**Klaus Schredelseker**

# Information Processing in Financial Markets

**An Austrian Approach**

***Abstract:***

Austrian economics seem to be appropriate in solving some of the basic problems of modern finance: is it worthwhile to do financial analysis, for whom is it worthwhile, and how does a market work where some investors do it and others do not? As the financial market is an example par excellence for a complex adaptive system, simulation technique may help: it does not force one to make simplifying assumptions for the sake of tractability; the heterogenity of information and the ambiguity of information-values make the problem to resolve so complex, that it does not allow analytical solutions. On the basis of very simple simulations of a closed market with heterogeneously informed traders it can be shown that (i) with increasing information the expected gains of the traders firstly decrease and then increase, (ii) it is rational for investors to decide passively even if the market is not fully efficient, (iii) passive strategy tends to weaken with a growing number of investors making use of it.

***Key words:***

Asymmetric information
Austrian economics
Efficient markets hypothesis
Information value
Simulation

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## 1) Textbooks in Finance: 'academics' versus 'practitioners'

There are two quite distinct types of textbooks in Finance, the true academics' and the true practitioners' books (and a lot of non-true inbetweens). Despite their very different approach, both claim to be 'scientifically founded' as well as 'useful in practice'. Looking somewhat closer, it seems that neither the one nor the other type really may hold its promises.

Academic textbooks in Finance usually rely heavily upon the paradigm of informationally efficient markets which has been developed in the 60ies and 70ies. A financial market is called to be efficient, if "stock prices at any time fully reflect all available information" (*Fama, 393*). This implies that a person, who knows nothing but the price, actually knows as much as if she knew everything that is knowable. In such a world most kind of information activity as financial analysis and studying the annual reports of firms is obsolete. You cannot add more if you already have reached the maximum. There is nothing in social sciences which has been tested so often, under so rigorous statistical conditions, in nearly all financial markets in the world and under so various aspects, as has been the efficient markets hypothesis (EMH). By far most of the evidence has been supportive for the EMH, some, however, showed opposite results. As in social science you never can verify a hypothesis and in very limited cases you can falsify it, the question is open (and will remain open even in the future). Both parties live quite comfortably: The efficiency-people rely upon the strong body of supporting empirical results; the inefficiency-people rely upon common sense and even a considerable amount of empirical results.

As most modern academic textbook authors belong rather to the efficiency people, they tell us nothing, or just a little, about the techniques of financial analysis, how to get the data, how to proceed information and how to interpret it. Even if those books put a tremendous emphasis on portfolio theory, they just mention in very few words, that this approach is based upon the assumption that financial analysis has previously been done successfully. First we have to assume that, for *n* securities in the market, we have generated *n* expected returns, *n* standard deviations and $n(n-1)/2$ covariances (e.g. for just thousand securities more than half a million reliable forecasting data!), before we can seriously adopt more sophisticated tools of portfolio theory, capital market theory and so on.

Sophistication counts a lot in finance, we all in the scientific community like it. Paul Samuelson called finance theory the 'crown-jewels' of social sciences and I agree. The CAPM is one of the most elegant, most suggestive, most intuitive and most appealing models in economics[1]. The *Hohe Schule* of finance nowadays, however, is valuation of derivatives, it is intellectually fascinating, directly applicable in practice and, that's the best, it is exact! Never in history of social and economic sciences has a theoretical model found such an immediate and widespread practical acceptance; just some months after the publication in the Journal of Political Economy there was no one left anyone in the profession who did not calculate the fair option's price, using the now legendary *Black/Scholes*-formula. But, elegance and exactness are not free lunches. You have to pay for it. As in portfolio theory, an older 'exact' financial science, you pay for it with

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[1] The same eulogy cannot be given to the CAPM's alternative, the Arbitrage Pricing Theory (APT). I have never understood why this – non economic, but just statistical - model became a serious competitor to the – endogenously economic – CAPM. The APT states that there may be some factors which may have some impact upon stock returns; however, we do not know anything about the type of these factors, we do not know anything about the number of these factors, we do not know anything about the persistence of empirically found data … The only thing we know is: if possibly there may exist anything

the assumptions. All arbitrage-free valuation models for options, futures, swaps etc. work if, and only if, the valuation problem of the underlying is properly solved. That is, if the market prices for these underlyings are efficient in the sense of the EMH! This may be one of the main reasons why financial textbooks are bound to stick on the efficient markets hypothesis: not so much because the authors assume EMH to be true, but rather because otherwise the most beautiful, the most advanced, the intellectually most appealing, and the most practically accepted parts of the discipline would simply lose their theoretical foundation!

