,5019	35,8200	30,4500	176,7000
-11	72,5698	28,8481	33,8000	178,0600	81,4916	35,8091	30,4500	176,7000
-10	72,5975	28,8925	33,8300	178,0700	81,4835	35,7873	30,4500	176,5600
-9	72,5912	28,8847	33,8000	178,1100	81,4771	35,7877	30,4400	176,5500
-8	72,5717	28,9215	33,7914	178,0800	81,4736	35,7950	30,4400	176,6250
-7	72,5496	28,8958	33,8100	178,0400	81,4843	35,7960	30,4375	176,8100
-6	72,5712	28,8817	33,7850	178,0300	81,4944	35,7976	30,4355	176,8100
-5	72,5750	28,8849	33,7950	178,0160	81,5138	35,7827	30,4100	176,6500
-4	72,5904	28,9001	33,7950	178,0300	81,5068	35,7839	30,3900	176,5050
-3	72,5805	28,8745	33,8000	178,1400	81,5202	35,7877	30,4000	176,3200
-2	72,5998	28,8784	33,7600	178,1300	81,5372	35,8010	30,3800	176,2450
-1	72,5978	28,8800	33,6950	178,0900	81,5471	35,7968	30,3850	176,2450
0	72,5955	28,8719	33,6500	178,1100	81,5711	35,7853	30,3850	176,2300
1	72,6276	28,8804	33,6400	178,1600	81,5460	35,7919	30,4050	176,1450
2	72,6490	28,8800	33,6600	178,1800	81,5153	35,7727	30,4100	176,2100
3	72,6586	28,8840	33,6600	178,2200	81,4862	35,7448	30,3900	176,2100
4	72,6924	28,8850	33,6967	178,2200	81,4548	35,7386	30,3650	176,0839
5	72,7218	28,8881	33,6950	178,1500	81,4507	35,7502	30,3540	176,0150
6	72,7447	28,8986	33,7100	178,1900	81,4561	35,7335	30,3600	176,0700
7	72,7332	28,9051	33,7000	178,2000	81,4631	35,7581	30,3500	176,2300
8	72,7176	28,9177	33,7000	178,2400	81,4700	35,7669	30,3600	176,2350
9	72,7225	28,9160	33,7050	178,2200	81,4652	35,7740	30,3800	176,3000
10	72,7418	28,9263	33,7150	178,2000	81,4624	35,7889	30,4000	176,3800
11	72,7203	28,9355	33,6950	178,3000	81,4573	35,7810	30,4200	176,3800
12	72,7132	28,9287	33,6900	178,3400	81,4635	35,7666	30,4200	176,3800
13	72,7224	28,9261	33,6950	178,3600	81,4693	35,7753	30,4350	176,4990
14	72,7244	28,9309	33,6950	178,4200	81,4726	35,7711	30,4400	176,5200
15	72,7391	28,9240	33,6950	178,3700	81,4839	35,7691	30,4500	176,5400
16	72,7436	28,9239	33,6900	178,4100	81,4822	35,7693	30,4200	176,5400
17	72,7505	28,9301	33,6850	178,3250	81,4648	35,7470	30,3850	176,4400
18	72,7446	28,9194	33,7000	178,3600	81,4555	35,7388	30,3900	176,4300
19	72,7547	28,9289	33,7300	178,3900	81,4529	35,7412	30,3675	176,4000
20	72,7588	28,9241	33,7000	178,3800	81,4525	35,7394	30,3650	176,4500

Table A. Summary statistics of the closing stock prices for the 81 positive and 67 negative news alerts.

