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Social Media sentiment integration to financial analysis

Exploiting its predictive dimension for remunerative trading activities and avoiding stock market irrationalities

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ABSTRACT

With the recent occurrence of some incredible and senseless financial phenomena, first of all the famous short-squeeze of the GameStop stock, accompanied by other so-called "meme stocks", there is a clear need to review the way we have studied financial markets so far.

Social Media play a role in terms of disseminating opinions, sharing information and attracting attention even specifically concerning financial activities that can no longer be ignored. The Covid pandemic has amplified both people's interest in online trading and the already massive use of Social Media as a forum to discuss market trends.

In this essay our focus consists in understanding the degree of influence social network talks have on financial behaviour of people and consequently on financial market performances themselves, going to see if through sentiment analysis of Social-Media-extracted content future trends of stock markets can be predicted.

The same recent emergence of "meme stocks" is analysed from a social network standpoint, surveying its level of correlation with online forums and trying to guess if it could be foreseen in advance, allowing both investors and regulators to take precautions and prevent huge losses.

In this sense, we suggest some kind of modernization of the financial analyst's activity, or perhaps the integration of a new professional figure that specifically deals with studying the spread of economic messages and sentiments on Social Media, and the potential future actions of coordinated collective trading.

In a world where trading activities have become so fast and where financial talks are ubiquitous in our social platforms, economic and financial fundamentals and traditional theory are not enough to keep up with the times and trying to understand and predict market performances.

SUMMARY

INTRODUCTION

Among the several effects the Covid-19 pandemic has had on our societies, one was the increasing number of individuals getting involved in online trading and other self-driven financial activities. Being forced home, people who at the same time experienced both decreasing income and increasing time to dedicate on the Internet saw online trading as an easy and accessible way to earn money. Considering their way of behaving, they could be defined as self-driven web traders; not only they didn't look for guidelines from experienced financial advisors and professional consultants, acting all by themselves, but they also got most of their information and advices on which they based their trading decisions from the Internet and, specifically, from Social Media platforms. Something particular about this process of self-taught traders filling the market was that it was all self-powered once it started. When back in march 2020 the whole world was all of a sudden stopped by the spread of the pandemic, people started exploiting Social Media more than they had already been doing in the last decade. Little by little more and more people have entered the world of trading, mostly thanks to countless advertising of trading platforms, services, courses and so on. Once the process started, the sharing of thoughts and ideas on Social Media by those people getting involved at first, made it spread at a faster and faster pace, involving all their "virtual friends" who were potentially interested in such activities and decided to get into them after reading about their Social Media contacts doing so.

Considering the huge number of individuals who threw themselves on the markets, the first question that arises spontaneously is: how did they perform? Did they succeed in earning money online with trading?

At first glance, the general tendency would be to believe self-driven traders must perform pretty bad, for sure worse than institutional or experienced ones. Anyone who has had experiences with trading platforms should have read warnings when subscribing apprising that "*more than 90% people lose their money when trading*". Natural consequence should be the fact all those people getting involved in trading hoping to make extra and easy money not only didn't make profits, but also lost part of those funds they put on financial markets.

It sounds so obvious that people who simply trust what they read on Social Media, and on the Internet overall, following opinions of others amateurs investors, non-proven news, meaningless reports about firms' performances, and probably several fake news too, not even have the possibility to "compete" in the market with professional investors who have been dedicating all their lives to the financial universe, who get exclusive information and advices from inside the most famous firms, and who manage millions (if not billions) every time they perform a single market operation. On a general level these considerations are perfectly founded and very often reflected in reality, but there have been some events (and also studies) in recent times that questioned this absolute rule. The most famous one was definitely the Gamestop Short Squeeze that happened on January 2021, on whose wave strange and unwarranted price oscillations are still frequently happening months later.Bbut this is only the most famous phenomena of small amateur investors that made something completely unpredictable happen in the market and made all "experts" predictions turning out to be wrong; at least, considering a medium-short time horizon. From a wider perspective, this specific event belongs to the field of study of the relationship of influence Social Media platforms, and the Internet overall, as a source and mean for the spread of information that are not necessarily proven and true, have had with financial markets during about the last decade. More and more researchers have wondered

whether there could be any interaction that hasn't been studied and understood yet linking in some ways Social Media activities and talks to financial outcomes, performances and predictions. Several scholars investigated such phenomena and various interesting studies were published in the last few years; their content, as well as presenting an alternative view, could lead to completely revolutionary approaches when it comes to study the performance, and not only, of financial markets and all sub-categories that belong to the financial world.

In 2015, a study in which textual analysis was applied on two of the most popular social media platforms (*Hexun and Finance.sina*) for financial investors in China, seemed to prove not only that "*opinions revealed online can strongly predict the credit risk of enterprises and actually provide valuable information to retail investors*" but also, with great surprise, that information superiority and professional advantages of analysts did not seem to affect and improve their ability to make predictions; in fact, according to this study, their predictions with regard to the credit risk of enterprises seemed to be meaningless, for sure less reliable than opinions from crowds extracted from those Social Media platforms under analysis. (Fei, Gu, Yang, & Zhou, 2015)

These simple conclusions already put the point years ago that aggregated opinions of crowds of non-professional investors/opinion makers could somehow beat financial experts.

It is very important to point out the fact this study, taken as a starting point, just like several others we are going to see, considers individual opinions of amateurs not on their own, but as the overall sum of a collective sentiment, where each single idea of a person on a social network accounts a little bit in building a unique general opinion of the crowd. It is essential to make this clarification early at the beginning of this essay in order to make the reader aware of the fact we do not claim to be able to analyse the single performance of an individual investor; besides being useless for a research that wants to be as generalizing as

possible, we must assume that it is true that most of self-driven traders perform bad, otherwise it would not make sense for trading platforms to put such a warning on their registration forms. For sure there are those "Black Swans" who operating all by themselves, maybe getting all their info from the Internet and social platforms feeds, are able to earn money online with trading activities; but, as their appellative itself says, they are the exception, not the rule.

The kind of reasoning and analysis of this paper is made to suggest a new approach towards the way we consider Internet (and specifically Social Media) circulating information and their implication/application to financial markets; such flows need to be no longer seen as mere junk, second-hand, irrelevant and inconsistent information, precisely as regards their interconnection to the world of financial operations.

Yongjie et al. begun their study on "*Market reaction to Internet news*" quoting the fact that, already back in 2016, according to the CINIC (China Internet Network Information Center), Internet had surpassed Mass Media as the mainstream channel for information acquiring. They then try to investigate whether there is any correlation between the volume of news spread in a specific day on the Internet and the volume of market activities within that same day. According to their findings there exists a positive impact of Internet news on abnormal returns on a specifically reported event date, meaning the market seems to strongly react to Internet news. Particularly, a relatively great market reaction is observed for those defined as "*High Information Subgroups*", meaning those stocks for whom was reported a significantly numerous number of news spread on the Internet during the date under analysis; on that date are observed excessive trading volumes for those stocks, compared to their averages. (Yongjie, Weixin, Dehua, & Wei, 2015)

The results of the study, which demonstrate this very close relationship, suggest the need to go deeper with analysis and comprehension, in order for scholars, and even financial analysts themselves, to be able to exploit

the interconnection between Internet circulating news and financial markets not only for mere theoretical reasons, but also for practical and economic advantages. Understanding the relations of influence, their dimension, meaning and predictability, between Financial Markets and the Internet world, in particular Social Media, with their fast and fleeting circulating messages, could be the key path to take in order to avoid losing control, at least theoretically, on the behaviour of financial instruments, which are nowadays becoming faster and faster, just like their information counterpart on the web.

LINKING SOCIAL MEDIA TO FINANCIAL MARKETS THROUGH SENTIMENT ANALYSIS

According to "*Traditional Financial Theory*", investors behave in a rational and homogeneous way; all decisions are taken following concrete analysis, studying data and applying realistic forecasts to financial instruments that are proven by real-world-performances of underlying firms, corporations and economic agents, generally speaking. However, over the past 30 years, researchers have expanded their analysis range to the field of "*Behavioural Economics*", incorporating the role of human sentiment as a determinant factor in all decision-making processes, including economic and financial ones. To include behavioural studies and discoveries to economic models was more a need researchers had to satisfy, rather than a mere academic interest, and such thing for two main reasons. The first one was that economic models based on assumptions of optimizing people behaviour had too often difficulties in accounting for key real-world observations; even stronger, the second reason was that, according to how both cognitive psychologists and experimental economists have documented, there exists "*a number of systematic deviations between the decision of human beings and those of the "economic man"*. (Driscoll & Holden, 2014) The introduction of human sentiment as a concrete and important factor to Classical Economic Theory opens new ways of understanding and analysing the economic operation of people as irrational individuals; one of the economic fields of action where decisions and actions are most influenced by subjective mood state is definitely financial markets. If it is true that people sentiment significantly accounts on their trading decisions, then we must assume financial markets are in turn influenced and shaped to some degree by collective mood state of investors; and if so, analysts could try to "measure" in some way this collective mood in order to evaluate how it

affects specific financial products, if not the market overall. The point is that being able to extrapolate reliable values of measures for the sentiment of crowds made of thousands and thousands of people is for sure a complicated task, but here Social Media can play a crucial role: working as a container of information of the mood of potentially every single person in the world who has an account, they can be the most efficient source of information for an analysis of this magnitude.

In a study called "*Modelling public mood and emotion*", published back in 2011, Bollen et al. analyse how events in social, political, cultural and economic spheres affect the various dimensions of public mood. In order to do so they performed a so-called "Sentiment Analysis" on Twitter, detecting as many mood signals as possible from very brief Tweet messages. Sentiment analysis often applies machine-learning techniques to extract indicators of public mood from social media content. Anyway, in this case Twitter was chosen because it is a data source where contents are so flexible and ephemeral that it is possible to efficiently obtain indicators with a simple term-based/syntactical approach, which does not require any further application of machine learning in order to be valuable. By doing so, researchers were able to build some "mood-trends" that developed parallel to some specific events happening in society.

Johan Bollen himself is probably one of the ancestors of the analysis of the relation between Social Media and various socio-economic phenomena, and one of the first to demonstrate the correlation between financial markets and Twitter (and Social Media in general) and the concrete applicability of an analysis of this type.

In this study, him and his team show that economic, social, cultural and political events seem to have an effect on public mood; by then comparing those mood trends to fluctuations recorded in the stock market they find out the two are significantly correlated, even if delayed, suggesting that it takes time for changes in the collective sentiment to be

reflected and to influence markets. (Bollen, Pepe, & Mao, 2011)
Anyway, to our interest, their fundamental contribution was to perform such an analysis in this proper way, demonstrating that collective mood trends can be modelled and to some degree predicted using large-scale analysis of user-generated content. Most important, they did so exploiting a Social Media (Twitter), and they couldn't have done otherwise to gather such an amount of information that could allow them to determine the collective sentiment of so many people.

1.1 - SOCIAL MEDIA TALKS DRIVE PEOPLE ATTENTION

This idea of utilizing Social Media as a basket of valuable information content from which analyse and measure information themselves for academic purposes is something that spread a lot among researchers during the last decade.
Traditionally, such kinds of measurement and studies were only based on professional sources of information: business news wires, analyst reports, newspapers and official surveys. Anyway, the advent, but mostly the impressive spread of social web networks, captured scholars' attention; if it is true that information collected from professionals is more reliable and probably truthful, as it is derived from analysis based on their expertise, on the other hand gathering information from social networks allows to build measurements with the opinions of billions people as their foundation. Collecting data from Social Media and being able to utilize them to develop models that identify common opinions, feelings or behaviour tendencies of a huge set of individuals, linking them in consistent ways to economic and financial movements, can represent the new frontier of analysis and markets prediction attempts. Thinking in this direction, Rakowski et al. (2017) bring the attention on the effect the diffusion of information through Twitter has among investors. Seen as an information source that generates investors' attention and facilitates its

diffusion among them, they consider Twitter activity as unique and meaningful in generating and driving attention towards financial activities, with statistically and economically significant impact on asset prices. In particular, "*Twitter increases the magnitude of contemporaneous day's returns in the very short-term, while it drives price changes that seem to persist over time in a longer-term perspective*". (Rakowski, Shirley, & Stark, 2017)

This association they perform between Twitter and trading activity shows that the first one matters a lot in directing investors' decision making processes: at least for those Twitter users that are market oriented and follow with attention all those tweets posted with regard to financial activities that meet their interests. Furthermore, according to their results, the impact of Twitter attention on financial markets is stronger for stocks that are kind of "less visible", which are small, with low capitalization and low liquidity; this fact gives clear evidence to the idea that the interest that is generated by Tweets is actually driving actions of small users/investors, with an even more apparent impact than we would expect: if for large stocks with huge capitalization institutional investors somehow dominate the market, for those smaller stocks where big hedge funds have not put their eyes on yet, trading and financial actions made by simple individuals who act in a coordinated way, have relevant and visible effects. This outcome by Rakowsi et al. is telling that Social Media influence is actually present on financial markets, and it can be detected and seen; contents generated in social platforms influence users' interests and actions, which are in turn transmitted to financial products and are shaping the market. In this sense, the three scholars give in their study the idea that user-generated content affects stock returns in ways that are different from other previously considered measures of investors attention: it has nothing to do with consistent official publication or financial report analysis, nor with expertise predictions of sales made by a given company, to give some examples. This time, the measurements of

attention are all based on interests and maybe some kind of curiosity that is simply generated by users who tweet their opinion, maybe following other Twitter-users opinions, and who will probably as a consequence influence other users who happen to read them.

The fact attention generated on Twitter plays a relevant role in determining investors' decision-making and actions reconnects to the importance human sentiment has when taking financial and economic decisions. All opinions that can spread online, particularly through social networks, remain opinions only as long as people do not act basing their decisions on them; once they have done so, they have transformed those signals collected online into feelings, and those feelings drove their trading activity.

Let's imagine a Twitter-user interested in stock trading reads several tweets in his feed telling that Apple is releasing the worst iPhone ever, that nobody will like it and it will meet difficulties in selling. If that reader was for any reason an Apple stock owner, he will probably decide to sell its stocks: this won't be because of others' documented opinions with regard to Apple financial performances; that investor will be driven by the fear that other Twitter-users were right about the new iPhone.

On the other hand, if he wasn't a stock owner but was still an interested investor, he could decide to short-sell Apple, led by the hope others' opinions translate into reality and the new iPhone will sell so low that its stocks consequently drop.

In this imaginary situation the incredibly fast spread of talks through Social Media about the new iPhone would reach such a large number of people that for the law of large numbers there would be for sure thousands and thousands active investors among them: it can be assumed that some will act in financial markets driven by this sharing of opinions. But if for a huge stock like Apple probably nothing consistent is going to happen as a consequence of this collective amateurs' activity, things would be different if the stock under discussion and pressure was

a small one, maybe with low capitalization and large individual ownership, as previously mentioned by the last study cited.

