What Do Analysts Do ? Investor Decision and the Analyst Remuneration Mode.

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Abstract

This paper questions the interaction between security analysts and institutional investors. We focus particularly on the role of analyst remuneration mode in investor decision. To do so, we propose a model in which the investor decides to trade or not to trade regarding the analyst recommendation. First, with a commission-based salary, the analyst is interested in the volume of transactions. This leads to a conflict of interest, as he might sometimes issue untruthful recommendations, which the investor is likely to follow, in some cases that we precise. We find that the investor's risk perception is lowered when the analyst credibility increases. Second, with a remuneration mode inciting the analyst to recommend truthfully, the conflict of interest disappears. In this case, the investor probability to trade is higher, compared with the commission-based remuneration mode.

Stock market analysts are sometimes accused of making conspicuous errors in their recommendations. Many studies find an explanation in their irrationality. Because of psychological bias or of some characteristics of information distribution, they would be unable to perfectly allocate the resources on the market, and as such they would be imperfect intermediaries. We would like to emphasize, besides this serie of reason, another one which is the kind of remuneration and prestige that build their incentives. This mean that their behavior can no longer be considered as irrational. Recent events illustrate the notorious phenomenon of bubbles in stock market history : a strong increase period preceding a more or less long-lasting decrease. The fact that analysts may untruthfully announce a recommendation which is different from their private expectation of price is often put forth as a specificity of these periods. But we can consider that this peculiar behavior of analysts needs not be driven by market circumstances, but by deeper determinants. The remuneration mode is an organizational factor that influences the analyst action ; and with institutional factors like social pressure, prestige and reputation, it represents a great part of what can drive the "untrue" type of behavior described below. A comparison between two types of analyst incentives would therefore give two kinds of behavior, having different consequences on the investor decision.

Furthermore, not only can analysts rationally decide to recommend a stock for which they privately expect the price to fall, but we endeavour to show that it seems difficult to interpret this behavior as an "evil" influence upon investors. It is possible to show that an investor can follow this recommendation in equilibrium, i.e. maximizing the probability to make the best choice.

We then have to consider the importance of information distribution and risk perception in this process. It is necessary to suppose a hiatus between private opinion of the analyst which can never be known with certainty by the investor, and his recommendation which is currently available. The investor can only base his judgement by taking the recommendation as his private information - at least he can consider a probability of which opinion the analyst really has. It is then interesting to view the analyst task as a modification of the investor's perception of risk. His recommendation changes in a specific way the initial belief of an investor in the increase or the decrease of a stock price.

But one has to introduce investor's sentiment. The evidence of sentiment, besides calculus, as an important input of investor decision, has been widely documented, but less modelled as a part of the investor decision-making[1]. Brower and Wright (1992) show that risk' perception of a choice is affected by feelings ; more specifically, bad moods are associated with more detailed and critical strategies of evaluating information (Baker, Petty and Gleicher (1991)). Actually, investors can draw inferences about the environment from their affective states (moods, emotions or feelings) considering that these states are informative (e.g. Clore, Schwartz and Clonway (1994)).

To illustrate this, we model a two-agent interaction in a probabilistic approach, derived from the principal-agent herding class of model, such has those evoked in Brunnermeier (2001) and particularly the model of Scharfstein and Stein (1990), revisited by Graham (1999). We focus on the stock market,

[1] For a superb survey on psychological factors of investor'behavior, see David Hirshleifer (2001).

illustrating the situation when a analyst from a brokerage company or an investment bank is giving an advice to a Mutual Fund manager. But the architecture of those models is used in a different manner, as our purpose is not to show the emergence of rational herding. The aim is to set an environment where it is possible for the analyst to "lie" and for the investor to rightfully follow his advice, when both maximize their preference functions. A second purpose is to compare this situation with another environment setting where analyst incentives are different, especially because of a change in the variable part of his salary, so that he truthfully announces his private opinion.

In the first section, we describe the model, in the case when analyst is partly paid on a commission basis. The variable part of his wage increases proportionally with the volume of stocks traded by his company - we mainly refer here to brokerage analysts.

Section two relates the agents' program and shows the importance of the interaction with the analyst upon the investor perception of risk. Although knowing the analyst interests are different, he may rightfully follow him.

Section three describes the new shape of interaction when the analyst does not have a variable part of his wage proportionated to the volume of stock traded, and is instead embedded in institutions that entail a cost when not recommending truthfully. Section four concludes.

1 The interaction with a commission-based incentive

We first need to consider an initial belief in the increase or a decrease of single stock prices, besides the analysts private expectation about a specific firm share, and to describe how those two inputs produce the investor opinion. Then, we explain the process of investor initial belief updating, which gives rise to his stock investment decision.