	Positive Instant News				Negative Instant News			
Interval(t)	**Mean**	**Std.Dev.**	**Min**	**Max**	**Mean**	**Std.Dev.**	**Min**	**Max**
Volume								
-2	30090,88	56744,24	142	318086	23382,64	38388,36	531	192469
-1	26849,64	49850,07	505	356777	19053,52	26474,66	11	177578
0	25650,43	43683,35	105	290206	26258,69	52253,43	371	345292
1	27736,02	47819,36	122	283603	22139,30	48688,15	1406	390894
2	22183,28	47516,61	145	356777	23831,97	38841,35	405	253621
3	24377,01	42298,20	155	290206	23974,39	51246,80	21	346541
4	20065,42	28504,07	490	166195	24109,15	42840,00	215	250878
Number of trades								
-2	189,77	302,59	5	1764	155,09	221,28	7	1524
-1	169,94	262,67	9	1913	133,55	125,23	1	681
0	165,68	215,03	2	1459	175,84	264,70	7	1712
1	149,62	172,69	3	866	145,46	199,24	16	1549
2	138,15	249,18	3	1913	159,52	207,67	6	1435
3	151,77	208,56	4	1459	162,06	303,22	2	2242
4	144,80	172,90	5	985	164,06	249,42	3	1645

Table B. Summary statistics of the volume and the number of trades for the 81 positive and 67 negative news alerts.

	Positive Instant News				Negative Instant News			
Interval(t)	**Mean**	**Std.Dev.**	**Min**	**Max**	**Mean**	**Std.Dev.**	**Min**	**Max**
Number of byuer-initiated trades								
-2	74,94	129,54	0	668	53,94	71,39	1	341
-1	70,62	135,45	0	1058	53,04	59,72	0	313
0	66,07	97,56	0	644	74,93	127,64	1	725
1	64,53	88,65	0	510	50,73	84,35	0	657
2	59,99	136,47	1	1058	57,40	79,20	0	540
3	62,79	95,75	0	644	61,07	114,69	0	811
4	55,68	63,80	0	326	54,97	103,88	0	698
Number of seller-initiated trades								
-2	77,33	136,51	0	908	52,18	66,06	0	328
-1	66,32	101,84	0	647	45,33	45,60	0	209
0	63,51	97,75	0	679	57,96	86,36	0	574
1	52,91	67,85	0	329	56,25	75,29	2	551
2	49,37	90,64	0	647	60,85	91,09	0	605
3	57,59	91,57	0	679	64,58	142,30	0	1070
4	49,12	64,85	0	335	65,09	103,83	0	674

Table C. Summary statistics of the number of buyer-initiated and seller-initiated trades for the 81 positive and 67 negative news alerts.

	Positive Instant News				Negative Instant News			
Interval(t)	**Mean**	**Std.Dev.**	**Min**	**Max**	**Mean**	**Std.Dev.**	**Min**	**Max**
Prices of buyer-initiated trades								
-2	72,5833	28,8822	33,7961	178,1300	81,5251	35,7852	30,3884	176,3277
-1	72,5920	28,8845	33,7294	178,1300	81,5389	35,7989	30,3949	176,3277
0	72,5898	28,8744	33,6888	178,1210	81,5420	35,8073	30,3820	176,3000
1	72,6047	28,8762	33,6417	178,1345	81,5549	35,7897	30,3956	176,2004
2	72,6324	28,8841	33,6485	178,1874	81,5262	35,7783	30,4123	176,2004
3	72,6523	28,8855	33,6597	178,2506	81,4933	35,7569	30,3922	176,1595
4	72,6544	28,8670	33,6754	178,2150	81,4720	35,7470	30,3734	176,1454
Prices of seller-initiated trades								
-2	72,5336	28,9271	32,2229	178,1233	81,5657	35,8260	30,3864	176,2811
-1	72,5721	28,8711	33,7235	178,1000	81,5261	35,7897	30,3937	176,2811
0	72,5744	28,8715	33,6704	178,1100	81,5458	35,7872	30,3792	176,2700
1	72,5964	28,8788	33,6453	178,1018	81,5450	35,7834	30,3992	176,1606
2	72,6245	28,8804	33,6419	178,1891	81,5146	35,7725	30,4069	176,1606
3	72,6392	28,8833	33,6542	178,2315	81,4861	35,7488	30,3979	176,1357
4	72,6548	28,8841	33,6637	178,2057	81,4602	35,7446	30,3689	176,1145

Table D. Summary statistics of the prices of buyer-initiated and seller-initiated trades for the 81 positive and 67 negative news alerts.

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