A recently happened financial event that is somehow traceable to this kind of reasoning is the GameStop short-squeeze of January 2020, but we will come back to this topic and analyse it in depth in the next chapter. Thinking about the fact Social Media have been proven to be influencing people attention and interests, both generically speaking and more specific, to our focus, for financial markets and trading activities, it can be said that, due to their usefulness as a source for information and prediction in these kinds of reasoning, Social Media themselves work as a projection of the real world. Due to their nature, made up of fleeting, unlimited and uncontrolled messages, but at the same time visible and accessible to anyone with an Internet connection, they represent kind of the virtual counterpart of the physical world we are living on. And this "parallel world" is quite populated, by a huge share of the real world population and their social networks' alter-egos, made up of 4.2 billions active Social Media users (Global digital population as of January 2021), just to give an idea of the dimension of resources and information useful for research that can be extracted.

Tamura & Matsuo (2020) ask themselves whether, besides working like a social sensor showing what's happening in the real world, just like a projection, information on Social Media could have a predictive and influencing dimension too. If they agree that through sentiment analysis Social Media do work as a sensor able to detect from online talks what are the common feelings and moods spread in reality, they also try to develop a model able to measure effects on financial market all the phenomena of interest, attention and influence relation with Social Media themselves do generate. Without dwelling on the method they used as it is not really of our interest, and going directly to the results obtained, they were able to predict future volatility from Social Media messages with higher accuracy with respect to other more traditional analysis

methods. Most important, they found out that for those markets or financial products for which talks on Social Media are less visible, meaning for those products that do not generate particular interest in online speeches, the same method applied did not have the same prevision accuracy; this clarification is important as evidence of the fact that Social-Media-extracted information are valuable properly due to their number and breadth, and as soon as their vastness comes short, they lose much of their strength.

Moreover, the two scholars provide food for thought as they point out the fact the degree in which the influence relation on Social Media affects financial markets depends on the nature itself of the financial product or activity. They show evidence those financial products for which there is more interest in online networks and those with lower capitalization are more likely to be affected by Social Media sentiment and spread of talks about them. (Tamura & Matsuo, 2020)

This conclusion they achieved supports the hypothetical case we were imagining earlier about Apple, and it is at the same time confirming Rakowski's results telling that Twitter attention mostly impacts those "less-visible" stocks.

1.2 - EVIDENCE OF SENTIMENTS INFLUENCING MARKETS

Going back to the attempt of understanding the way in which sentiment is connected to financial markets, and how Social Media play the role of intermediary in this type of relationship, it's once again Johan Bollen who begins his study called "*Twitter mood predicts the stock market*" recalling the fact "*Behavioural Economics tell us that emotions can profoundly affect individual behaviour and decision-making*". (Bollen, Mao, & Zeng, 2011)

In this paper, they investigate whether measurements of collective mood states collected from large-scale Twitter analysis, once again, can be somehow correlated to the value of the Dow Jones Industrial Average.

Their analysis of Twitter feeds is made with two interesting tools: the first is "opinion finders", which measures syntactically all tweets in order to rank them among positive and negative mood signals; the second one is more precise, "Google profile of mood states" measures Social Media signals for 6 specific dimensions of mood (calm, alert, safety and happiness the more relevant). With all this data from tweets is created a "mood time series", and together with that is created a time series for the Dow Jones Industrial Average; it is observed that there is quite a significant correlation between these mood and DJIA time series. In particular, calm sentiment expressed by mood time series appears to be the most correlated: changes in past values of calm, predict similar rise or fall on the Dow Jones Industrial Average, which are seen to be reflected 3 days later, suggesting that calm mood dimension could have some kind of predictive value. Generally speaking this study contributes to show with concrete statistical analysis that stock prices do not follow a random walk but can to some degree be predicted exploiting social media sentiment analysis.

Even though calmness has been identified in this case alone as a very significant feeling that, when detected and used to build a consistent time series, could appear to be reliable in the attempt of predicting stock market movement, this does not mean that this feeling can be recognized as having the unique and absolute capacity of working as fundamental indicator in financial market analysis. It would be an error to think there could be that one sentiment that, once revealed, identified and measured, could be exploited alone in order to anticipate movements of stocks and indexes.

Things are quite more complicated. If further we recall the role played by irrationality in the process of economic decision-making for individuals, it's obvious that believing in one single sentiment to be determining their financial activities is an inconsistent hypothesis that goes against the "irrational dimension" of behaviour itself. Despite these considerations,

last study's results are proven to be valuable: applying sentiment analysis to Social Media in order to understand market movements is possible. The only point we are arguing about is that this analysis can't be limited to one single sentiment, thinking that once this is proven to be reliable as an indicator the research is concluded.

In fact, just to give a quick example, another study we have focused on reveals there exists at least one different mood state that, according to the obtained results, is significantly correlated to market performances.

Zhang et al. (2016) introduce their study on "*Daily happiness and stock returns*" pointing out that, if on one hand traditional financial theory assumes that investors are rational and there is no room left for irrational behaviour in asset pricing, on the other hand *"the behavioural economics has shifted the academic focus to investigate the relations between investor sentiment and asset prices*". (Zhang, Li, Shen, & Teglio, 2016)

They too see Social Media as an efficient data source from which to extract information to perform sentiment analysis and build collective mood trends, and believe that, if things are so, then they could be the perfect tool to exploit in order to examine that "irrational human" side investors transmit to financial markets. In their study, Zhang et al. utilize once again Twitter as a source of information in order to build an index of "Daily Happiness": they subdivide this feeling into distinct levels, from the less-happy to the most-happy level; they then investigate whether there is any possible correlation between this index and market trends of some of the most important market indexes (S&P500, NASDAQ, Composite, DAX, FTSE100, Nikkei225, etc.). According to their analysis there seems to be a positive correlation and Granger causality between happiness sentiment and financial indexes returns. Findings are important in particular for the "most-happiness subgroup": it is observed a strongly significant correlation with both trading volumes and indexes performances, as well as a considerable increase in volatility.

Since we know the strength of happiness as a sentiment for us human

beings, and how much our decisions and actions are largely dictated by our mood, these findings seem to confirm the idea that investors do not always act in a cold, controlled and strictly technical way, but are driven, at least for an important part, by their feelings: happiness is definitely one of those which is more able to drive people behaviour.

Moreover, the results of the study highlight a significant dependence between online sentiment and overall stock market performances, confirming once again that Social Media not only can be used to understand the state of mind of the community, but further that the sentiment itself present in those social platforms is in some way connected to financial markets.

Bouri et al. (2021) too analyse the specific role of investors' happiness, this time on the Total Connectedness Index of financial markets, in order to evaluate whether, and if so, how much, the variation over time of happiness sentiment, also caused by particular events or periods affecting society temporarily, is having visible and direct influence on stock market performances and risks. Extracting all necessary information needed for their analysis once again from Twitter, they based their model on the partition of happiness into 9 gradations, from the least to the most-happy one (similar to how Zhang et al. did), all made up through the evaluation of sentiment behind every tweet. What they found out first, pretty interesting, is central quintiles (meaning those attributable to "normal happiness of people") are those that mostly contribute positively to Stock Market returns connectedness, with more consistent effects. On the other hand, at the extremely high or low happiness quintiles (those were people meet either a fleeting or a spasmodic and irrepressible happiness) the relationship turns negative and connectedness is lost, or at least decreases, suggesting that extremely evident sentiment shocks, whatever their type is, are always taking with them risks and irregularities in markets. (Bouri, Demirer, Gabauer, & Gupta, 2021)

Anyway, the overall connectedness of returns is found to generally

increase with perception of happiness among investors, confirming the hypothetical role of this sentiment as powerful in driving investors' decision making.

So far we have only mentioned positive feelings valuable for the attempt of understanding the relation between sentiment and market performance. Both calm and happiness, indeed, give the idea of leading those investors who feel them in a sweet and optimistic way towards decision-making. Let's change this perspective and move on to a radically opposite situation, where a kind of "anxiety" dominates, to make readers aware of the fact it is not only positive sentiment to be directly affecting financial markets.

This time, the sentiment behind the decision-making process is not derived from events occurring in society, nor extracted from Social Media messages sentiment analysis, but it is directly connected to the technological nature of social media themselves and, more specifically, to their use through smartphones. Mobile technology has nowadays become pervasive and ubiquitous in our society and it has been experienced over the last decade a constant increase in mobile devices use for investment tasks: they make it easier for individuals to be aware of events, to get fast and short information and, generally speaking, to be a little informed with regard to every potential aspect of their interest.

Particularly interesting and relevant, to our research and analysis, is the ephemeral and almost insignificant dimension of the so-called "push notifications" through mobile devices Apps. With time passing by, Push Notifications have established themselves as the main and fundamental communication message that each of us receives on his smartphone. They come directly from the apps we have installed and consequently concern the topics of our greatest interest.

A peculiarity of this kind of information we get through notifications is they are very short and so-called "ungrouped": what this term refers to is the fact all the short messages we get from our installed apps do not

contain the whole content of the topic or information they refer to, but just a short part of it. This is done by purpose, studied by mobile and app developers, but first by psychologists, since it was demonstrated that giving mobile users only a little taste of an information potentially of their interest increases the interest itself towards that information, encouraging people to open those apps that provide this kinds of notifications more frequently. To our specific interest is a particular psychological consequence generated by these "push notifications" on all those people that utilize their smartphones with investment purposes; those who have probably installed several apps regarding financial markets, economic news feeds and, most important according to the analytical path we are carrying out, social trading platforms (identifiable as a branch of social media) that specifically target customers interested in trading, with all the common features and functionalities of other "more generic" Social Media (a more detailed exploration of the social-trading-platforms question will later be found in the second section of chapter three).

Clor-Proell et al. (2017) put evidence on the so-called I-FoMO (Investment fear of missing out), that psychological consequence we mentioned earlier on those investors who receive these kinds of notifications. The very type of these notifications, the hype they create and at the same time the absence of concrete information in their content do produce in those mobile device users who happen to read them a kind of "anxiety", generated by the fear they feel about the fact they could somehow be missing some investment opportunities. This feeling is caused by the specific fact they are reading something that seems to be important and relevant in these notifications, but at the same time they cannot comprehend in depth the content of the notification as long as they do not open and read entirely the information it introduced. The problem is those fast traders often feel like spending time in understanding the entire content leads to the loss of the investment opportunity, since even

very few minutes matter when taking a trading decision (at least, according to their specific trading behaviour).

Those individuals who are reported to be highly prone to this I-FoMO appear to be more influenced by investment news through push notifications directly on their investor's behaviour. I-FoMO makes mobile users more subject to react and decide to invest based on this continuous appearing of notifications about news on investment opportunities. (Clor-Proell, Guggenmos, & Rennekamp, 2017)

This study's results, besides being a further confirmation of the irrational dimension that exists behind financial and trading decisions, also provide a potential starting point for future research aimed at measuring and modelling more in concrete the way in which the development, spread and attention driven by push notifications, and more generally by mobile device instruments that specifically concern financial topics, affect the economic and trading behaviour of investors.

1.3 - SPECIFICALLY INVESTIGATING THE PREDICTIVE POWER

A fundamental further step to make now consists in studying and understanding precisely the order of the addends in the relationship that has been shown to exist between people sentiment, Social Media messages and financial markets; so far it hasn't been discussed in depth how this kind of interconnection works: whether market outcomes have a positive influence on people mood, shaping their sentiments as a consequence of financial well-being and consequently driving them on posting positive contents and messages in their social platforms; or if conversely it is the common feeling of crowds, determined by other external-to-markets factors, which are able to contaminate each other via Social Media interlinking in such a way that their feelings are then transmitted into trading activities, influencing somehow overall financial

performances. This point is still to be discussed and understood clearly in our research.

Readers may already have an idea built from previous studies this paper has mentioned; to anyone who paid attention, but even by logical consequence applied to what has been written so far, the answer must appear almost obvious. Anyway, for the correctness of the analytical path we intend to continue, it is necessary to explicitly discuss this point, providing clear evidence of what is consequent to the other.

In this sense, Broadstock and Zhang (2019) specifically test whether sentiment extracted from Social Media has pricing power towards the stock market: they do so by empirically consider responsiveness of prices to twitter-extracted sentiment trends for 6 specific stocks. For each of them there seems to be significant intraday reactions to sentiment; moreover, on a less-significant basis, there seems to be at least some reaction to sentiment even on the broader market index.

The regression they perform provides clear and significant effects on prices, which are attributable mostly to firm-specific sources of sentiment, but to some market-wide sources too. Most important outcome of their study, according to our analysis' interest, is the fact they show markets take some time to process and incorporate the full value-implication of sentiment; this fact suggests that it is the market overall, and stocks specifically, that respond to collective sentiment trends, not the other way around. (Broadstock & Zhang, 2019)

Moreover, an interesting input provided by how they conducted their study consists on the fact they focused on analysing single specific stocks and their related extracted sentiment. So far we have mentioned researches that have been conducted from a more generalized perspective, analysing the relation of influence Social-Media-extracted-sentiment has with overall financial markets, or maybe with some particular indexes that are, anyway, composites and complex.

Due to the complexity itself, and to the amplitude of the financial world if

trying to be understood and capture its behaviour and movement as a unique entity, it is obviously a more complicated task for researchers to reach valuable results. We are not assuming this is something impossible; on the contrary, what we want to end up with is a consistent outcome proving that Social Media analysis can lead to reliable models which are generically predictive for financial performances. Anyway, reconnecting to the last study cited, if the analysis is conducted for a given stock alone, this can definitely lead to more precise results. For sure it requires a more specific, probably difficult preparation, when trying to detect sentiment from Social Media for this unique stock: there is the need to extract only those messages that are directly attributable to it, managing to filter all the ones that are not specifically referred to it. But if analysts were able to extract this specific sentiment and build a model of its performances and variations, then this could be a very powerful tool to be used for trading activities, exploiting its predictive dimension, in addition to its specificity, to decide how to behave with this stock when playing in financial markets.

Back in 2012, Rao & Srivastava had already given proof of how identifying the relationship between Social-Media-based sentiment and short-term market performance of a particular index or company can lead to very robust results in terms of predictability. They based the first step of their analysis on Twitter-extracted sentiment too, using large-scale collection of Tweet data, trying to identify the relationship between a single company or index with the specific collective sentiment towards that company or index. If back then all other previous research works were looking for the influence on the market generic mood states could have, in this case sentiment analysis was performed not generically, but for specific individual companies and indexes, with this question in mind: if the sentiment for this one company we can detect from Twitter is so, then how is this sentiment consequently influencing the company stock performance in the market?

They demonstrate that negative or positive dimensions of public mood carry, and anticipate, strong cause-effect relationships with price movements, seeming to confirm, already at that time, the predictive dimension of Social-Media content towards market performances of companies. Particularly strong correlation values are demonstrated indeed between a stock performance and sentiment features of that one company: their model performed so strong properly because it captured mass public sentiment towards a single particular index or company. (Rao & Srivastava, 2012)

The capability, beyond the possibility itself, of detecting from Social Media messages common sentiment with regard to a specific company financial performance, represents a necessary and fundamental point of departure to perform a valuable analysis and try to obtain consistent results in the attempt of understanding the possible interconnection between Social Media and market movements, as we want to do. The main obstacle in this first step consists in the fact it can often be difficult to distinguish for a given company name, when performing Social Media messages collection and evaluation, all those irrelevant (to our interest) messages that generally contain the name itself of the company from those that, on the other side, specifically contain financial performance opinions about it: those are the ones we are interested in and the only that, after skimming, are valuable to make a consistent sentiment analysis. Zheludev et al. (2013) put emphasis on this point in their work, where they specifically tried to seek a "*sentiment analysis methodology able to quantify and statistically validate which assets can qualify for trading from Social Media analytics in an ex-ante configuration*". (Zheludev, Smith, & Aste, 2014) To be clearer, what they wanted to do, recalling the precise intent of this sub-chapter, was to demonstrate that Social Media sentiment data contain statistically-significant ex-ante information on future prices in financial markets. Convinced about their hypothesis they seek to understand when and under which conditions things can be so. First

thing to be underlined, as mentioned before, they noted how the more it is possible to detect Tweets containing precisely opinions about a stock performance, rather than merely mentioning the company's name for generic reasons, the more statistically-significant lead-time information can be derived from them.