1.1 The setting : initial beliefs about price variation, analyst expectation and investor opinion

There exists an a priory probability that the financial community believe in share prices increase. Let $\Pr(I)$ be the probability that the price will increase according to the common beliefs about macroeconomic perspectives of the sector, i.e. according to the consensus or the convention. Event I realization means that the common beliefs, or the "market's opinion", are bullish - and does not mean that the price actually increased : price variations *per se* are out of the present model. This is equivalent to the notion of "public signal" traditionally modelled. Symmetrically $\Pr(D)$ is the probability that financial community is mainly expecting a price decrease. The common beliefs, including the investor' initial beliefs, are bearish when D is realized. Our investor being part of this financial community, $\Pr(I)$ can be viewed as his initial belief, as he does not have any other information at the start of the game. Let us define :

$$\begin{aligned} \Pr(I) &= p \qquad \text{with } p \in [0,1] \\ \Pr(D) &= 1-p \end{aligned}$$

This is the initial belief that the investor is going to update with the analyst recommendation and with his own personal opinion.

However the analyst cannot base his behavior on the same domain of information, as he precisely is an information producer. His work is to gather data from the firm' accounts, to study the reported earnings, to discuss with the management, study the markets in which the firm is involved, in order to assess forecasts about the future level of the stock price. He therefore obtains a price target which implies a specific opinion about what would be the "right" investment decision. One can notice this is a quite "fundamentals-driven" expectation. Studies like those of Brav and Lehavy (2002),Bradshaw (2001),Galanti (2002) highlight this process of information production. Hence, we must admit that the analyst "produces" his own private signal, and consequently he does not rely on $\Pr(I)$ as his initial opinion. In the contrary, he relies on a personal private signal, a private information about the specific firm he studies. We have :

$$\begin{aligned} \Pr(b) &= k \text{ with } k = [0,1] \\ \Pr(s) &= 1-k \end{aligned}$$

with $\Pr(b)$ the probability that his fundamental analysis of the firm drives him to think the stock price will increase, hence that it would be better to buy, and $\Pr(s)$ the probability that the price will decrease and that it would be better to sell the stock. If $k > \frac{1}{2}$ then his opinion is b and s if not. This private opinion is a priory totally independent from the recommendation he will issue and discuss with the investor, which we denote as $\overline{b}$ and $\overline{s}$.

The decision of the investor is processed differently. The crucial point is that the investor does not have any possibility to know whether event b or s is realized, i.e. investor ignores the analyst's private information. Even if we suppose he might know k this gives him no information about the analyst's information as long as he is supposed to ignore the rule of event realization. For example, knowing $k > \frac{1}{2}$ does not allow him to implement that b is realized, as this event could happen with $k < \frac{1}{2}$ if the realization was randomly determined ; b would be still possible if $k = 0.01$, like with any other level except 0. The investor sentiment derives from two inputs : the analyst recommendation, $\overline{b}$ or $\overline{s}$, and the "market's opinion", I or D. These inputs influence the opinion of the investor, B (he feels he has to buy) or S (he feels he has to sell the stock). We qualify as opinion the investor sentiment about the variation of price. Hence, we introduce something near to a mood, a feeling, a passion, rather than a calculus. It must be clear that a sentiment is not decided by the agent, it is not free choice or a product of a reasoning. The agent remains passive in the emergence of this sentiment. Here the arguments of the analyst are essential to influence the investor, especially during a face-to-face or phone conversation, but also when the relation is mediated by the reading of the analyst's report. Here the findings of social psychology are important, from the earlier works of Elton Mayo (1933), or the experiments of Asch (1956) to recent studies (e.g., see the survey by Bond and Smith (1996)), which show how people are influenced by the judgements of others. Conversations, as shown in the article by Robert Shiller (2000) seem to be a key factor in the opinion-making of investors, for example, almost all of the investors of his 1989 questionnaire declare having purchased a stock when having their attention drawn to it by interpersonal communication.

Nevertheless, this link is not mechanical, especially because the common beliefs and the recommendation can diverge. It is reasonable to think that the recommendation will appear more plausible when reenforcing the consensus opinion (like in the belief formation process described in Kuran and Sustein (1999)). At least we can suppose that the probability of the investor having the "buy" opinion is different when the analyst is "with" or "against" the consensus :

$$\Pr(B \mid \overline{b}, I) = z = \Pr(S \mid \overline{s}, D)$$
$$\Pr(B \mid \overline{b}, D) = v = \Pr(S \mid \overline{s}, I)$$

with $z \neq v$ (relaxing the $z > v$ assumption) and $z, v \in [0,1]$.We have $\Pr(S \mid \overline{b}, I) = \Pr(B \mid \overline{s}, D) = (1-z)$, $\Pr(S \mid \overline{b}, D) = \Pr(B \mid \overline{s}, I) = (1-v)$. So that z is the probability of the analyst convincing the investor with the consensus, and v to convince him although the consensus, or equally, investor's initial belief, is contrary to his recommendation. Respectively, $(1-z)$ and $(1-v)$ are the probabilities of failure to convince him about the rightfulness of the recommendation - the investor forms the opposite opinion.