In the brokerage firms you find thousands of professionals who adopt *Black/Scholes* and other valuation formulas without any hesitating. They have learned the corresponding theories in their well-paid MBA-courses and they use them daily. According to that, they advice clients and manage their portfolios. If you tell these people that stock prices move along a random walk, they don't take you seriously and will say to you: "Random Walks are a nice idea for academics - when I've been a student, I've heard about, it was funny, I liked it - but reality is different". May be that's different, but if one does not believe in (log-normally distributed) random walks, he cannot believe in the five-decimal-digits-result of his financial pocket calculator neither. The random-walk-assumption is one of the basic pillars of the call-options pricing formula. The results are *conditioned* upon the assumption that the market of the underlying is efficient. This implies that all investors adopted portfolio theory in an adequate manner and in order to do that, financial analysis has been done properly by them. But financial analysis is no longer taught in finance classes which claim to be taken for serious. Financial analysis has rather become an intangible of financial theory: it has no theory (the maximum of

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like that, the relationship between 'that' and the expected stock return has to be linear! Such a 'theory' is surely not a crown-jewel! I apologize for being too emotional.

sophistication is the well-known *Gordon*'s formula of constant growth rates in expected dividends), it is intellectually not appealing and it doesn't deliver exact results! We have nevertheless to admit, that still today financial analysis is the core business in finance! Ask your investment advisor or your portfolio manager how much of his daily time he devotes for gathering, analyzing, and proceeding information, that is how much time he devotes for financial analysis and how much time he is busy with calculations of efficient frontiers! Compare his answers with the relative weights a modern academic textbook in finance gives to various arguments of the discipline.

On the other hand, the practitioner's type of textbook seems not to be better, even if it deals much more with the topics finance professionals really do in their offices. These books tell the reader where 'relevant' information comes from; but, unfortunately, they don't tell them what 'relevant' means. 'Relevant' seems to be what practitioners take for 'relevant', i.e. a strange mix of fundamental and technical trading rules. Those books tell us how to read the financial pages of Wall Street Journal and Financial Times, how to interpret point-and-figure-charts, how to navigate in the financial websites of the internet, how to react if stock prices show a head-and-shoulder-pattern and how to use the information systems provided by Bloomberg or other well-known information brokers. A special emphasis is given to the analysis of the annual (and interim) reports of the firm, balance sheet, income statement, cash-flow statement, notes and so on. Different accounting standards and accounting traditions are discussed and hundreds of financial ratios (leverage-ratios, asset-turnover-ratios, profitability ratios, liquidity ratios etc.) are offered to the reader in order to let him get a deeper understanding of the accounting figures delivered by the firm's report, even if all those 'ratios' are redundant information with respect to the report itself. All this is done because it is assumed to be *useful* to the financial planner. The strong belief *that* it's useful stems from two arguments

a) The first is the settled belief that markets are *not* fully efficient (*Hooke*, 1999, 3). Stock prices are assumed to be sometimes overvalued and sometimes undervalued and it is assumed to be possible to detect these mispricings by the means of technical and/or fundamental analysis. In the practitioner's type of literature the conviction of markets to be somewhat inefficient is so deeply grounded, that usually it needs not to be explained further. For the authors it is obvious. Nothing in the real world is so perfect as in theory, it is proved by daily experience in practice, it is well supported by empirical results (and by theoretical reflections too) and, one of the strongest arguments for an economist, we cannot assume that all those big investment banks are so stupid as to spend huge sums for a job that doesn't pay!

b) Much more crucial, however, than the assumption of less than perfectly efficient markets, (here, we think, the practitioner's view is rather right than wrong), is the assumption of necessarily non-negative utilities of information. Textbook authors are convinced that the better an investor is informed and the higher the quality of his interpretation of given information is, the higher will be his expected performance in the market. Bad research is assumed to be no worse than no research and good research is assumed to be no worse than bad research (*Treynor 1998, 179*). But unfortunately these basic assumptions are not in line with simple logic: Suppose the market is to some degree not fully efficient and there may be a very good informed investor, you may, but you must not call him an insider, who is able to beat the market. If the price of a stock is underpriced he is more likely to be a buyer than a seller; if instead the stock is underpriced he is more likely to be a seller than a buyer, that's why in the long run he makes excess returns on average (at least if you don't consider transaction cost). But, if

> he exists, there is at least one other investor, who is more likely to be a buyer if the price of the stock is overpriced and is more likely to be a seller, if it is underpriced! When we allow for excess-return-winners, we have to admit the existence of excess-return-losers. Investors, however, whose decisions are made upon a zero-information–level, who literally know nothing about stock, valuation rules, capital market dynamics and so on, will *not* be among the losers, or at least to a very small amount considering the noise-trader-effect as modelled e.g. in *Kyle* (*1989*). An investor who goes long in a stock, if his dog's tail swings to the right and who goes short if his dog's tail swings to the left, will be with (nearly) equal probability on the right as on the wrong side of the market. His expected return will thus be higher than the expected return of an investor, who knows perhaps a lot, but not much enough!