They begin their study with the evaluation of which of the two schools of thought about best methodology for assessing financial markets via Social Media is the one that leads to more consistently predictive values. There exist in fact two main ideas: the first one is that it is the "Overall Volume" of Social Media messages scholars should focus on in order to be able to build predictive models for financial performances, while the second considers not the mere volume, but the quantitative together with qualitative evaluation of content of Social Media messages themselves.

As readers may expect, they found out and confirmed this paper's idea that the latter is the best way to assess financial performances through Social Media, being analysis of sentiments of messages that lead to a deeper evaluation of their power to lead markets.

They did analyse the reaction of stock prices at different time-shifts, up to 24 hours, to social media sentiment movements and noted that at growing time-span there is, for any financial instrument under analysis, a general increase in statistical significance of the predictive power of Social-Media-extracted information. Anyway, if for the majority of financial instruments considered, sentiment begins containing a little lead-time predictive power relevance only for wider time lapses, and moreover hourly changes in Social Media sentiment do not contain at all any lead-time information about securities' returns, 12 specific financial instruments are found for which indeed even hourly sentiment changes do contain lead-time information about hourly returns.

The identified reasons able to explain why for these 12 specific instruments it was possible to obtain statistically-significant observations even at a so short time-shift are very interesting to be pointed out: first of

all, they are those highest value brand (Apple, Amazon, Google) and generally the most popular stocks or indexes (S&P500, FTSE100), able to attract the most Twitter message volumes; if it was already said that message volumes do not count on their own, it is also true that the largest is the overall volume and diffusion of opinions on which sentiment analysis can be performed, the more meaningful and reliable will be those sentiments that are detected from them.

Second and more detailed reason is the fact it was possible for these financial products, through specific analytic instruments, to detect all those messages that particularly contained market performance, and generally speaking economic, opinions, ideas and talks, distinguishing them on a very selective basis from all those other messages that did not specifically referred to them for trading and financial reasons.

Quoting a conclusive sentence of the work by Zheludev et al., they "*do identify instances where Social Media sentiment data contain statistically-significant indications of leading financial data*"; this is a further confirmation Social Media content is directly connected to financial performances, and if a proper sentiment analysis is conducted on all those messages and information there contained, scholars and analysts can reach very robust results in terms of understanding and explaining interconnectedness. Moreover, as discussed in this last section, not only the existing interconnection can be demonstrated and studied for mere academic purposes, from an ex-post perspective: there exists the possibility of an analysis of such type that from Social Media messages future stocks' movements can be predicted in advance.

This conclusive point potentially opens huge possibilities to the whole world of financial analysts and not only, but to any person endowed with important analytical skills and for some reason interested in trading; this discovered predictive power of Social Media content towards financial

market performances could be at the very basis of remunerative trading strategies. If it is possible to create a model, or a system, capable of accurately measuring the collective sentiments of the masses interested in financial markets, through the messages they post on their social accounts, which are specifically referring to the financial sector, this model could be used as a very powerful analytical tool helping investors and traders to decide when, and how, to play in financial markets.

Of course, like any other analysis method, this will never lead to 100% certain data and forecast, which is something impossible to reach, at least in the economic world, but it could bring reliable support to other already existing analytical tools and consistent improvements in the way nowadays financial analysts conduct their job, bringing a breath of fresh air and modernization to their profession.

But not only this method could be helpful for individuals in their job or trading passion. Large institutions and hedge funds could exploit it too.

Thinking about the recently happened Gamestop short-squeeze of January 2020 and the damages and losses it has brought to several large investment funds (which had short positions opened on this stock that perfectly made sense according to traditional financial theory and practical economic data), the question that comes naturally to ask on our case is whether it would have been possible to predict the phenomenon in advance through Social Media messages evaluation and sentiment analysis. What could have all those investors with short positions on GameStop done if they knew something completely senseless was going to happen?

The GameStop case lands itself perfectly to our analysis, since it combines the spread of messages that drive shared feelings, expectations and hopes on Social Media, with the occurrence of a logically (economically and financially speaking) inexplicable phenomenon happening in financial markets: the next chapter is precisely dedicated to its discussion and to the attempt of understanding its development and evolution through the

spread of messages on social platforms, (Reddit in particular) as well as its close interdependence with such online channels.

ANALYSING GAMESTOP SHORT SQUEEZE INFLUENCE RELATION WITH SOCIAL MEDIA

The beginning of the financial year 2021 was marked by a phenomenon that amazed the whole world and aroused enormous surprise: "GameStop short squeeze".

In financial markets, the term "short squeeze" denotes the situation in which a sharp rise of the price of an asset compels traders who previously sold short that asset to close their positions; in this sense, the strongly unexpected buying pressure forces short sellers out of the market. (Short Squeeze)

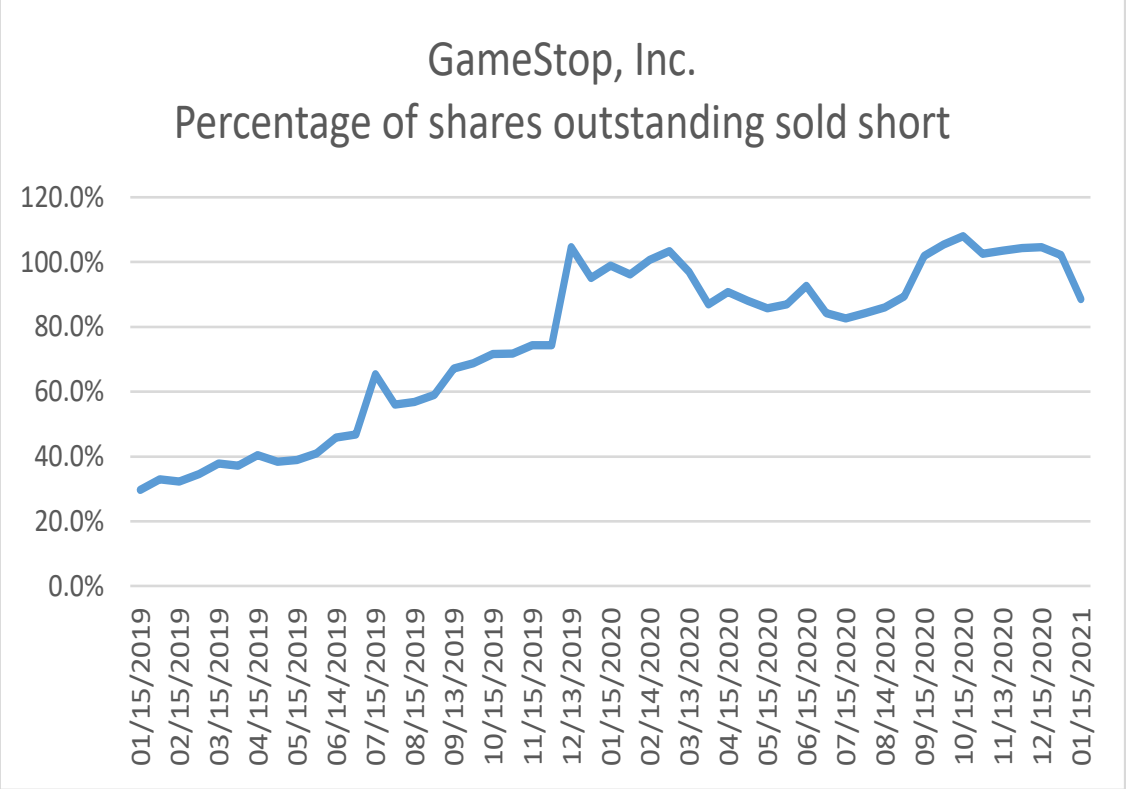
Indeed, the mechanism for shorting a stock involves borrowing and selling it now (usually from a broker), hoping that in the future the price will fall and buying it back later for a lower price will allow the investor to make a profit. In any case, the investor bears the burden of buying back that asset, even if the price goes up and causes him a loss. Moreover, he is obliged to maintain a sufficient level of liquidity in the operation, as a guarantee of being able to cover the potential loss. A short squeeze verifies if not only this price drop does not occur, but the price of that stock grows at a completely unpredictable and unexpected level, to such an extent short sellers are forced to give up their positions if they do not want to keep on paying money to maintain their investment open, hoping a reversal will soon happen. (Probasco, 2021)

Intuitively, short squeezes are possible for highly shorted stocks, and almost always the most shorted stocks are those of companies experiencing very difficult situations.

American video game retailer GameStop was experiencing very bad financial and economic performances, even before the birth of the Covid-19 pandemic, due to the growth of online gaming market that was making its physical stores, from which it derives most of its revenues, less and less frequented. The worldwide spread of the pandemic and the

consequent lockdowns that forced the closure of physical stores in each sector contributed to further worsening the company's economic situation: about 200 stores worldwide were forcibly closed in the period, (Campagna, 2021) while a total of 783 have been closed in the last two years. (Schneider, 2021)

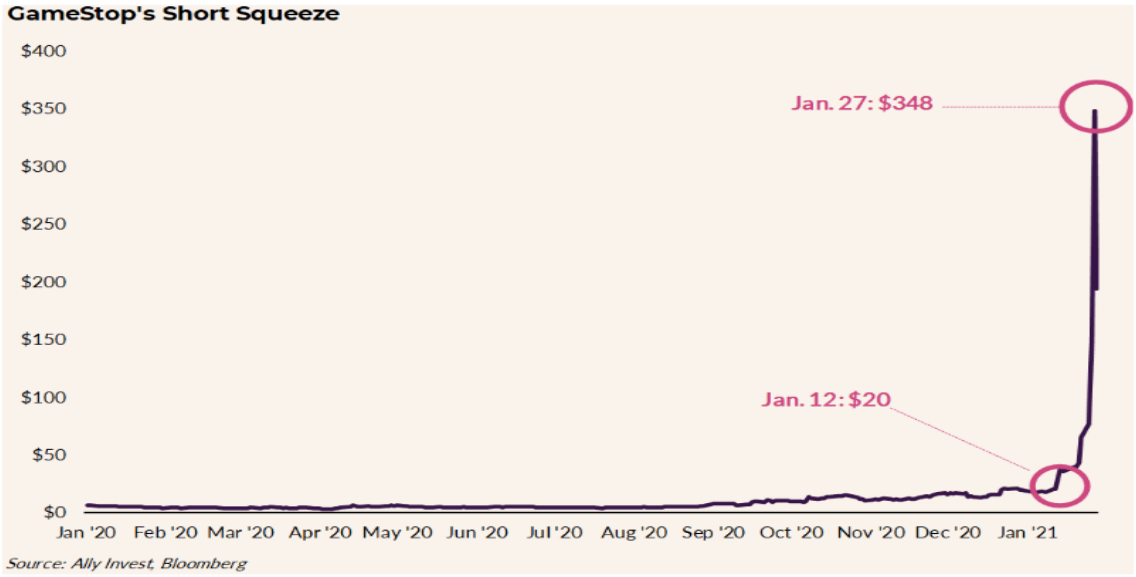
All fundamentals suggested a downward trend in its shares and indeed Wall Street showed a particular shorting interest towards GME stock shares. If on average for most companies in the financial market short positions are far less than 5% of the stocks outstanding, GameStop already experienced a constantly growing shorting interest from 25% or more since the beginning of 2019. Impressive peaks were then reached in 2020 when the short interest surpassed several times the 100% of the shares outstanding. (Angel, 2021)



Source: Angel, *Gamestonk: what happened and what to do about it*, 2021

These data represent a key factor to explain how the short-squeeze could have happened. There is indeed the necessity of large amounts of short positions opened in order for the occurrence of such an event. Even though the perspective of a declining price makes perfectly sense according to a company's economic performance, in such a situation short-sellers bear a high liquidity risk brought about by the very same downward pressure on the stock.

What indeed happened following this state of things was a case of so-called "*predatory trading*": with this term is described the situation in which investors withdraw liquidity from the market, instead of providing it, and this happens by operating in the opposite direction of large investors, in order to force these distressed investors to liquidate. This massive liquidation leads to price overshooting, allowing predators to make profits. Perfectly in line with this concept, GameStop experienced a significant increase of Bid-Ask spread for its stocks in the second half of January 2021, highlighting market illiquidity during the period under discussion. (Hasso, Müller, Pelster, & Warkulat, 2021)



Source: Bell, *GameStop, short squeezes and fad stocks*, Ally, 2021

The sudden and impressive increase of GME stock price consequent to this predatory trading operation is clearly shown starting in January 12th to 13th, as shown in the image above.

According to researchers this event was particularly interesting because it was the first case ever of "*predatory trading*" attributable to retail investors. The official narrative around this case considers small investors operating in a coordinated way as the architects of this event. It immediately became widespread opinion that what was happening was a battle between retail investors and hedge funds, with the first capable of opposing the power of the latter and provoking the short-squeeze by aggregating on Social Media and collectively trading in the same direction (with long positions on GME stocks, as can be guessed). It was agreed from the beginning that subReddit "WallStreetBets" played the role of stepping stone for the realization of events.

The WallStreetBets forum was funded in 2012 in the social platform "Reddit"; its precise and specific purpose is to discuss stock and option trading. Since its foundation, participants had been posting and exchanging opinions, news and previsions regarding financial markets, but what distinguishes this forum is its profane and juvenile nature, with topics under discussions usually treated with frivolity and superficiality, as it were always just a game. (Wikipedia)

Nevertheless, the forum has gained increased popularity over the years, becoming a reference point for users interested in stock exchange activity. When GameStop short-squeeze verified, it hit the headlines all over the world, being immediately considered as its origin. This belief was immediately so widespread that its truthfulness is taken for granted, but how sure can we be?

If things are so, considered the nature itself of a forum, researchers should be able to find at least one or few posts and discussions recognizable as the beginning of the phenomenon: it must have started with someone posting and talking for first about it, if it originated on

social media. Furthermore, can we somehow measure the correlation between the spread of discussions on the forum and the behaviour of the share on the stock exchange? And if so, could one have somehow foreseen the occurrence of such a phenomenon if he had been able to analyse the spread of talks on WallStreetBets?

The next sections will try to find answers for these questions.

2.1 – THE GENESIS OF EVENTS

When one intends to reconstruct a historical fact, and this case of ours makes no difference, we always go in search of a background that gave rise to the events.