As we can see, our interpretation is that the probabilities represent individual valuations, thoughts or opinions. Even p is the probability that a community of people think that the share price will increase. But we could also interpret them as statistical probabilities. p would be the percentage of people expecting I, k the percentage of analysts having information b. The investor meet randomly one analyst without knowing its information. Then z or v would be the average reactions of investors facing a given recommendation and a given consensus. It could be available in pools or databases. For example, one could measure that, for analysts recommending $\overline{b}$ and I a consensus about a precise share, $z \times 100$ % of the investor are convinced of B. Our investor is randomly sorted out of them.

Nevertheless, we do not consider this objective probability interpretation, in the following we keep our subjective probability interpretation.

1.2 Analyst agency incentives and investor decision

Besides the passive arising of an affective state, the investor has to take a decision, which is, undoubtedly, a conscious choice, guided by a reasoning, with the help of a rational calculus based on available informations. His decision rule depends on the updating of his initial belief I or D. The investor's decision is based on two informations : his sentiment or private opinion B or S, and the analyst's recommendation $\overline{b}$ or $\overline{s}$.

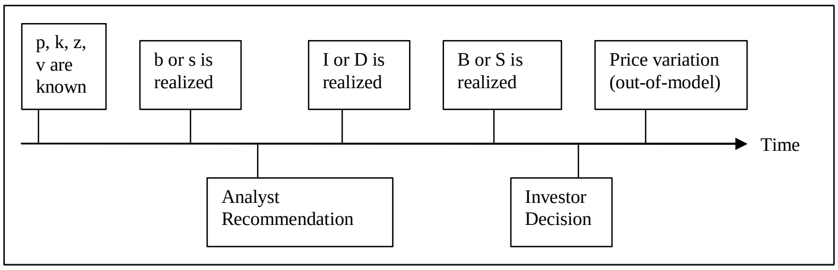
Here, the recommendation appears two times in the investor mind : once as an opinion-making factor, and second as an informational input guiding the decision. This is unsurprising, as a human mind has the ability to re-consider, with the critical analysis of reason, a stimulus which initially gave birth to an non-chosen impression. This second glance at the analyst' advice, when the conversation is past, is made with the knowledge of a possible conflict of interest. The investor knows that the analyst may encounter an incentive not to reveal his private opinion.

We have to introduce the fact that analyst may have a variable part of their wage proportionated with the level of trade generated by their recommendation. This organizational factor can drive the analyst to issue recommendations ($\overline{b}$ or $\overline{s}$) largely differing from their private opinion (b or s), in order to drain more commissions. It can be the case for brokerage analysts, or also investment banks analysts when the company rated is a client of the bank, as shown in Boeker and Hayward (1998). But we also have to consider institutional incentives like prestige or credibility, as a vivid social norm among analysts is that a "good" analyst is a convincing analyst, able to make the investor discards his "fears" and take measured risks (Galanti (2002) and Michaely and Womack (1999)). To fix ideas, we can illustrate this by writing :

$$\begin{aligned} analyst' \; benefits &= W + w \\ w &= \delta.Max \left\{ (\Pr B \mid \overline{b}) \, ; (\Pr(S \mid \overline{s}) \right\} \end{aligned}$$

with δ a positive constant. It means that the analyst's aim is to be followed, to convince the investor, so that his opinion is consistent with the recommendation.

Before we comment this, let us describe the full process of the interaction.



The interaction process

The investor decision is based on a Bayesian updating of his initial belief, given the recommendation of the analyst ($\overline{b}$ or $\overline{s}$) and his private opinion about the investment (B or S). For example, if the analyst issues $\overline{b}$ and the feeling of the investor is to sell, he will update his prior $\Pr(D)$ by calculating $\Pr(D \mid \overline{b}, S)$. We suppose that the investor ignores b and s, but also it is reasonable to suppose that he ignores the common belief I or D that is realized. The reason is that $p > 1/2$ means that having people believing in an increase is more probable at the moment - it does not mean that they will believe it with certainty. The consensus exists at a given moment, agents can have an idea of its probability, but they ignore the exact rule of realization of the event. The investor can only update his prior belief in order to asses the conditional probability of price increase or decrease.

We define three kinds of possible decision of the investor : $N, \overline{B}, \overline{S}$, respectively : the investor does not trade, he buys or sells the stock. In the next section we describe the analyst and investor' rules of decision.

2 The role of analyst credibility in investor decision

We first solve the analyst program in an environment with commission-based variable part of wage, before we study the investor program.