The New York Times, with an article published January 29th 2021, written by Nathaniel Popper and Kellen Browning, goes precisely in search of a starting point for the GameStop phenomenon. The person, or more properly the user, on which the article focuses, might make the whole speech sound like a joke, but this is perfectly in line with the characterizing sarcastic/non-serious dimension of WallStreetBets we have mentioned earlier. *"Roaring Kitty"*, this is the nickname of Keith Gill, a former financial educator for an insurance firm in Massachusetts, uses in some social media accounts, posted back in mid-2019 in the WSB forum a picture depicting his $53,000 investment in options of GameStop, all of them betting the stock would go up.

At the time, the American video-game retailer company was far from the attention of the news it would have reached about a year and a half later, and the reasons behind this seemingly senseless operation are probably known only and exclusively to the author himself. A possible explanation is that it was an intentionally insane decision, made to be shared in a forum where there is a tendency to be acclaimed and supported the more the operation sounds revolutionary. Maybe Mr Gill was aiming at

gaining popularity.
This theory is coherent with the fact this post represented his first ever on WallStreetBets and later on he began tweeting frequently about GameStop and making YouTube and TikTok videos talking and commenting his investment. (Popper & Browning, 2021)
It didn't take long for several Reddit users, driven by the same madness, to start following him. An authoritative contribution to give validity to his moves was soon provided by famous investor Michael Burry, became known to the public for being one of the analysts who predicted the collapse of the real estate market caused by sub prime mortgages in 2008, who soon shared interest for GameStop after Mr Gill placed his trades.
Regardless of all the theories and hypothesis that could be made about this trading operation, what is definitely sure is it represents the first case of interest, at first inexplicable, manifested on social media for GameStop from a financial perspective. The attention immediately shared by Michael Burry probably allowed the operation not to disappear from the radars of potentially interested retail investors/social media users, making them, despite not getting directly involved with active investments, keep talking about it on the forum.
Anyway, for about a year, nothing irregular happened to GME stock price, which kept constantly oscillating around $5 price with downward tendencies, appearing to agree with a bearish sentiment.

A fundamental turning point verified in September 2020 when Ryan Cohen, a famous investor who became billionaire from the sale of "Chewy", a pet e-commerce company that he himself founded, acquired 10% of GameStop shares, becoming the largest single shareholder in the company. Cohen's notoriety as an investor and his appeal in the financial world immediately aroused a new interest that was soon reflected by market performances, with GME increasing its shares value soon after his acquisition.

His importance anyway goes well beyond the simple purchase of shares. He is reported as one of the few billionaire investors who had already understood how Reddit forums worked in the field of financial operations even before the occurrence of the famous short-squeeze. (Zambonin & Martins, 2021)

Financial institutions and affirmed analysts, investors and consultants, always share a sense of superiority towards retail investors and social media talks about the topic, considering them incompetent and devoid of capabilities to operate in the market or even discuss consistently about it.

In a totally opposite position, Mr Cohen has manifested several times his appreciation for common individuals that do their best, despite often lacking power and knowledge, to operate in financial markets: there's nothing wrong with users aggregating on online forums. By doing so, they are able to make up for individual shortcomings through the sharing of knowledge that every single person, in his own way, possesses.

He even got to the point he himself started using social media, and WallStreetBets forum itself in particular, to write his ideas, publish posts about his financial operations and commenting others' discussions.

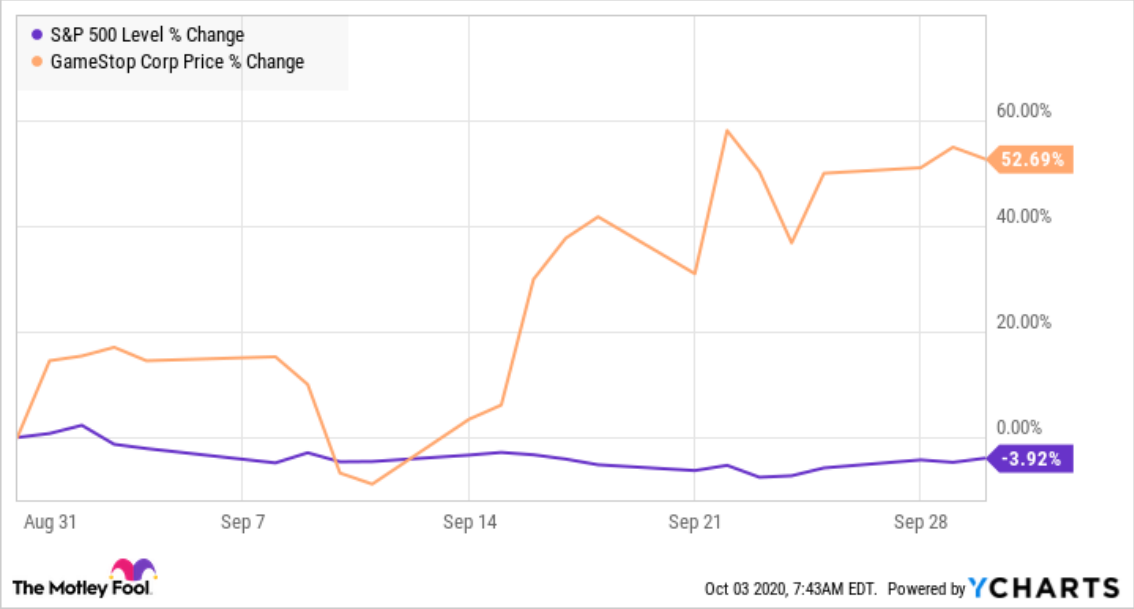
This behaviour allowed him to distinguish himself from all the other big names in finance, attracting sympathies of retail investors/online forum users: being in this position, any of his actions arouse immediate interest among the web.

GameStop already enjoyed some WSB attention due to the "roaring kitty phenomenon" mentioned earlier and as soon as the news of his purchase of such a large number of shares of this company spread in the web, this attention, sympathy and interest got higher and higher.

Nevertheless, his was not an operation for its own sake, but with a future perspective and a broader project. Bloomberg reported Cohen would have pushed GameStop towards a new direction through his acquisition, leading it to reinvent itself in the field of ecommerce, with a focus that goes beyond the boundaries of the gaming industry. Always Bloomberg

reported the investor was willing to take an even bigger equity position in the company, as he would have liked GameStop to expand and sell a much wider range of goods online. (Noonan, 2020)

Stock prices immediately reacted in a very positive way to his acquisition and such voices, as the following picture demonstrates.



Source: Noonan, *Why GameStop Stock Skyrocketed 52.7% in September*, The Motley Fool, 2020

The promise to take a bigger role inside the company did not take long to materialize as by January 11th 2021 GameStop announced it had added three new directors to its board, including Ryan Cohen, who was named chairman of the group.

It certainly cannot be a coincidence the fact that only two days later, on January 13th, prices clearly started to take that upward path that ended up in the short squeeze explosion about two weeks later, when they "*skyrocketed to the moon*", to use a WallStreetBets' users expression.

It must have played at least a discreet role the integration of the new management group. On one side, probably institutional investors liked the fact Cohen brought digital experience to the group and had a proven

track record of what the company needed most: growth in ecommerce and start-up-like momentum; on the other side, retail investors must have appreciated so much his influence and unconventional behaviour as a chairman of, despite it all, a big company. (Morrow, 2021)

The answer to the research question about how the GameStop short squeeze was possible for sure cannot simply be the new role inside the company taken by someone who is highly regarded: otherwise, we would probably be experiencing dozens of short squeezes of this magnitude every year. At the same time, it cannot be denied that this change in GME's management team played its part in triggering an event to which several factors contributed.
What in fact can be agreed upon is the fact the GameStop phenomenon verified as a consequence of a perfect overlapping of circumstances coming from different directions, and it is practically impossible to identify and recognize a single trigger that has contributed 100% by itself (although we will go and analyse in the next section the fact reddit forum WSB was presumably the most important among all the factors).

Among all the arguments, one also wonders why it was GameStop the designated company to undergo this special attention and treatment.
Open, an Italian online newspaper, got in touch with some moderators of the Reddit forum just to try to understand the reasons that led them to choose it. Contrary to the wild attitude shown on Social Media, the conversation between the journalist and interlocutors takes place in a formal way, one would almost say prudent on the part of the moderators. Their preparation and attention in asking questions demonstrates a certain awareness and knowledge with regard to the purely financial topics dealt with, in clear separation with the common idea all users who took part in the process were just a bunch of madmen with no financial education. One of them explains their action was previously reasoned and studied. He told they knew there was such a high buying pressure on

GameStop title that should have been satisfied at some point, and that the large amount of short positions open was very tempting to push them in the opposite direction in which, by forcing them to close, the price would have acquired considerable upward momentum. They themselves would have never thought, however, that prices would have skyrocketed so madly. (Berra, 2021)

WallStreetBets had already a previously well-known history of interest for those stocks for which there is the higher shorting pressure by Wall Street. Its users have manifested several times the willingness to oppose a priori the modus operandi of the great names in finance, and there is no higher sympathy than the one felt for those companies that enjoy the worst disadvantage of Wall Street: it is a matter of principle, retail investors will always try to oppose the powerful bad guys.

Those companies that have the most unfavourable opinion are the ones that are most heavily shorted and GameStop at the time, as we have seen, was the leader of this category. (Misra & Grewal, 2021)

2.2 – INVESTIGATE ROLE OF WSB AND SOCIAL TALKS

Financial institutions, as well as big hedge funds that lost billions because of the short squeeze, accused trading forums like WSB of market manipulation: this special case is the proof of a process of financial system decentralisation and of its risks in destabilising financial markets.

The growing ease of access to the markets for individuals, without entry barriers, fixed tariffs or preventive selections, led a transition in financial mechanisms, which became evident with the GameStop phenomenon.

If previously the markets were territory of competence exclusively for direct workers and experts in the sector, nowadays open-access trading platforms like “Robinhood” (the most involved in our specific case) allow every single person to operate and make a contribution, however small,

to securities performance. The problem comes when by operating collectively people are able to influence consistently the stock market, and this is seen, as previously written, as a manipulation.
In our idea, it is fundamental to understand what is the real dimension of this collective action, and to do this we must analyse the specific interconnection between Reddit forum WallStreetBets and GameStop stock performances.

In the first chapter we explained how sentiment analysis is a powerful and efficient tool to detect the feelings of the community from social media and study these feelings' interconnection with market performances. A little initial difficulty is, compared to Twitter (the main Social Media exploited for sentiment analysis we ourselves found with our research), with Reddit it is more complicated to perform sentiment analysis due to the extreme language used by its users, which usually communicate through absurd and offensive comments. Understanding WSB lexicon with particular reference to the GME phenomenon is the key departure point. The following table groups the most common expressions utilized in the Reddit social platform by retail investors, going to identify its meaning from the point of view of financial activity.

Word/Phrase/Hashtag	Signal	Interpretation
I just like the stock	bullish	Used to justify purchasing the stock or holding it
We like the stock	bullish	Used to justify purchasing the stock or holding it
To the moon	bullish	Used to justify purchasing the stock or holding it
Mooning	bullish	The stock goes up
Diamond Hands	hold	Used to encourage community to not sell the stock
Paper Hands	hold	Used as an offence to discourage community from selling the stock
YOLO	buy	"You only live once" used to encourage to invest more in the stock
Buy High Sell low	buy	Used to encourage to invest more in the stock
Buy the Dip/BTFD	buy	Used to encourage to buy the stock has dropped in price
Guh	bearish	Used when share price fell caused losses
Drilling	bearish	The stock price goes down
Bear Gang/Gay Bears	bearish	People who gets happy when stocks go down
Bull Gang/Big Dongus Crew	bullish	People who gets happy when stocks go up
Kang Gang	hold	People who gets happy when stocks go way up and then way down
Theta Gang	hold	People who gets happy when stocks go sideways

Source: Long, Lucey & Yarovaya, *"I Just Like the Stock" versus "Fear and Loathing on Main Street" : The Role of Reddit Sentiment in the GameStop Short Squeeze*, 2021

The research paper this table was taken from has the stated goal of seeking correlation between WSB sentiments of discussions and GME 1-min open-to-open returns. (Long, Lucey, & Yarovaya, 2021)

To assess this relationship between Reddit's retail investors' sentiment and GameStop price movements, the three scholars employ the wavelet coherence framework; additionally, to assess causal linkages between the two, a Granger causality test is employed too. From the regressions performed using as data these GameStop price performances and sentiments extracted from only comments specifically referred to the company, scholars were able to report several important evidences.

Impact of tone and number of comments posted in WSB on GME 1-min returns is confirmed. Results revealed Reddit users were more actively engaged in discussions on the forum during the hours in which the US stock market is open, while volume of discussions was considerably lower in all the rest of the day.

This study by Long, Lucey and Yarovaya also shows a strong relationship

between the number of comments posted per-hour and GameStop prices. By examining results in a more detailed way, it appears that only a few tones manifested by redditors were significantly impacting GME 1-min returns: Sadness, Anger and Surprise. Contrary to what one might think, the tones of Happiness and Fear are insignificant according to the performed regression analysis. Ultimately, among all discussions on the WSB forum, those with longer threads revealed to be far more influential than short ones: overall sentiment is demonstrated to affect significantly the price only if extracted from long threads, while any sentiment extracted from short ones revealed to have no relationship with it.

This confirms the theoretical idea that it is aggregation that counts and has power in determining market performances. Long threads are those attracting more attention, more interest, more discussions and comments and, consequently, those that most influence users' activity and decision-making.

Umar et al. (2021) expand the horizons of Social Media analytics about GME to Twitter. The idea behind the inclusion of another social platform in the analysis is that all Social Media together function as a sounding board; any interesting topic beginning in one of them acquires notoriety thanks to Social Media's nature itself: spread of thought and sharing of opinions, even among different platforms that are not the specific one where it first originated.

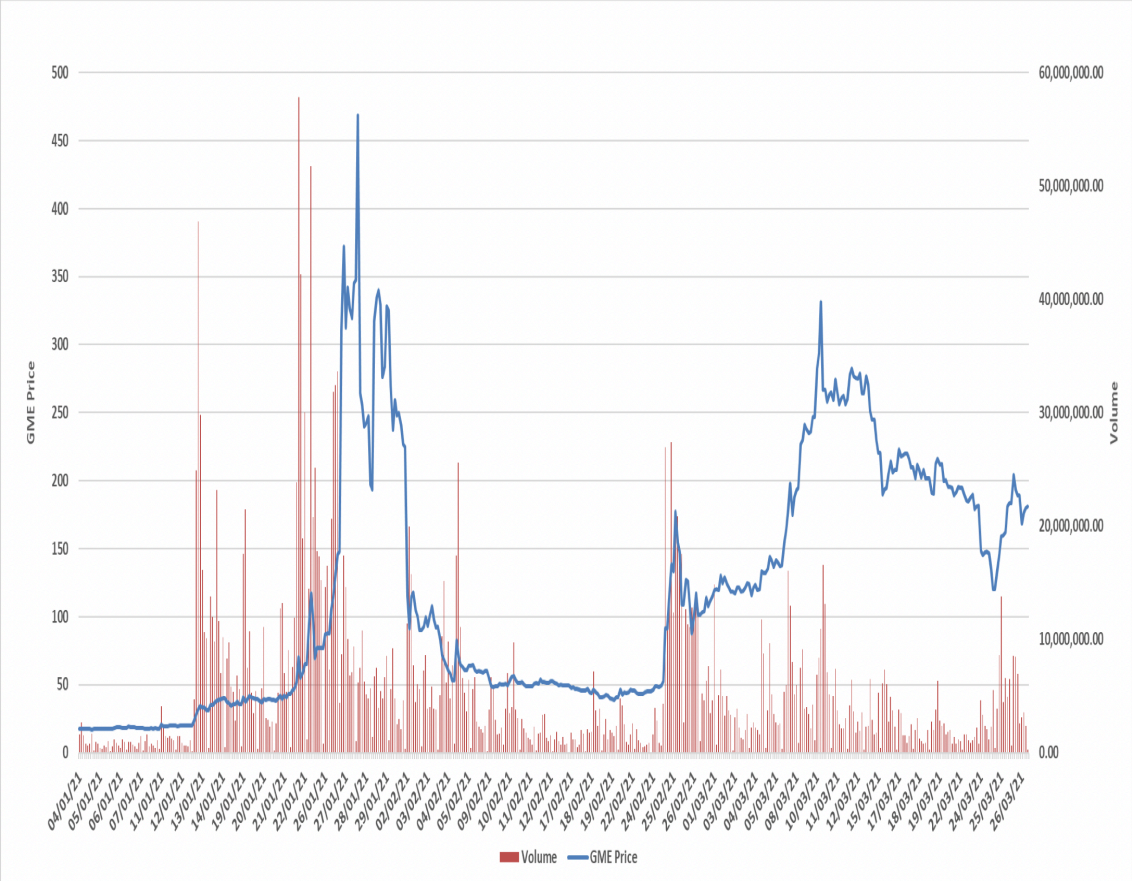
They start their research by looking at the evolution of 5 factors: GameStop prices, short sale contracts, put-call ratio, news publication count and Twitter publications count. According to the above intuition, the last one has the role of measuring retail investors' sentiment (WSB users). The wavelet coherence framework is applied in this statistical research too, always in order to analyse the interdependence between GameStop returns and investors' sentiment. (Umar, Gubareva, Yousaf, & Ali, 2021)

What's an important contribution from this study is it is performed for

two distinguished groups of investors: media-wise and media-averse.
By doing so, it provides results separating two different influence relations and their proven statistical dimension: the first one is that between GameStop performance and investors active on social media (media-wise), to which Redditors belong; the second is between the company's stock movements, but with investors that did not explicitly use social platforms for trading purposes (media-averse). Analysis' results evidence media-wise investors have positively affected GME returns, while it is unlikely for media-averse ones to have contributed significantly on their side.
Furthermore, with this study scholars identified a significant positive co-movement between put-call volume ratio and stock returns. This finding tells the growth of the put-call ratio played an important role in causing the short-squeeze, as well as confirms once again the role of retail investors.
Indeed, the put-call is a ratio representing the balance between put (the right to sell at a pre-set price) and call (the right to buy at a pre-set price) options, coming from derivatives trading activities: this is the specific trading mechanism utilized by most redditors. They mostly didn't buy GameStop stocks, but operated in options trading. Options are bets placed on a stock that allow investors to play on the stock exchange without directly owning the shares. (Murphy, Brock, & Perez, 2022)
Those platforms that came to the fore during events (Robinhood above all) allow users to play in the market specifically through this mechanism. Despite not being directly the shares of a company, big options volumes have a significant influence in driving stock prices up or down, CNN Business reports. (Morrow, 2021)
One thing that is still missing in this research is a pretty simple look at trading volume of GameStop (namely, the number of its shares traded during a day) and its Google related searches, trying then to analyse if any correlation exists between them and price performance. The

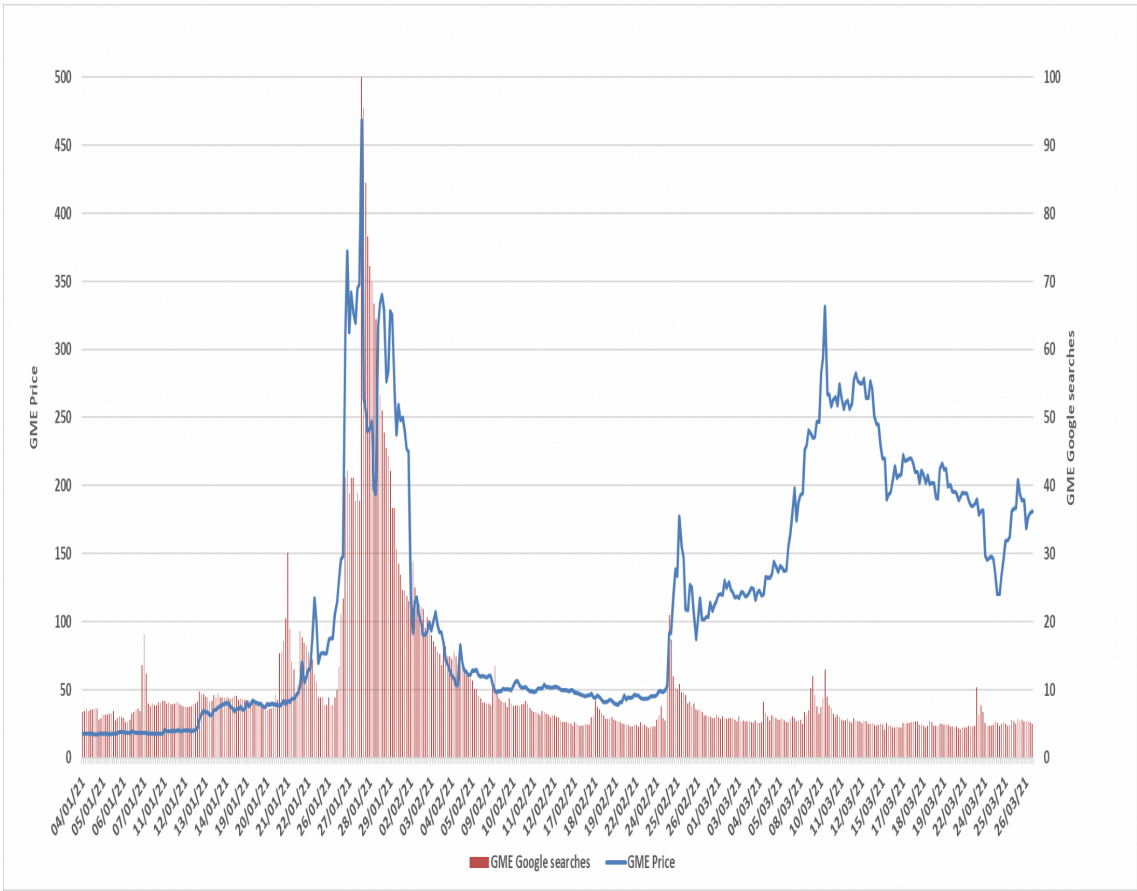
following pictures represent precisely GameStop prices compared respectively to Volume of shares traded and number of Google searches related to GME.

Price performance and volume of GameStop shares



Source: Vasileiou, Bartzou & Tzanakis, *Explaining Gamestop Short Squeeze using Intraday Data and Google Searches*, 2021

Price performance and GME related Google searches



Source: Vasileiou, Bartzou & Tzanakis, *Explaining Gamestop Short Squeeze using Intraday Data and Google Searches*, 2021

Vasileiou et al. (2021) employ a GARCH model to explore GameStop performance relationship with the data shown in the previous images. Their research goes well beyond what could be easily guessed just by looking at the graphical representation, providing statistical value to simple intuitions. The results of the mean equation indicate that both Google searches and traded volumes are significantly correlated to price movements: when the first increase, prices consequently increase too.

They perform the model also by adding the explanatory variable with 1-hour lag to Google searches data: this is done to understand the importance of timing in this kind of interdependence. Results indeed tell that when information from Google is instantly available it has a positive relationship with GME prices, but as soon as this information comes with 1-hour lag, the influence becomes negative. Traded volumes too lose any statistical significance with the introduction of the one-hour delay variable. (Vasileiou, Bartzou, & Tzanakis, 2021)

These findings confirm the close correlation between price trends and online and trading activity. It is such a subtle and defined relationship that the simple postponement of one of the two time series by an hour removes any statistical evidence of interdependence. This specific discovery works too as a proof of the importance of the speed of information: the faster investors can have access to online circulating info, the higher the possibility for them to operate in the market with positive outcomes.

If other tests were needed to confirm the link between the operations on the WSB forum and the performance of GameStop, we find another research that specifically analysed the correlation between them, providing further evidences.

This study exploits Reddit data to construct three very informative social media variables: the level of traffic regarding GME in the platform, the overall tone of posts and comments and the level of connectedness among users. All of them are found to lead to increasing prices, higher retail order flows and lower shorting flows. In essence, what these results demonstrate is the WallStreetBets forum encourages a buying behaviour while at the same time discourages a shorting one, something pretty consistent with the narratives around redditors and their bullish push that forced the short squeeze. (Hu, Jones, Zhang, & Zhang, 2021)

Furthermore, it is also found that the higher the Reddit traffic with particular reference to the company is, the stronger is the capability for

retail order flows to anticipate and somehow predict future returns. These results recalls one of the findings we evidenced in the first chapter, which was telling us that the higher the volume of social discussions regarding a particular financial product, the greater the possibility of exploiting that data to build a sentiment analysis capable of predicting the performance of that stock. In this sense, the GameStop phenomenon is a proven demonstration of the potential of this analysis tool.

This section provided several evidences to support the thesis that GameStop's short squeeze was significantly influenced by discussions on both specifically the Reddit forum WallStreetBets and more generally speaking the Internet and its Social Networks. Different researchers have summarily come to the same conclusions, or perhaps to results that support and confirm each other. The fact they all got to the point through different paths, exploiting different statistical models and tools and all of them building their dataset and time-series on their own, demonstrates the validity of the obtained results and validates consistently the starting hypothesis.

January 2021 was anyway from our perspective not only memorable for GameStop, but for a number of other stocks that moved and skyrocketed in a completely senseless and unpredictable way and were consequently named "*meme stocks*", precisely due to the fact that this trend was driven by social operations and by investors who make of the so-called "meme culture" their way of experiencing the web. GameStop is simply the most famous stock, the one with which the whole fact became known.

2.3 – MARKET-WIDE INFLUENCE OF SO-CALLED MEME STOCKS

Other stocks besides GameStop experienced sudden rises of prices together with their strange and uncontrolled oscillations. American Multi-Cinema Entertainment (AMC), Blackberry (BB) and Nokia were the others that have risen to the headlines. What's common between these companies is the fact they have all somehow become obsolete, far from the times when their products were highly demanded by customers.
Retail investors demonstrated interest and operated particularly on these kinds of stocks: maybe because of their sympathy and nostalgia for them, recalling the times when they used their products as teenagers; however, most probably because all those stocks shared a particular shorting pressure by large institutional investors and hedge funds, just like we have previously seen for GME.
If the phenomenon is limited to a single company it may be not that interesting, but if it goes further and involves several stocks the whole market is likely to suffer more seriously with long term consequences; it is fundamental to understand the "meme stock" advent from a wider perspective.

The first thing to go and analyse in this sense is how those strange financial behaviours spread from GameStop to other companies.
Umar et al. (2021) specifically asked themselves whether GME episode affected directly other companies, if a short squeeze can be transmitted to other firms sharing the same high short interest and if such events can lead to an overall systemic risk.
Two different mechanisms could be at the very basis of the transfer of bubble price increase experienced by GameStop to other stocks:
1. Herding behaviour, meaning those situations in which a large number of individuals react, operate and behave collectively in a coordinated way, may have gravitated retail investors active on social media towards stocks sharing similar characteristics. In this sense, online forums and the

same social media work as facilitators for the spread of information; furthermore, investors who have just come to the attention of events are inclined to copy very quickly each other's trading activities.

2. Managers of funds that are experiencing losses in their short position may be prone to outflow their funds from other shorted ones. This funds' movements and transaction could result in transmitting bubble behaviour to those stocks from which they are withdrawing money; if you take off funds from a position opened to the downside, it is like you are buying back that stock, fostering the upward push of prices led by all those retail investors that entered the market purposely to buy it and make its price increase.

Probably both the two mechanisms contributed in synergy to the spread of the bubble of prices from GameStop to all other stocks under analysis.

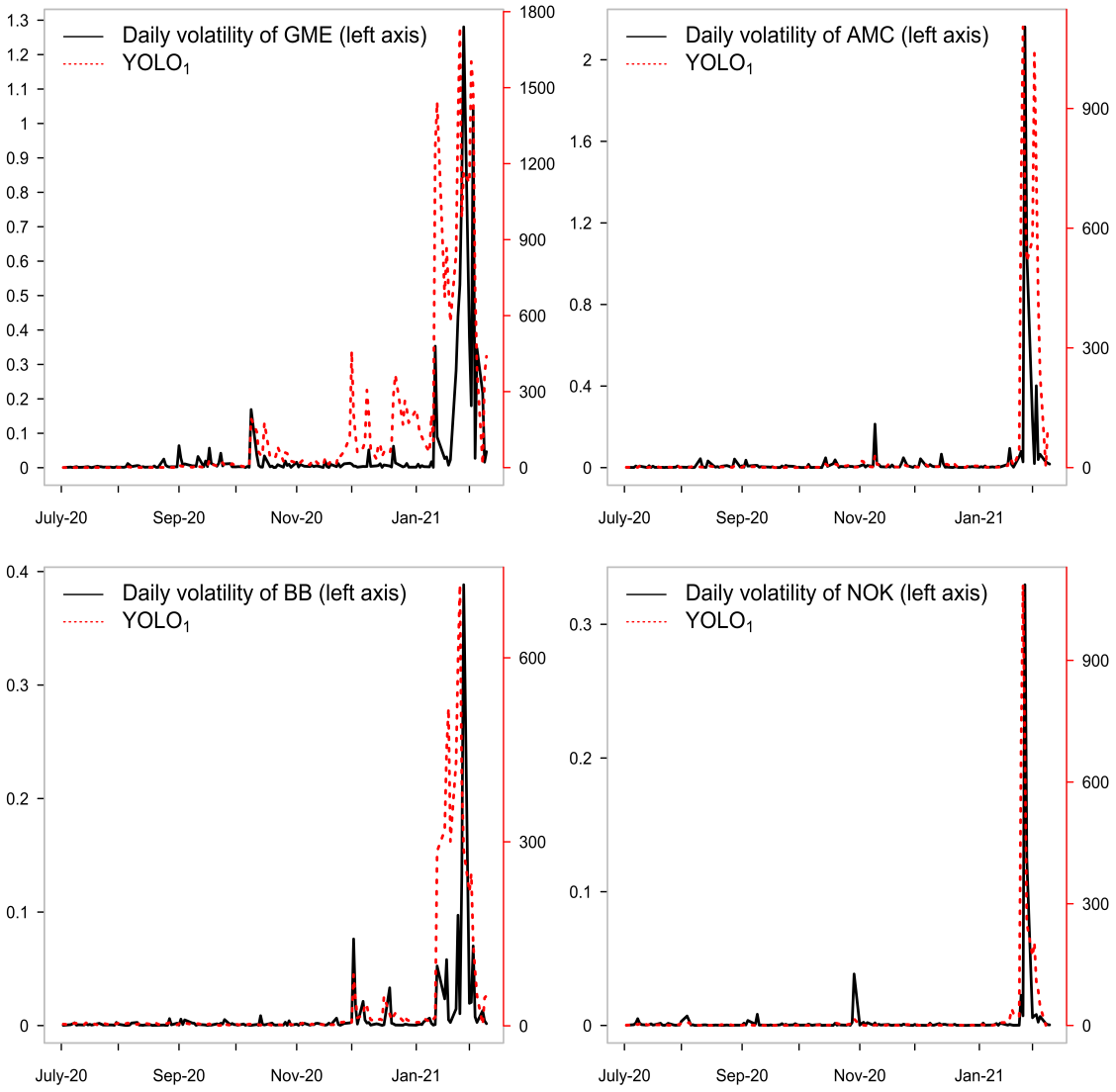
Researchers exploit the wavelet coherence approach to analyse the co-movements between GME prices and other short stock indices (data are taken from Barclays, specifically looking for "High Short Interest Indices"). Both time and frequency factors are taken in serious consideration to examine the behaviour of the time series under analysis and their correlation. The study is conducted with data from February 2020 until February 2021. (Umar, Yousaf, & Zaremba, 2021)

According to the results obtained, between February and December 2020 no significant correlations were detected between the prices of GameStop and those of other firms with high short interest in the market; but things changed radically with the beginning of year 2021.