2.1 How the analyst decides to issue a recommendation

The analyst rationally maximizes the probability to convince the investor. We call θ the states of the consensus $(\theta = I, D)$; $\Omega = B, S$ the set of sentiments that are to be felt by the investor, and $r = b, s$ the results of the analyst fundamental research. When r and Ω are in contradiction, we write the investor opinion as Ω'. We can write the probability of convincing when issuing r as $\Pr(\Omega \mid r)$ and of not convincing as $\Pr(\Omega' \mid r)$. Hence, analyst recommends :

$$\begin{cases} \overline{s} \text{ when} \Pr(B \mid b) < \Pr(S \mid s) \\ \overline{b} \text{ when} \Pr(B \mid b) > \Pr(S \mid s) \end{cases}$$

As he is not interested in $\Pr(\Omega' \mid r)$, he does not have to calculate it. In contrast, it is possible that both $\Pr(\Omega \mid r)$ are under $1/2$, or both over $1/2$, this does not modify the fact that he has to decide the "best" of the two recommendations according to this criteria. We have :

$$\Pr(B \mid b) = \Pr(B \mid b, I) \Pr(I) + \Pr(B \mid b, D) \Pr(D) = zp + v(1-p)$$
$$\Pr(S \mid s) = \Pr(S \mid s, I) \Pr(I) + \Pr(S \mid s, D) \Pr(D) = vp + z(1-p)$$

Hence we can determinate when the analyst will recommend to buy :

$$\begin{cases} \overline{b} \text{ when } p > \frac{1}{2} \text{ and } z > v \\ \text{or when } p < \frac{1}{2} \text{ and } z < v \end{cases}$$

and when he will recommend to sell :

$$\begin{cases} \overline{s} \text{ when } p > \frac{1}{2} \text{ and } z < v \\ \text{or when } p < \frac{1}{2} \text{ and } z > v \end{cases}$$

The problem is not defined when $z = v$, neither when $p = 1/2$. These cases will not be considered. We can therefore comment that k does not interfere in the analyst decision : this is directly caused by the form of his incentive, which drives him only to consider, in average, the probability of being believed, i.e. of being credible. We allow the possibility, in some cases, of being more credible by issuing a recommendation that differs from the private information of the analyst. Let us precise the following rule of realization :

$$\begin{cases} b \text{ is realized when } \Pr(b) = k > 1/2 \\ s \text{ is realized when } \Pr(s) = (1-k) > 1/2 \end{cases}$$

It means that the analyst can conjecture to choose $\overline{b}$ whereas he has found s, for example. Although, in the interaction with the investor, he has of course to develop fundamentals-driven arguments to make the investor think that the recommendation is derived from his research : the analyst cannot tell anything anyhow - we will precise this in the next section.

2.2 How the investor decides to buy, sell or hold

Taking the recommendation and his affective state as given, the investors updates his initial belief. But he is supposed to be perfectly aware of the fact that the analysts faces an incentive not to reveal his information. Remember the investor ignores this rule of realization of the event r, he only observes $\overline{b}$ and k. So he will weight his revised probability of increase by the probability that the analyst has truthfully or not truthfully followed his information. For example, when $\overline{b}$, and B, investor calculates $\Pr(I \mid \overline{b}, B) \Pr(b \mid B)$. It is the updated probability of increase, weighted by the probability that the analyst received information b, given the investor felt a "buy" opinion B. If $\Pr(I \mid \overline{b}, B) \Pr(b \mid B) > 1/2$, he will decide $\overline{B}$. [2] The smaller the probability of the analyst being true ($\Pr(b \mid B)$) the smaller becomes the updated probability of increase.

If the overall probability is under or equal to 1/2, there is a great dissonance between : his sentiment and the recommendation, which are bullish, and his rational consideration of the probability of increase, which is equal or under 1/2. In such a case, the contradiction between his informations and the probable variation of price he forecasts drive him to stay apart and not to trade, choosing the neutral decision N, which would be more precisely the cognitive impossibility to decide. We follow the "distaste for ambiguity" put forth in the works of Camerer (1995) or Heath and Tversky (1991), as related in Hirshleifer (2001). Shiller (2000 b, p.138-147) also showed how investor are looking for moral anchors when facing events they cannot clearly interpret. Our situation could describe the absence, or the fragility of such anchors - i.e. situation when uncertainty, within investor perception of risk, is not eradicated enough to make the transaction even possible. The aim of the investor is to maximize the probability of having a price variation that confirms his opinion. The original writing of the investor program would be $Max\{\Pr(D \mid \overline{r}, S) \Pr(r \mid S) \, ; \Pr(I \mid \overline{r}, B) \Pr(r \mid B)\}$, but as $\Pr(I \mid \overline{r}, \Omega) = 1 - \Pr(D \mid \overline{r}, \Omega)$, the program is strictly equivalent to the one indicated below. Denoting $r = b, s$ as in the previous notations, the investor chooses to act ($\overline{B}$) according to his sentiment (B) when :

$$\Pr(I \mid \overline{r}, B) \Pr(b \mid B) > 1/2$$

And when there exists a contradiction between his opinion, the recommendation and his rational conjecture, he will be neutral (N), refusing to trade :

$$\Pr(I \mid \overline{r}, B) \Pr(b \mid B) \leq 1/2$$

[2] It can be easely shown that $\Pr(b \mid B) = 1 - \Pr(s \mid B)$ and that $\Pr(b \mid S) = 1 - \Pr(s \mid S)$. Thus, the highest the conditional probability of the analyst having information b, the lowest the one of having s.