For the entire duration of January 2021 results display significant co-movements and positive coherence between the two time series under analysis, namely that of GME prices and that of highly shorted firms index. Furthermore, the positive co-movements are observed to have GameStop as leading the trends. From this discoveries can be inferred a positive influence of GME performance to the portfolio of highly shorted firms during the peak of its short squeeze.

These results are telling us the momentum of GME prices generated by Reddit users moves and transmits towards other shorted stocks and being things so, the collective action of a large number of retail investors can affect financial markets on a huge scale, not being limited to the one company (or few companies, in our case) they focused and operated on.
Talking about those companies that, apart from GameStop, captured retail investors attention and received directly their trading operations, we want to go and see whether part of their next day's price variation can be indeed explained by the increase of activity on the WallStreetBets forum. All the four stocks under analysis (GME, AMC, BB, NOKIA) experienced a sudden decoupling of their prices from the rest of the market in January 2021, showing similar price patterns. Their huge explosion was likely driven by activity on the WSB forum.
For each of the four stocks, price movements are reflected by the volatility coefficient of that specific stock, and a targeted research can analyse the correlation between volatility and online discussions regarding the companies under consideration. Two key variables are constructed in this sense: first is the "Relative Reddit Intensity" (so-called YOLO coefficient), intuitively reporting the volume of discussions on the WallStreetBets forum, built from a specific research aiming to collect all messages posted in the platform referred to 19 identified search terms precisely correlated to the events (and companies) under analysis; second is the "Relative Event Intensity", analysing more generically intensity of Google searches always referred to those 19 specific terms/sentences related to the events. Both variables are positively and significantly correlated to all four stocks performances.
Talking about the YOLO coefficient what is further observed is it spikes right just before, or at least in conjunction with when volatility rears. (Lyócsa, Baumöhl, & Vŷrost, 2021)
Data show the greater is the occurrence on WSB of those recurrent 19 search terms the greater next day's volatility is reported to be. If we go

and consider instead the overall "Relative Event Intensity", which gives a general measurement of what we define herding effect, its effect is not only always positive and significant, but even much larger on volatility. This in consistent with the idea that to generate large price movements in the market, an enormously popular discussion on a forum plays definitely a role, but the spread of attention on this phenomenon internet-widely has a much larger potential and power. Nonetheless, it is evident WSB played a role and its discussions have their importance in explaining part of next day's price variation.



Source: Lyócsa, Baumöhl & Výrost, *YOLO trading: Riding with the herd during the GameStop episode*, 2021

If indeed prices are positively and significantly correlated to volatility, and on its side volatility is influenced at different levels by both Reddit discussions intensity and Google interest intensity, it follows that both these factors contributed to the rise of share prices, and this is valid for all of the four companies we are focusing on.

Following the considerations made so far, it is evident the importance both WallStreetBets and the Internet and Google overall have had on generating the "Meme Stock" phenomenon. It is important to remember that behind any evidence of Social Media influence there is actually real people playing their part and determining those consequences that we identify as "originating from platforms and forums" but are nonetheless driven by investors' opinion and decision-making spreading through such online channels. Social Media work as a coordination device to synchronize on buying signals in this sense, and if WSB was proven to have a key role, it was for sure not the only forum where retail investors coordinated; the internet-wide interest and intensity factors importance tell us investors' activity was likely to be multi-platform and the Meme Stock phenomenon can't be considered as Reddit-specific only.

The birth of these events generated particular interest among researchers, to such an extent that some coined the term "*Mementum*", that is the Momentum when synchronized buying signals originating on Social Media have an effect on stocks price and trading volume.

So far it has been seen and proved that the short squeeze transmitted from GameStop to other stocks, and that these stocks sudden price increases were driven to a significant extent by the spread of interest towards them on Social Media; what we miss is to provide evidence that so-called meme stocks share common stylized facts for the dynamics of their price, trading volume and Social Media activity, going then to recognize their precise "meme period", that is nothing less than the identified aforementioned "*Mementum*".

According to Costola et al. (2021), there are three basic conditions to be

respected for a stock to be identified as experiencing the "*Mementum*": first, and pretty obvious, there must be coordinated buying signals originating from social media towards that stock, and these signals must induce co-integration between both prices of the stock and Social Media messages time series, and volumes of trade operations on that stock and the same social media messages time series. Second, there must be synchronicity in time when these two co-integrations verify. Third, for both of them, co-integration regime must persist over time and not be an instant or fleeting phenomenon. Researchers provide evidence in their study that many of those shares that would later be named meme-stocks experienced at least one "meme period" during the crazy month of January 2021. (Costola, Iacopini, & Santagiustina, 2021)

The introduction and application of the three conditions to the research allow to distinguish the behaviour of several stocks between those that specifically belong to the meme phenomenon and those on the other side that maybe only share some features or bizarre behaviour on the market.

If indeed GME and AMC are documented to have experienced their "*Mementum*", other companies like Pfizer and Disney that experienced notable price oscillations lack synchronization and persistence. This is interesting as it allows to distinguish through the identification of their "*Mementum*" which are the stocks that can be recognized as "meme" ones; but not only, as it further demonstrated by the way such companies share common market behaviour as well as Social Media attention and movements, making scholars able to distinguish those that are specifically involved in depth in the phenomenon and which are not, or maybe are only at first appearance.

According to Costola et al. (2021), this mementum can be interpreted as a market manipulation strategy with potentially destabilising effects in the longer-medium term. This idea is supported by what markets have continued to experience months later, some time after the occurrence of

events; or perhaps we should correct ourselves and rather say, after the "start" of the occurrence of events.

What in fact we can still note today is that all those stocks recognizable as belonging to the meme phenomenon, despite having stabilized their market performance in some way, compared to the frenzied fluctuations that occurred in the beginning, are still maintaining price levels that make absolutely no sense compared to what their companies' fundamentals are.

A simple look at the graphs of the prices of GME and AMC in the last five years, taken easily from Google, highlights immediately at first glance the breaking point occurring in 2021 that separates market performances and trends pre and post-mementum.

GME performance over the past 5 years

AMC performance over the past 5 years

Consequences of these strange performances are not limited solely to the stocks that are affected by social traders. Many of the companies behind these stocks are participated by large investment funds, and moreover; some of them, due to their large capitalization, are collocated in several financial indices.

The problem with this persistence of prices staying at levels far from their standards, from an economic rationality point of view, is that investment funds that replicate those financial indices through instruments like ETFs do not have the possibility to exclude any of the stocks belonging to the indices replicated. If therefore the capitalization of meme stocks increases, their weight and importance as a share of an index increases too; as a consequence, investment funds selling ETFs that reproduce indices where meme stocks have a considerable weight, are found accordingly in the position of being among the main owners of those companies' stocks.

Furthermore, being ETFs one of the preferred instruments to invest with for individuals that want to build a long-term provisioning plan, these little investors end up being, despite their prudence and shrewdness, the last holders in the chain of a large part of such crazy stocks.
Due to these considerations, it is often the final investor who bears most of the risks of sudden fluctuations.
Meme stocks include titles on which interest has been fuelled excessively by Social Media in the last year. These stocks enjoy great attractiveness due to the extraordinary performance recently driven by this online interest and have therefore been included in various certificates to increase their economic desirability. But recent great performances are not the guarantee of future positive results, and the high volatility of the securities involved makes these certificates consequently highly risky.
A recently happened event confirmed the high-risk exposure of those who buy these certificates: it involves Beyond Meat, the US-company producing vegetable meat that experienced its stocks dropping almost 50% after an extraordinary rise that lasted for about one year. Having been included in several of the aforementioned certificates, many small investors who bought them experienced huge uncontrollable and inevitable losses. (Gennai & Della Valle, 2021)
This slightly complex reasoning gives the idea of the depth of the financial structure; it makes us understand how what happens to a stock is not limited to its direct holders, but there is a complex mechanism that ends up involving several actors at various levels in the market.

The complexity of the previously discussed issues, and their influence on the whole financial market, makes it necessary not only for scholars, but for financial analysts and regulators themselves to put emphasis on it and study in detail all its features.
If on one side research for academic purposes is somehow limited to the

attempt of comprehension and explanation of the events occurring, on the other hand it is a matter of analysing them in order to find practical solutions to this kind of problems which, presumably, are going to happen again in the future if we don't give them the attention they deserve.

However, it is not just about avoiding market shocks caused by online trading and its organization through social media. The meme stock event represents the emblematic, maybe the borderline case, of the power that can be generated through Social Media in this sense. Preventing other similar cases from occurring, with some potential to compromise the entire market structure and carry enormous risks for anyone involved, is certainly important. This is however only the "defensive" side of the work we believe analysts must do: there is also an "offensive" one.

Indeed, as previously discussed in the last section of chapter one, the interest in investment activities moved by and through all social platforms is not only destructive and dangerous, but it can also be exploited for the benefit of analysts and, consequently, of informed investors. We have seen that sentiment analysis can be exploited to make statistically valid forecasts on the performance of securities in the market.

The whole world of financial analysis should in a certain sense evolve from this point of view. The potential of the messages circulating on social networks as a forecasting tool is enormous: it is a matter of becoming aware of it and consequently working to understand how to exploit it in a clearly structured and defined way, building and developing the proper analytical tools and dedicated models.

Proofs of the validity of such tools already exist, as we have documented: now it is necessary for the so-called "experts in the sector" to notice this and to free themselves from their position of presumed superiority, which has in a certain way now become obsolete.

PROMOTING AN EVOLUTION IN THE FIELD OF FINANCIAL ANALYSIS

Whenever people think about financial markets, the figure they rely on to get valuable information is that of the financial analyst. He can be an individual alone, or rather an institution or corporation, which anyway reports the job done by single experts whose results are aggregated: people interested in investing look for what analysts say and tend to act according to what their reports are telling.

In this chapter our aim is not to discredit their job and competences, but rather discuss the possibility their working methods do not allow the suggestions and forecasts they build to be as reliable as people tend to think. We want to believe and demonstrate that there is room for improvement in this regard, especially in relation to the continuous evolution of the financial world they operate in; a key step, in this sense, could be precisely to start exploiting social networks as an efficient analytical tool and source of valuable information.

3.1 – SOME EVIDENCE OF LIMITS FOR FINANCIAL ANALYSTS

Technological progress has had a huge impact on financial markets; impressive steps forward in this regard have been made since the 1980s and 1990s, and the more development in this field goes on, the deeper the impact is going to be on the market and on all those mechanisms that gravitate around it. Through automation and innovation, as well as increased competition, technology has contributed to growth in efficiency and to costs decrease. It however resulted in new risks and it is fundamental for players and regulators in financial markets to keep pace with the times and constantly evolve according to the influence that progress itself has on every financial aspect.

Financial markets have probably been for decades the most information-

intensive places in the world, but today they are no longer so unique from this point of view. New systems, mechanisms and datasets emerged, particularly during the last 20 years: search engines, social networks, messaging systems and mostly the growing colossus Big Data are all recently born digital creatures that capture and possess innumerable amounts of information. Financial markets are therefore no more exclusive in terms of capacity to collect and contain so many data.

This evolution contributed to change the environment where analysts operate; since markets are no more the one and only place from which to get useful information, financial analysts should pay attention to all the information coming from enormous datasets: Social Media themselves could contain valuable data the market itself was not able to provide. Constant progress and evolution makes any previously exploited method of analysis, statistics and analytical model almost certainly not working: at least, not as efficiently applying as before. (Lo, 2016)

These considerations become even more urgent if we have a deeper look at the modus operandi of those financial analysts who stand on the pedestal, viewing all the fuss that small Social Media users/investors generate as a mass of senseless and inconclusive actions.

In his book titled "*Stories of capitalism*", Stefan Leins reports on his experiences gained in two years of working alongside financial analysts in the Swiss Bank offices of the analysis department.

What he witnesses in first person is a type of work activity, and an attitude on the part of the workers, radically different from the collective imagination. The rigor, precision, scrupulousness that is assumed to be omnipresent in such an activity do not match the real situation: this, at least, according to the author's experience.

What he tells is in fact of analysts who define themselves as having some kind of "*sixth sense*", a magical touch, for the market. Behaving accordingly to this belief, they let their feelings guide them when it comes to make predictions. In this process, there do not appear to be real data

and statistical studies that lead them to form an opinion; but rather, as told in a conversation he had with one of the leaders and more experienced analysts, the formation of a forecast takes place starting from the analyst's own opinion, prior to any deeper and detailed focus on technical and mathematical data. Their study and research takes place only at a later time, and is aimed at finding numerical evidence to support the initial thesis: to put it simply, analysts tend to look only at data that support their feelings.

Calculative approaches are used in combination with affective elements, which should, theoretically, be kept as far away from finance as possible; analysts not only do select a small and limited number of data that prove them right, but further adjust projections obtained through mathematical models in such a way that they finally correspond to their feelings towards a stock's future performance, Leins writes.

Another aspect worth of attention narrated in the book, concerns the language used in conversations between analysts: it can be traced back to expressions and jargon typical of gambling. But it is above all the difference in the ways of expressing themselves that the author noticed between when analysts converse with each other and when instead they speak with interlocutors outside their niche. If in the first case gambling language is repeated and widely used, in the second one any expression somehow traceable to gambling talks completely disappears.

Leins's hypothesis is that analysts are well aware of the inherent gambling nature of their work, but they do not want it to be perceived from the outside for fear that the aura of superiority and reliability that surrounds them as experts in the field could be questioned. Whenever it comes for them to talk to someone outside their offices, they always refer to what they say by citing them as facts, although they are well aware that theirs are opinions: potentially justified, maybe apparently supported by some of the data they found and decided to include, but they always remain opinions.

Analysts are highly recommended by supervisors to present their investment reports as a result of a scientific methodology, to argue that the outcomes they have reached are the result of an analytical process that consistently followed the precise steps of the scientific method.
But, by their own admission while exchanging opinions and talking about critical issues, it is always difficult to predict the future in a consistent and reliable way, as all forecast they make present the typical random levels of bets.
There is also a widespread belief among analysts that in order to be efficient in one's work, it is necessary to be faithful to a predetermined strategy. Each analyst chooses his own strategy, and it is considered indisputable that the success of the work does not depend on which one among all was chosen, but rather on the ability to keep following it over time, despite all the doubts and difficulties that may arise along the way.
The problem with this absolute belief, which can be considered an axiom, consists in the risk of being so devoted to one's strategy to the point of losing contact with what's happening in reality and to be unable to recognize errors and learn and adapt accordingly to how the situation is actually evolving: to correct themselves along the way, would imply to admit the mistakes made, and there is fear that doing so could compromise authority and expertise consideration. (Leins, 2018)
Leins explains there exists an "*investment narrative*" that is built ad-hoc to make financial analysts perceived as undeniable experts and their reports, forecasts and recommendations as trustworthy. According to the author, this narrative is developed through three clearly recognizable steps:
- First, it comes the research of numbers and calculative approaches targeted at confirming and supporting a "market feeling" that was developed a-priori.
- Second, there is the exploitation of visualization techniques, building charts, figures, graphs and tables, as they help any forecast being

perceived as having technical fundamentals behind its development.

- Third, analysts tell there are not only numerical data supporting analysis, but a number of personal, individual and exclusive information that only they do own in their areas of expertise: all these "classified information" make them capable of predicting the future of markets in a completely exclusive way.

It is a story, a narrative, that is constructed and told, but which does not correspond to the real way in which this work is conducted; or, at least, allows to hide some of its aspects.

The point of how investment narrative is constructed is the main focus of another research too, titled "*Competing for narrative authority in capital markets*". (Stolowy, Paugam, & Gendron, 2022) One of the key points discussed regards the same search by analysts for this kind of authority and reliability. It demonstrates that the search for it is not carried through explicit responses, but rather through so-called "*off-the-record activities*". Given the very definition of this kind of activity, we understand how analysts want to be perceived as reliable as they are full of confidential information they do possess but can't reveal.

By doing so they are able to avoid, at least partially, the need to demonstrate and argue in a more technical and practical way their reports and forecasts.

Equally interesting results of the above-mentioned study tell us there is evidence financial analysts often significantly lower their target prices and predictions for stocks, or at least revise their numerical estimates, after the publication of AShSs reports. The acronym stands for "activist short sellers", which are a "*category of hedge fund activists who, unlike "long" activist investors, benefit from stock price declines and frequently act as whistle blowers denouncing alleged corporate frauds or financial misstatements*". (Paugam & Stolowy, 2020)

This evidence reveals original forecasts may be a little swollen; indeed, analysts happen to have commercial relationships and interests with

firms, whose shares are consequently pushed up for utilitarian purposes.
It is true AShSs do also have their own interests on their side, as this is valid for both parties; we can therefore expect both of them to push for personal gain, and we are not arguing about which of the two is the more reliable.
It is simply a matter of comparing positions to understand how everyone is moved by a purpose that goes far from mere analytical prediction: consequently, statistical, mathematical, numerical objectivity in evaluations is absent, or at least it is not at such high level of reliability as it is intended to be thought.
Engelberg et al. (2018) confirm this upward trend in analysts' forecast. Recommendations tend to be more favourable than the actual results that then occur. They precisely study the relation between analysts' price targets and recommendations with stock market real performances and anomalies. They find out that when anomalies happen in the market (namely, when actual performances are radically different from what was expected), forecast errors are higher for those stocks that performed worse, than for those that performed better. This means, explained in simple terms, that under any circumstances analysts' previsions tend to be on the upside: the more negative the stock market performance of a share, the more it deviates in absolute value from what had been its estimate. It is interesting that they emphasize how this study's findings hold also when the focus in on forecasts made by institutional analysts or firms with large analysts' coverage: that is, with those from whom one would expect greater credibility.
Generally speaking, analysts' price targets and recommendations contradict stock return anomaly variables. These anomalies capture a huge flow of circulating information, partly including those generated on Social Media, which are overlooked on the side of the analysts, but end up anyway having effects on the evolution of market prices. (Engelberg, McLean, & Pontiff, 2020)

Despite the fact these lines are talking about excessively long forecasts, and they may seem to contradict the GameStop and "meme stocks" phenomena where, on the contrary, forecasts were significantly short, the aim is not to understand whether analysts generally push too high or too low, but rather to question the absolute validity of the way their job is conducted: to prove that they can be wrong, and indeed, that often they are not as much reliable as they pride themselves to be.
These considerations suggest that there may be room for significant improvement and progress for their profession. And maybe this step forward can appear to be a necessity rather than a possibility, if we extend our reasoning and analyse how the world of financial markets is evolving, leaving aside the role of the analyst itself.

3.2 – THE FINANCIAL ENVIRONMENT IS RAPIDLY CHANGING

Financial intermediation, and with it the prestigious role and position occupied by analysts, have probably with time become an end in itself.
At its origin their role was conceived as an activity aimed at mediating between lenders and borrowers, for the purpose of improving resource efficiency and the functioning of the market itself. (Glossary of statistical terms).
Nowadays, in this field the expertise that is most valued is the one that consists on understanding the activities of other financial intermediaries. In this sense, it is no longer a matter of sole dedication to creating new assets, but skills are rather devoted to the rearrangement of already existing ones. Acting in such a way, a large part of the capacity to generate opportunities of wealth for all is lost; almost only financial intermediaries themselves benefit from such kind of operation.
The brightest minds, the geniuses of the profession, "*are employed to devise algorithms for trading in securities that exploit the weaknesses of other algorithms for computerised trading in securities*". (Kay, 2016)

A system where this is the modus operandi does nothing but stand up, and for, its own existing purpose. We can say finance becomes self-referential when it evolves like that.

In this kind of degeneration, the significance of prices is no longer found in real economics, but rather in the market itself. (Orléan, 2013)

The self-referential hypothesis mentioned by André Orléan is different from traditional approaches towards finance on a crucial point: rationality can no longer be assumed as common knowledge shared by active agents involved in financial operations and activities. Investors even get to the point where they consider normal that the real value of a security does not correspond to its market value. It is not only acceptable, but it makes even perfectly sense that the two are different; there is distinction between finance and real economics, according to their way of reasoning and evaluating prices that are found in the market.

From a rational economic standpoint this is clearly unacceptable; nevertheless, we have come to this point. Financial analysts and experts have for sure contributed in a substantial way to such an "involution": always wanting to push the markets higher, very often for personal benefit or interest, as previously mentioned, they needed to find justifications to keep bullish trends; even though theoretically this should not make sense. But investors, listening and following their indications, due to their presumed reliability and consciousness, have metabolized and considered as valid such a perspective.

Nevertheless, cases are documented in which agents in financial markets attempt to devise trading strategies through improvised models, intersecting time series in a rather forced way, creating links and correlations between them that do not actually respond to any economically scientific way of proceeding. (Wyart & Bouchaud, 2018)

Wyart and Bouchaud study some situations in which financial agents try to identify regularities in the historic oscillations of the prices of stocks or indices: when it happens that such agents recognize a price trend that

seems to be recurrent, they rely on this presumed repetition to make an estimate of the future price of that financial product.

The two scholars note that this is a rather common attitude among those who operate in the markets; for those stocks erroneously forecasted in such a way, excess volatility ends up being one of the main consequences, but there are also situations in which the price of a stock reaches a new equilibrium, justified and correlated to its past history, but far from its current economic fundamentals.

This kind of attitude towards the study of financial performances of stocks has lost any contact with reality: there is no look to the future and to the growth perspective in real economy, which should be the basis for analysis if any prediction of companies' future financial performances was ever to be made.

Strange, fallacious trading and investment strategies, as questionable as they might be, are adopted and applied; consequently, they end up having effects on the market, potentially destabilizing it from an efficient behaviour. (Barber & Odean, 1999)

What modern financial economics assumes, that is, people behave in a perfectly rational way, as we will never tire of repeating, does not correspond to how things go in reality. Observable, systematic and very human departures from rationality are observable in almost any financial circumstance, and behavioural finance aims at incorporating them into standard models for improving the study of financial markets: "*Those modern financial markets that depend on trading volumes for their very existence*", quoting Barber and Odean.

This change in the financial world, compared to how it had traditionally been, both in its way of working and being studied, requires all the factors that can potentially influence its performance are paid the right attention they deserve: Social Media, online forums and networks, definitely need to be included.

Talking about trading, another aspect to be considered is the growing use

of online trading platforms: these are online platforms that combine the trading functionalities of classical online broker services with the communication and interaction features of social networks; they are the virtual places where Social Media and investing perfectly collide. (Glaser & Risius, 2018)

In this sense Covid19 was an important turning point: since its advent they experienced a considerable growth. In the US market alone, liquidity moved by such platforms increased by half a billion between 2019 and 2020; being it a market that moves today around 8.6 billions, this represents a gigantic percentage increase. Nonetheless, it is expected to surpass the 12-billion-level within 2028. (FortuneBusinessInsights, 2021)

The growing application of artificial intelligence and the increasing penetration of Internet, significantly helped by omnipresent advertisements, are contributing in synergy to the growth of such platforms. (MarketWatch, 2022)

Anyone expressing interest in the markets, even carrying out a simple Google search, leaves an indelible trace of his interest in the search engine; this trace is exploited by algorithms whose purpose is to understand people interest in order to target them with the advertisements of their greatest interest. Consequently, the person who simply searched for a financial term online finds himself bombarded with countless advertisements of such social trading platforms. Not very long ago, the most advertised was E-Toro, but now these kind-of Social Media for investing purposes are innumerable, and it seems like new ones are constantly emerging. This simple increase of the market supply is proving how the turnover driven by these platforms is actually growing; such targeted and pervasive advertising is definitely going to attract several new clients; and in the end, these new clients are all nothing but investors.

The larger their number of customers, the bigger the monetary volumes they move, and, consequently, the deeper the co-integration social

trading platforms will have with financial markets themselves. Social Trading Platforms represent a relatively new instrument, but considering the estimated growth margin, they will probably end up playing an important role in the interaction they will have with the various market mechanisms.

This interaction will certainly not be easy to study, and one certainly cannot think of analysing its effects on the financial world through classical approaches and theories.

Online trading platforms could indeed promote irrational and non-traditional investment behaviour. Their users could influence each other in the processes of decision-making, following the typical herd behaviour we have seen Social Media generate. In this sense, two types of traders that operate in these investment platforms can be distinguished:

- The first is the "leader", the investor that is able with his activity to capture the attention of other users, who consequently try to copy and replicate his trades.
- The second is the "follower", that investor who, in fact, takes inspiration from the leader and tends to copy his operations.

Pelstera and Breitmayer (2019) demonstrate that social traders who are able to draw attention of their peers (the "leaders") show an increased willingness to take risks and increase their trading activities, probably because of the excitement caused by the awareness other people are looking at what they are doing and probably following them. (Pelstera & Breitmayer, 2019)

Xuejuna et al. (2019) add evidence that "followers" too manifest a preference for high-volatility stocks and increase their trading frequency over time from the moment they subscribed to the platform. (Xuejuna, Yua, & Ying, 2019)

It appears obvious that both of the parties involved in this usual two-way mechanism occurring in social trading platforms end up behaving in a clearly irrational way.

Analysing the performance of traders in such platforms, Dorfleitnera et al. (2018) provide evidence that those whose investing behaviour simply consists in copying trades of users with the highest accumulated returns, do nothing else but loose big amounts of money invested in such a way. Social platforms indeed allow this kind of behaviour with a function precisely called "copy-trade", but evidences are evidently telling this copy trading activity does not lead to good market performances and positive returns for investors. Operating in such a way would be too easy. Anyone would be able to do so and we would all end up being rich simply running a few online commands.

Nonetheless, scholars tell positive returns exploiting such platforms are possible, but only if sophisticated strategies are adopted: these strategies must carefully consider all related risk factors associated with the portfolios of "*signal-providers*" (namely, those whose trades are copied). (Dorfleitnera, Fischera, Lunga, Willmertingera, Stanga, & Dietrichb, 2018)

This reasoning about social trading platforms is aimed at making the reader aware of the fact their emergence implies new challenges for the world of scientific research and financial analysis. On one side because of their impact and consequences in all deeper and subtle market interactions, on the other for their very own unprecedented nature and structure. Both of these two aspects are an integral and fundamental part of the dissertation of this entire paper.

We have been writing about extracting people opinions, feelings and behaviour tendencies from traditional Social Media in an effort to predict future market movements; but what could be better as a source of information for such an analysis than a social network specifically created to talk about investments?

Here the two main benefits can be specificity and transparency. The first allows quality and direct data collection, without the need to filter innumerable data out of which only a small portion would be of real interest; this is a unique advantage only social trading platforms provide.

Transparency instead is common to all Social Media platforms: people openly discussing investments ideas allow the whole community to educate each other; users learn from their online fellows, since all actions, decisions and trades, as well as sharing of opinions, are of common domain, visible to anyone.

Data taken from social investment platforms, as they grow, could provide a new insight into market mentality and momentum; they could augment and sum up to other non-traditional data for the purpose of financial analysis. (Deloitte, 2021)

In a not-so-far future, professional investors, as well as financial analysts or institutions, could turn to Social Media, and more specifically to social trading platforms, to mine for information and valuable data on market sentiment, exploiting such platforms to supplement their processes of investment decision-making, as well as advices and forecasts development.

3.3 – SOCIAL MEDIA VALIDITY AS A SOURCE OF INFORMATION

Probably sharing this our last reasoning, Ortu et al. (2022) try to assess whether the addition of social indicators to models exploiting only technical ones, allow for any improvement in the classification of future price changes of cryptocurrencies. Their focus is specifically on Bitcoin and Ethereum, exploiting and analysing the results provided by algorithms that are properly built and developed for their study and estimations. They compare the outcomes of two different models: the first one ("Restricted") composed of technical indicators only; the second one ("Un-restricted") including trading and Social Media indicators too, extracted from social trading platforms through neural networks called "*Bidirectional Encoder Representations from Transformers*" (BERT). (Ortu, Uras, Conversano, Bartolucci, & Destefanis, 2022)

Their main outcome with this research is precisely proving that it is possible to achieve ameliorations in cryptocurrencies' price prediction with the addition of social-platforms-extracted data and information. The evidences they provide tell indeed an improvement in accuracy and precision with the Un-restricted model, compared to the Restricted one. The best results obtained with algorithms that utilize only technical information are a 54% accuracy obtained for Bitcoin and Ethereum future price movements forecast. On the other side, the integration of social indicators allow for an impressive growth to 84% accuracy obtained in the best scenario with the Un-restricted model. For intellectual honesty, it must be admitted such a precision in the prediction is only for the direction of prices, and not for their magnitude. Nevertheless, this is a significant improvement that certifies once again the information potential of the data extracted from social platforms.

It also gives the idea of a pretty strong link between financial markets and social communities for the cryptocurrencies ecosystem. This is indeed nor the only, neither the first research paper, studying the close interaction between Bitcoin, Ehereum and so on, and those Social Media where a huge part of cryptos' holders write, discuss, share their opinions and investment decisions.