When investor observes the private opinion S, the decision will be :

$$\begin{cases} \overline{S} \text{ when } \Pr(D \mid \overline{r}, S) \Pr(s \mid S) > 1/2 \\ N \text{ when } \Pr(D \mid \overline{r}, S) \Pr(s \mid S) \leq 1/2 \end{cases}$$

Let us take two examples. If $\Pr(I \mid \overline{s}, B). \Pr(b \mid B) > 1/2$, (strictly equivalent to $\Pr(D \mid \overline{s}, B). \Pr(b \mid B) < 1/2$) the analyst recommends to sell ($\overline{s}$), but the investor had the sentiment that it would be better buying (B). It means that, in the interaction, when the analyst presented his arguments, he failed to convince the investor, he was not credible enough. Taking into account the probability of the analyst having the "b" information given that he felt B, the investor calculates that it is worth buying and thus decides $\overline{B}$. This may reflect a fund manager who feel able to "de-bias" the recommendation, in a case when the analyst was probably driven to deviate from his private information[3]. If $\Pr(I \mid \overline{s}, B). \Pr(b \mid B) \leq 1/2$, the contradicting reason and sentiment lead to a neutral position N. The investor conjectures that $\Pr(b \mid B)$ is not high enough to prove that the analyst did not recommend truthfully his information. As $\Pr(s \mid B)$ seems high, he probably found s.

Second example, if $\Pr(D \mid \overline{s}, S). \Pr(s \mid S) > 1/2$, the analyst succeed in convincing the investor to sell (S is realized). After reflection, investor finally decides $\overline{S}$, as the decrease is more likely to occur. But if $\Pr(D \mid \overline{s}, S). \Pr(s \mid S) \leq 1/2$ his reflection gives him the result that the probability of decrease is less likely to occur than his sentiment and the analyst indicated him. This may be because $\Pr(b \mid S)$ is high, revealing that the analyst probably had b although recommending $\overline{s}$. This cognitive conflict leads to the neutral decision N.

We now investigate the case when $\overline{b}$, (which implies $p < \frac{1}{2}$ and $z < v$ or $p > \frac{1}{2}$ and $z > v$), B and I are realized. We first have to write :

$$\Pr(I \mid \overline{b}, B) = \frac{\Pr(B \mid \overline{b}, I). \Pr(I)}{\Pr(B \mid b)} = \frac{zp}{zp + v(1-p)}$$

Then the conditional probability of b is :

$$\Pr(b \mid B) = \frac{\Pr(B \mid \overline{b}). \Pr(b)}{\Pr(B)}$$

Which requires $\Pr(B)$:

[3] Boni and Womack (2001), in a study on a hundred of fund manager and buy-side analysts, find that the 23 % of them indicate having this behavior.

$$
\begin{aligned}
\Pr(B) &= \Pr(B,b,I) + \Pr(B,s,I) + \Pr(B,b,D) + \Pr(B,s,D) \\
&= \Pr(b)\left[\Pr(B \mid \bar{b}, I)\Pr(I) + \Pr(B \mid \bar{b}, D)\Pr(D)\right] \\
&+ \Pr(s)\left[\Pr(B \mid \bar{b}, I)\Pr(I) + \Pr(B \mid \bar{b}, D)\Pr(D)\right] \\
&= [zp + v(1-p)]k + [(1-v)p + (1-z)(1-p)](1-k)
\end{aligned}
$$

Hence we have :

$$
\frac{zp}{zp + v(1-p)} \times \frac{[zp + v(1-p)]k}{[zp + v(1-p)]k + [(1-v)p + (1-z)(1-p)](1-k)} > 1/2
$$

As in Graham (1999) and Scharfstein and Stein (1990), we solve the inequality and then consider a function for which the left-hand side of the equation equals the right-hand side. We find that the inequality holds when :

$$
\begin{aligned}
k &> \frac{(1-v)p + (1-z)(1-p)}{(1-v+z)p + (1-v-z)(1-p)} = k^{*IbB} \text{ if } \frac{p}{1-p} > \frac{-1+v+z}{1-v+z} \\
\text{and } k &< k^{*IbB} \text{ if } \frac{p}{1-p} < \frac{-1+v+z}{1-v+z}
\end{aligned}
$$

We label the k-function for which the threshold is k^* as k^{*IbB} in this case. When $k > k^{*IbB}$ then investor chooses $\overline{B}$ and chooses N when $k \leq k^{*IbB}$ (when $\frac{p}{1-p} > \frac{-1+v+z}{1-v+z}$. Recall that the analyst's program solution excludes the case $p = 1/2$.) Depending on the case considered, there are four possible thresholds to study, k^{*IbB}, k^{*IsB}, k^{*DbS}, k^{*DsS}. We now present two remarks derived from this result in the case when $\bar{b}$, B.