McCoy & Rahimi published in 2020 a research about the same possibility to exploit Social Media to predict digital currencies' prices evolution; it was not based on specific social trading platforms, but instead on a more general social network like Twitter. This is particularly suitable to our whole speech as it allows to go back talking about social networks in general, not just about those specifically dedicated to discussing trading and investments. Extracting data from Twitter API and combining them with other useful information such as volumes-of-trading data from "Coinbase historical candles API" and "CryptoCompare API", they were able to apply machine learning to predict price fluctuations of Bitcoin. Moreover, this was possible to a sufficient accuracy extent to achieve real

profits.

They demonstrate that heuristic and Tweet analysis is helpful when it comes to make accurate predictions; this is a step further compared to the simple indication about what direction prices would take Ortu et al. proved to be possible. (McCoy & Rahimi, 2020)

More specifically, with the properly developed algorithms and machine-learning techniques, it is possible to build a model that predicts future fluctuations of the price of Bitcoin in the very short-term (about 15 minutes); and with consistent accuracy, enough to yield monetary profits, they report.

Rothman (2019) confirms the possibility for such future prediction of Bitcoin prices through the analysis of the volumes of exchanged Tweets regarding this specific digital currency. He however finds out that data extracted from Telegram and Reddit have an even stronger forecasting power compared to Twitter, suggesting that it is Social Media platforms in general that can assist in predicting real markets trends for financial products. (Rothman, 2019)

The constant growth since their birth, but most of all the large slice of market they have carved out in recent years, makes of cryptocurrencies a fundamental piece in the financial world. With the beginning of year 2021 the volume of traded cryptocurrencies surpassed, and almost never fell back down, the 100 Billions per-day; since then, it almost always oscillated in a range between the 200 and 100 Billions. (DeBest, 2022).

These are enormous figures that give an initial impact of the size reached by this type of financial product. The novelty they represent, the technological ecosystem in which they were born and raised, require innovative methods of analysis and study. An approach that takes into account their close interdependence with social networks, and exploits their information potential, has been proven to work. It can apply to this gigantic slice of the market that is digital currencies, as well as to "more classical" financial products like stocks and indices, as we have been

writing about in chapter one.
Social media are strong, valuable and reliable indicators of the sentiments of people, which are at the same time real persons, social networks users and investors: their feelings, ideas and behaviour tendencies are then transmitted to the markets.
Mai et al. (2018) put evidence on the fact that days with considerable increases in the number of positive posts regarding Bitcoin, tend to precede days with higher prices and higher transaction volumes. At the same time the opposite seems to be true as well: days with considerable increases in the number of negative posts tend to anticipate days of lower Bitcoin prices. (Mai, Shan, Bai, Wang, & Chiang, 2018)
In this same study scholars put emphasis on the fact Social-Media-extracted sentiment adds meaningful explanatory power of the future prices of Bitcoin: it is not simply the volume and relevance of Tweets (specific to this study interest) or of other posted contents on other social networks (more generically speaking) to be valuable for analytical purposes. But rather, it is of fundamental importance the capability to extract from them the sentiments of the crowds operating and posting such contents. Social Media sentiment is once again proven in this sense to be an important leading indicator for the prices of financial products: of a digital currency, in this specific case.

So far we have been discussing and demonstrating that social networks can be valuable sources of information. Helped by several studies and research papers, we have seen that data extracted from Social Media provide reliable and consistent results when they are used for financial analysis. But these results come from models that are properly developed for forecasting and comprehension purposes about financial markets. Social-Media-extracted data have been almost always used to simply fill these models.
It is true that quality of information plays an important role in the success

of a study, but it depends a lot on the way those models they fill are properly developed a-priori.

In this regard we want to go and see what is the intrinsic quality level of the information that can be directly obtained from Social Media: we mean with a simple look and read at what is there posted, which is something possible for every single user, without applying any advanced mathematical-statistical model or method of analysis.

What we want to obtain with this further research is to understand what is the level of financial preparation of users who discuss investments in social networks, and consequently how good is also the quality and awareness of the posts and comments that are posted there.

Is it true that retail investors and, more generically speaking, social-media-users, lack awareness and knowledge to such an extent their talks are totally worthless, like traditional experts of the financial sector tend to think?

If we were able to provide some evidence of the contrary, then all the reasoning about exploiting Social-Media-extracted data and sentiments would get stronger. In fact, we would not only have shown that useful information can be extracted through the aggregation of enormous amounts of data: in addition, we would have also shown that those contents on which advanced analytical techniques are then applied, are already starting out of a good quality.

This would mean that those users who write about investments on social networks are not necessarily incompetent, but can provide useful and valuable information thanks to their keyboards.

We can always take the emblematic case of GameStop to start discussing this point. One of the secondary effects generated by its short squeeze was to stimulate self-study (in the research we are referring to this is called "*herding autodidacticism*") among Social Media users, particularly on retail investors, with a reported effort of specific focus on research and learning about financial strategies and derivatives. (Klein, 2022)

Not only a huge number of small investors got involved in the event and the attention it generated, being attracted to become part of it: this attraction forced on them an educative component that was provided by the same social networks and by self-driven search queries in the Internet.

Intuitively therefore, it was not a purely passive involvement, with users blindly copying what the crowd seemed to be doing (buying shares or derivatives on GME, in this case): they looked for understanding what was happening from a more technical and theoretical perspective. Consequently there was a kind of self-driven financial education led by the spread of the phenomenon, and this was presumably new for many; otherwise the growth of searches for explanations of several financial terms would not have been so evident.

This evidence is telling people tried and did their best to operate in a conscious way; if herding behaviour was anyway demonstrated to be fact, it was somehow moderated by the individual willingness to be prepared or at least informed about what was being undertaken.

Individual, smaller retail investors will certainly not have the advanced skills Wall-Street analysts possess, but they are certainly not fools either.

Confirmations on this point can be found going back talking about WallStreetBets. While it is true it got the attention of the world only after it played a crucial role in generating the GME short squeeze, as seen in chapter 2, nonetheless it had been an active and well-populated forum for the discussion of financial and investment topics for several years prior to the GameStop phenomenon emergence.

Bradley et al. (2021) go and examine validity for investors of due diligence reports published on Reddit's WSB during the period between 2018 and 2020 (in advance of the famous short squeeze event). What they find out is such reports are actually valuable sources for investment research. Specifically, WSB due diligence reports positively forecasted one-month-ahead returns of several stocks in a pretty constant and

reliable way during the whole sample period. This prevision power is reported to be particularly strong when users massively commented and talked about them, sharing their agreement and interest for what the reports were telling: this is once again confirming the power of aggregation and shared interest on Social Media. (Bradley, Hanousek, Jame, & Xiao, 2021)

Nonetheless, a discrete degree of financial awareness and knowledge on the side of those who elaborated and posted these reports is quite evident; this demonstrates even social users are capable of analysing and discussing consistently about the markets, and Social Media can consequently contain and present valuable contents regarding financial topics: the overall acquaintance of all smaller retail investors increased when they were reading and following due diligence reports there posted, Bradley et al. report.

For convenience of reasoning, we can distinguish two separate groups of players in social networks in this situation: those who published due diligence reports, and those who read them and act consequently. Due to the reported validity and forecasting precision of such reports, it can be assumed the first group is composed of Social Media users that are particularly competent in the financial field. On the other hand, those belonging to the second group benefit, from the point of view of the knowledge and information acquired, of what the first group is sharing in the Reddit forum.

We are therefore seeing both a pre-existing knowledge, present in some of the users, and the possibility by others to acquire it and improve their financial skills: this can happen through the "study" of what financially-prepared-ones share on social networks, which is available to every other user.

To conclude their reasoning, Bradley et al. put emphasis on the change caused by the advent of the GME short squeeze: indeed, since that moment, at least for the sample period between January and June 2021,

any significance and forecasting reliability presented by WSB due diligence reports came short. The factor that probably contributed the most to this loss of validity was the fact a considerable number of reports started placing emphasis on the price-pressure of a stock rather than on the fundamentals of its company.

What can be guessed from these outcomes is the fact Social Media do not provide valuable information only in extreme and exceptional cases (as for the aforementioned GameStop or the whole meme stock phenomenon). On the contrary, the occurrence of such events inhibits the capability of Social Media itself to be a reliable source for financial analysis, unlike what we have seen they were in "more normal" periods (between July 2018 and December 2020 in this case).

So, it is not in particular situations that Social Media become value-relevant sources of information, but they rather are on average, consistently over time.

Dim (2021) extracts from social investment platforms the opinions of users about individual stocks, and by applying machine learning he studies the level of information they can provide in terms of forecasting those same stocks' future performances. His results further confirm Social Media beliefs contain valuable information and can predict consistently future returns. (Dim, 2020)

According to the evidences he provides, there is a clear distinction between highly skilled Social-Media-investors (about 13% of the overall users) and lower skilled ones: while the first generate beliefs that yield to huge returns, the second do form beliefs that lead to more limited earnings; nevertheless, always positive. This is confirming the previous intuition there are two groups of people operating in social networks, one of which is evidently more financially skilled than the other. Dim however agrees with Bradley et al. on the fact it is Social Media as an overall group and basket from which to get information that does actually create value for investors, despite skills could be relatively

limited at the individual user level. Once again, it is aggregation that counts, and the very proper nature of social networks that allows its users to improve themselves learning from each other.

Dim also confirms the tendency to a herd behaviour drove by social networks, but denies that this systematically implies wrong consequences and bad performances for those who get involved. There are several behavioural biases on social users, as well as beliefs formation is not always consistent with rational models and ways of building an opinion.

However, these circumstances seem not to compromise the capability by social networks to produce value-relevant information for investment purposes, and these are available to both simple online users, as well as to scholars or analysts who would like to exploit such information in a more rational, theoretical and statistical-mathematical way.

It all depends on the type and way of use people will make of this information. Like it happens in any other situation, there will be those who are able to benefit, exploiting them in the proper way, and those who will use them in the wrong, unconscious and irrational way.

The potential, by the end of this whole reasoning, should however by now be evident to anyone who followed it.

CONCLUSIONS

A striking event like the GameStop one has the potential to mark a fundamental breaking point in the field of financial analysis.
Its occurrence evidenced two key aspects: first is the vulnerability of the financial market to potential manipulations coming from aggregating traders; second and probably most important is the power of Social Media as an aggregating tool itself for people interested in operating in the markets.
What immediately distinguished the GameStop case was the total lack of sense of the behaviour of its actions compared to what the company's economic results were suggesting. Made this premise, it can be said that it has caught every expert in the financial sector by surprise.
Anyway, considering that it was agreed right away that the Short Squeeze originated in a Social Media (and we provided evidences this was a correct intuition), we wondered if this event could be foreseen, if only the information and data to be analysed had been searched in the right place (the Reddit forum WallStreetBets, specifically).
This question sparked the curiosity that guided the entire dissertation of which the next lines will give a brief account.

The fact the irrational wave that overwhelmed GameStop expanded to several other stocks, giving life to the "meme stock" phenomenon and posing potential systemic risks to the whole financial compartment, made it urgent to try to understand the degree of influence and correlation Social Media can have with the markets themselves.
Pineiro-Chousa et al. (2016) argued years before the meme-stock advent that Social Media activity that investors deploy is significant for the variation of risks in financial markets. They identified that it is the sentiment that users/investors manifest in social networks to be the most

significant variable able to explain the influence social activity has on the market. (Pineiro-Chousa, Vizcaino-Gonzalez, & Perez-Pico, 2016)

What we discussed first was indeed the power of sentiment in guiding people's decision-making processes in the financial field, providing evidences of situations in which fluctuations of market prices were strictly connected to changes of some mood-states of the crowds.

It is Social Media activity that directs people's attention, interests and opinions with regard to the financial world to a quite large extent, conditioning the feelings of its users who later on report them in the market with their trading and investment actions.

It is therefore through the analysis of discussions on social networks that it is possible to measure the collective sentiment towards a specific financial product. This analysis method takes the name of "Sentiment Analysis": it takes advantages of the fact Social Media provide information about each individual's opinion, extrapolating and aggregating every single data to build an estimate of what the collective mood state actually is.

Going then to study the correlation between this sentiment and the performance of a stock, it is possible to evaluate how much the former actually affects the latter

This way of proceeding does not only allow for a-posteriori evaluations, but it also permits to anticipate market movements by simply looking at what the opinions and collective attitude of investors active on Social Media are. We indeed provided several evidences of such a method exploited to predict future oscillations of stock prices on the basis of what the opinions of investors expressed in social networks suggested: the forecasts thus developed turned out to be particularly reliable and truthful, allowing those who adopt them to operate profitably.

Social networks can be sources of data of big value for financial analysis, given the statistical consistency of the forecasts made starting from the information they provide. We believe their exploitation as analytical tools

and datasets should be implemented at the institutional level.

There are some criticalities of the traditional modus operandi of financial analysis that professional analysts themselves recognize as a limit of their profession. The integration of Sentiment Analysis could help to make up for some of the difficulties we evidenced about the way forecasts are traditionally developed.

It happens that analysts lack some consistent data on which to rely to build their estimates about the future.

The collective sentiment of investors could be that objective data they miss. It is true it represents the sum of each individual subjective opinion and feeling, but once all these single data are aggregated, they can provide an objective evaluation of what the mood state of the crowd as a unique entity is.

The greatest difficulty lies in identifying what these collective feelings are, but it is precisely here that Social Media must be included in the analytical field: in fact, they represent gigantic datasets, working as containers of information provided by each single user. It is just a matter of being able to extrapolate this information, but we have seen that this is an achievable goal with properly developed Sentiment Analysis.

Bizzi & Labban (2019) recommend organizations to invest in data analytics to explore and examine Social Media sentiment, in order to develop models that anticipate traders' reactions to this sentiment and foresee fluctuations of prices in the stock market. They write that "*the market may not always efficiently correct mispriced assets, resulting in multiple and significant fluctuations*". (Bizzi & Labban, 2019)

The GameStop case and the entire consequent meme-stock phenomenon perhaps represent the most evident confirmation of this intuition.

Social Media have been creating a new class of online traders over recent years; in particular, social trading platforms emergence is considerably contributing in the process of involving more and more users, tempting them to invest in the stock market and promoting online herding

behaviour: users' selection of the assets to trade is a function of the decisions and suggestions made by other active investors operating in social platforms.

Given the growth of this army of amateur investors and the influence Social Media have on making them behave as a homogeneous entity, the balance of power between individual retail traders and large investment funds is changing in the financial markets.

It is therefore necessary for professionals and organizations to broaden their analytical horizons to the entire Social Media world.

This evolution could allow them to obtain two fundamental results:

- Improving their forecasts precision and the reliability of suggestions they provide to people interested in rational investment and trading operations.
- Preventing potential risks to the logical equilibrium of the markets, deriving from a collective operation organized and promoted by investors' interaction on social networks.

By including Social Media analytics to financial analysis it will be possible to avoid, or at least anticipate, the occurrence of a new "GameStop case", acting accordingly to protect the funds invested and to avoid the enormous losses suffered by investors due to the sudden totally irrational oscillation of several financial products.

It will be up to institutions to understand which methods, strategies, practical and legal tools to develop in order to achieve this prevention.

However, we think we have provided a convincing argument on how to evolve from the analytical point of view in order to be able to know in advance the occurrence of potential irrationalities in the financial market.

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