Remark 1 There exists parameters values for which the analyst recommends the opposite of his information and the investor, even weighting the probability that the analyst truthfully announces his information, rationally follows the recommendation.

We know that the investors chooses $\overline{B}$, when $\bar{b}$ and B, if $k > k^{*IbB}$. If there exists p, k, z, v such that $k^{*IbB} < 1/2$, there exists possibly some $1/2 > k > k^{*IbB}$ ([4]). Therefore, the analyst could have made the conclusions that the price will fall ($k < 1/2$), but recommended to buy. After what the investor, ignoring the analyst information and the rule of realization of r, but suspecting he might be untrue, finally calculates that it is worth buying, and follows him. We find that

[4] This is obvious in the case $\frac{p}{1-p} < \frac{-1+v+z}{1-v+z}$ as investor chooses $\overline{B}$ when $k < k^{*IbB}$. We do not consider this case here.

$$
\begin{aligned}
k^{*IbB} &= \frac{(1-v)p+(1-z)(1-p)}{(1-v+z)p+(1-v-z)(1-p)} < 1/2 \\
&\Longleftrightarrow \quad p > \frac{1+v-z}{2v} \text{ when } \frac{p}{1-p} > \frac{-1+v+z}{1-v+z}
\end{aligned} \tag{1a}
$$

with p, v, z which satisfies the analyst's program conditions when the "buy" recommendation maximizes his preference. To take a numerical example, if $v = 0.7$ and $z = 0.8$, we must have $p > 0.64$. With $p = 0.7$ we verify numerically that the condition for $k > k^{*IbB}$ holds. Then we evaluate $k^{*IbB} = 0.44$. So there exists $k \in]0.44; 0.5[$ where the analysts find s, tells $\overline{b}$ and the best response for the investor is $\overline{B}$.

Remark 2 There exists parameters values for which the probability of the analyst to succeed in convincing the investor entails a decrease in the level of risk perceived by the investor.

In order to show this we can use comparative statics, numerically or by taking the partial derivatives of the k-functions defined above. We consider that these thresholds can represent the "boundary" between the possibility of a transaction and non-transaction due to a contradiction between the recommendation, investor's sentiment and investor's reflection. This contradiction can be viewed as an overwhelming uncertainty in investor's perception of risk, which results in paralyzing trade.

Thus, the less probable is decision N, the less the investor is paralyzed by uncertainty. That is why we study the variables that can affect the thresholds. If the investor decides to follow the analyst when, for example, $k > k^{*IbB}$, a lower value of k^{*IbB} will reduce the probability for the investor to decide N. Along with the ($\overline{b}$, B) example, when $p > 1/2$ and $z > v$, the partial derivative of k^{*IbB} with respect to z is always negative,

$$\frac{\partial k^{*IbB}}{\partial z} < 0$$

This implies that as z increases, the k-function produces a smaller threshold, which means that, all else equal, the probability of deciding N is lower when z (the probability that the analyst is convincing with a favorable consensus) increases. Nevertheless, we must observe that this result depends on the parameter values. For instance, the example above is not always true when $p < 1/2$, (this is unsurprising as long as the prior belief of the investor was unfavorable in this case.) However our purpose was to show the existence of at least one zone where the proposition is true, i.e. to highlight the fact that analyst's credibility can drive the investor to be less perceptible towards risk, less risk-averse in that sense.

We now investigate the interaction when the incentives are different.

3 The interaction when the analyst is independent

We examine the case when analyst only has a fixed wage. The former section's analyst could represent the brokerage ("sell-side") analyst ; the one we now study is closer to the independent research analyst. But one could also consider that the law could change the payment mode of those institutions, by allowing them to earn profit when "hold" recommendation are issued or when the market volatility is low[5]. We begin by analyzing the interaction in that situation, next we discuss the differences with the previous situation.

3.1 Investor decision and independent analyst incentives

The situation we study is not only a scholar exercise as, not so long ago, this was the prevailing situation. For example, before 1976 in the United States, investor used to pay for independent research, as the negotiability of commissions was forbidden. So that the competition between brokerage firms was not based upon the cost of the research but on its (supposed) quality. In France, the level of commission was fixed by law until 1986. The brokerage monopoly ended totally only since 1996.

This implies different organizational framework of the analyst' action, as his monetary retribution is a fixed wage. But this also implies different institutional incentives : in the previous case the social norm prescribed to possibly take excessive risks in order to be credible, that is why we modeled it as $Max\ \{\Pr(B \mid b)\ ;\ \Pr(S \mid s)\}$. We now suppose a hierarchy pressure that threaten the analyst to be immediately dismissed if he does not announce truthfully his information, or a peer pressure that discourages the untruthful recommendation, so that :

$$\begin{aligned} analyst'\ benefit &= W - \gamma \\ \gamma &= W \text{ if } \overline{r} \neq r \\ \gamma &= 0 \text{ if } \overline{r} = r \end{aligned}$$

In this environment, the cognitive task of the analyst is lighter as all his attention is drawn on the making of his private information, not on a strategic determination of which recommendation he will issue. His decision rule is :

[5] Such proposals to give more independance to brokerage firms or brokerage analysts are discussed in Boni And Womack (2002) or Galanti (2002).

$$\begin{cases} \overline{b} \text{ when } k > 1/2 \\ \overline{s} \text{ when } k < 1/2 \end{cases}$$

We can introduce a third recommendation, hold, if $k = 1/2$, which does not qualitatively modify the conclusions. The investor is perfectly aware of the institutional incentives the analyst faces - as in the previous case. But here the rule of analyst decision $\overline{r}$ gives him the rule of realization of r in the same time. Thus it is totally useless to weight his updated probability of increase by the probability of the analyst to truthfully announce his information. It is sufficient to calculate whether the updated probability is over 1/2 or not, for example :

$$\Pr(I \mid \overline{b}, B) > 1/2$$

which makes the investor decision similar to the one in Graham (1999), as it becomes a simple arbitrage between a public information (or consensus or initial belief) and private information[6] - as we said the investor' sentiment is a signal to himself. Actually, investor will decide $\overline{B}$ if :

$$\frac{zp}{zp + v(1-p)} > 1/2$$

$$\Longleftrightarrow \quad \frac{p}{1-p} > \frac{v}{z}$$
$$\Longleftrightarrow \quad \frac{\Pr(I)}{\Pr(D)} > \frac{\Pr(B \mid b, D)}{\Pr(B \mid b, I)}$$

and will decide N if not. This inequality is more likely to hold when the initial belief is rather bullish than bearish. Also, when the probability to convince the investor to buy with bearish initial beliefs of investor is low, and the probability to convince to buy with bullish prior beliefs is high. Writing it in general, we have, with $r = b, s$:

$$\overline{B} \text{ when } \Pr(I \mid \overline{r}, B) > 1/2 \Longleftrightarrow \frac{\Pr(I)}{\Pr(D)} > \frac{\Pr(B \mid r, D)}{\Pr(B \mid r, I)} \text{ and } N \text{ if not}$$
$$\overline{S} \text{ when } \Pr(D \mid \overline{r}, S) < 1/2 \Longleftrightarrow \frac{\Pr(I)}{\Pr(D)} < \frac{\Pr(S \mid r, D)}{\Pr(S \mid r, I)} \text{ and } N \text{ if not}$$

We interpret this result by comparing them with those of the previous section.

[6] A general result about such arbitrages is demonstrated in Gobillard (2002)

3.2 Investor perception of risk with independent analyst

Has our modified institutional environment an impact upon the occurrence of N ? It would hardly be otherwise, as the investor does not suspect anymore the analyst to deviate from his fundamentals-driven analysis.

Comparing the programs when the analyst is interested in the commissions (left-hand side) and when he is independent (right-hand side) we have :

$$\begin{aligned} \Pr(I &\mid \overline{r}, B) \Pr(b \mid B) < \Pr(I \mid \overline{r}, B) \\ \Pr(D &\mid \overline{r}, S) \Pr(s \mid S) < \Pr(D \mid \overline{r}, S) \end{aligned}$$

This result is general as long as the $\Pr(r \mid \Omega)$ are strictly under 1. This is always true when we avoid the extreme parameter values, i.e. when each p, k, z, v are different from zero and different from one. Thus, all else equal, the probability of choosing N is always greater with a commission-based payment mode than when the analyst has no peculiar interest in the volume of transaction.

It is quite easy to show it numerically by comparing two $\overline{b}, B$ situations all else equal - i.e. all parameters equal. The independent analyst, which has the institutional habit, or disposition, to reveal its private information, found $k > 1/2$. Investor felt a B opinion. He will confirm it by choosing $\overline{B}$, which holds for the following parameter set : $\{p = 0.6,\ z = 0.7,\ v = 0.8\}$. In that case, $\Pr(I \mid \overline{b}, B) = 0.57$.

With the same parameters, an analyst interested in the transaction volume will be followed if $\Pr(I \mid \overline{b}, B). \Pr(b \mid B) > 1/2$ which implies $k > k^{*IbB} = 0.705$. For example if $k = 0.8$, we have the investor choosing $\overline{B}$ with the probability $\Pr(I \mid \overline{b}, B). \Pr(b \mid B) = 0.52$.

Hence, all else equal, the probability of non-transaction is 0.43 when the analyst is independent and 0.48 if he is interested in the volume of transactions instead of truthfully reveal his information.

This could be viewed as a paradox, as long as the analyst with commission-based wage encourages clients' transaction of stock and bonds, and unsuccessfully raises less probability of transaction than the independent broker. But if we consider the importance of the investor's perception of risk, this cannot be any paradox. One has to consider than the recommendation seems more dubious in the mind of the investor when the commission-based incentive exists. Then, since confidence, in the sense of low level of perceived uncertainty, is a cause of the transaction decision, the probability of transaction will be lowered when there exists such a conflict of interest. A regulation that would give replace the commission-based payment mode of the brokerage companies, by such as those which existed in the past, would ease stock transactions by infusing confidence in the interactions.

A last remark is that, although k does not appear in the new program of the investor, it must not allow us to conclude that the analyst's reports has no role to play. As long as k determines $\overline{r}$, it contributes to the determination of the investor's sentiment Ω, which is in turn orienting the decision.

4 Conclusion

We now present three brief remarks concerning the advantages of the model, its limits, and its possible extension.

Although useful most of the time, the distinction between the study of psychological factors of behavior and economical determinants, representing the limits between Psychology and Economy, is not always worthy when analyzing certain situation within which this distinction brings more confusion than it helps improving knowledge. The interaction between stock market analysts and fund managers, the recommendation-making and the transaction decision, seems to fit this kind of situations. In most of the financial studies, psychological factors are reserved for empirical research, while rationality is the prevailing hypothesis of behaviors in theoretical models. Our model, as it endeavour to mix the approaches, follows those of Daniel, Hirshleifer, Subrahamnyam (1998), Gervais and Odean (2001) or Rabin and Shrag (1999), which enter a psychological bias into models with Bayesian updating of prior expectations. Although it is not fully descriptive of human behavior, Bayesian updating is non arbitrary and it is possible to isolate, in the model, what is rational from what is not.

That is why we describe a two-step behavior of the investor. First, he receives, passively, an impression, the opinion (B, S) which he does not choose to have. That is his intuition, the famous "animal spirits" of investor. But this is not sufficient, as investor also has the ability to analyze what he feels. He can calculate, rationally, the probability of his sentiment being a reliable intuition or not. Notice that there is no predetermined "bias" added to the hypothesis as if it was an abnormal disturbance of rational behavior. If it were so, we could have imposed an "increase-oriented bias", supposing that analyst find b when, say, $\Pr(b) > 1/3$. Here the rise of the investor sentiment (or private opinion) is considered as the normal way of cognitive functioning, consequently to the knowledge of a prior belief and of the recommendation. Moreover, we do no restrict a predetermined shape of the investor's sentiment, as, for instance, $\Pr(B \mid \overline{s}, I)$ can vary from zero to one.

A second advantage of the model is to avoid to radically distinguish risk theories and radical uncertainty theories. We simply mean that our k-functions (or the $p/1-p$ ratio in section three) , separating a transaction decision B or S from a non-transaction decision N , can be viewed as a boundary between a risky decision, taken knowing a risk measurement, and a negative decision (investor decides not to act) taken because of a contradiction between investor's sentiment and calculus, which reflects a situation under severe uncertainty.

Nevertheless, there is much to do to extend this kind of model to a theory of the stock market itself. It is still limited to the explanation of the financial recommendation-making and the investor's decision-making. A first limit is that we do not consider the costs of the analyst works. The independent research is traditionally more expansive than brokerage analyst reports, as emphasized in Boni and Womack (2002, p.120). Besides the costs of research, we possibly should consider other constraints on the analyst action in a repeated game. In our model, once the game is over, the investor cannot asses the payoff of the recommendation, its utility, its value. One could imagine a disappointed investor, punishing the analyst by ceasing any brokerage relation : the analyst should then take this into account.

However, this cannot be related to price variation or profit and losses : for practical reasons, the investor does not keep track of which broker made him trade what - so that it is impossible to infer the value of a given recommendation. That is probably why the literature on this topic investigates "reputational" punishment rather than a monetary one.

A second limit is that the model avoids the realization of stock market price. This would be a severe critic if our purpose was the impact of the analyst / investor interaction over prices, but our intention was to focus on the interaction itself. This entails to draw attention upon agents' expectations and their consequences over the decision ; hence it is not necessary to observe whether the expectations were "right" or "wrong". Observing the *realized* price variations only have sense if we consider that the expectation process has already ended, this must not interfere in the process *per se*.

A third important limit is the absence of costs related to the investor's decision, particularly credit costs and liquidity constraints.

Concerning the possible extensions of the model, it could encompass other analysts' payment modes. For instance, we could investigate the case when analysts are invited to manage a portfolio, holding the reported stocks, strictly related to the recommendations. By this way we should include price variations. Another extension could be the possibility of reputational punishment in a repeated game. The disappointed investor would lower the z and v (the probability for the analyst to be credible) of the next period, and a satisfied investor would increase them in next period.

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