Practitioner's books, may they rely rather on fundamental or rather on technical financial analysis, claim to instruct only winners (the selling proposition is, if you read the book you make better financial decisions than before). Where are the losers? Shouldn't we expect the majority of private and institutional investors to belong rather to the losers? Don't we write our textbooks for them too? Why do they accept to be losers? What makes us believe not to be among the losers? There are a lot of questions but very few answers.

We are convinced that there is a need for a new textbook: A book which doesn't avoid speaking about one of the most real problems of practitioners, that is how to do financial analysis. But it has to be a book that doesn't limit itself to describe what practitioners really do. *Either* it has to explain why they should do what they do, *or* it has to explain why they should not do what they do! In this paper I will argue that

Austrian economic thinking could be helpful in designing such a book. I'm far off writing it, but I'm convinced that it will come.

## 2) Austrian economics and financial theory

Compared to neoclassical (often called mainstream) economics, the Austrian economics approach seems to be much more appropriate to solve those problems. Its main characteristics are:

a) Austrian economics are strictly individualistic: all economic phenomena have to be explained by recurring to purposeful actions of individuals.

b) Austrian economics emphasize the process towards some kind of equilibrium and not the equilibrium itself.

c) Austrian economics assume basically rational behaviour of all actors, based upon their subjective utility, their intellectual capabilities, and their subjective beliefs.

d) Austrian economics consider the reflexivity of human action: what will the other(s) do when I act and how will I have to react upon their assumed decisions?

e) In Austrian economics asymmetry of information is not a shortcoming of the system but it drives the results of any market model.

Even if some of these criteria have been incorporated in neoclassical economic thinking, there are still substantial differences. Let us therefore look somewhat closer:

*Methodological individualism*: Not only Austrians, but mainstream economists also, claim to have adopted the methodological individualism. But what kind of individualism is a theory of general equilibrium (in the *Walras* and *Arrow-Debreu*-tradition) that states that nobody has an incentive to take actions? Can we say that we went back to the actions of individuals when we derive a solution where any kind of action is obsolete? *Hayek*, in his famous speech at the Philadelphia Society in Chicago 1968, pointed out that economists “have been discussing competition on assumptions that, *if* they were true of the real world, would make it wholly uninteresting and useless.” (*Hayek 1978, 179*).

The same counts in Finance: If the financial market is efficient in the sense of EMH, nobody has an incentive to be better informed and trade takes place only for exogenous reasons; people trade because they need liquidity or they have too much of it. But, if nobody pays to be informed, why should the market be efficient? Is not informational efficiency the natural outcome of serious information activities, done by the market participants? Till today there have been various attempts to solve this puzzle, but a satisfying answer to the question of *Grossman/Stiglitz*, raised in their seminal paper *On the Impossibility of Informationally Efficient Markets* (1980), has not yet been given.

The Austrian approach tells us that we need a theory which allows us, at any time, to explain why people are willing to take actions; actions which may, or may not, lead the system to achieve equilibrium.

*Process orientation*: If neoclassical economics represent the science of equilibrium, the Austrian approach is rather the science of how to get there, or how *Mises* called it the science of human action. Austrians do not deny the idea of economic equilibrium, but, if necessary, they stop their analysis prior to its full achievement. In the markets of goods and services there have to be always enough possibilities for entrepreneurs to make profits by exploiting unexploited opportunities; in the financial markets we have always to allow for investors for whom it is worthwhile to invest in information in order to make better returns which, at least, offset their cost: “The competitive market process occurs because equilibrium has not yet been obtained”, as *Kirzner* (1985, 130) states. Markets are excellent problem solvers but they are not perfect. If they were, then we would no longer have a problem to be solved.

For the financial markets we have to look for a kind of *equilibrium degree of disequilibrium* in the market. There have to be exactly as much inefficiencies in pricing that a sufficiently great number of investors succeeds to exploit them. If the market is less efficient than that, it would attract more active traders and its informational efficiency would rise; if, instead, the market exhibits a too high level of informational efficiency, investors reduce their information activities and pricing inefficiencies will increase.

The Austrian approach tells us that we need a theory of informationally somewhat inefficient rather than a theory of informationally efficient markets. What we need is a theory of the path towards equilibrium rather than a theory of equilibrium. Presently, no such theory exists.

*Rationalism and subjectivism*: In the last two decades even in academic finance the EMH has become more and more under serious pressure: too many empirical findings could no longer be explained within the efficient-markets-paradigm (being still the dominant approach, all evidence against EMH was called an ‘anomaly’!). Around those anomalies a new financial discipline, *Behavioural Finance*, has been created. Topics like under- and overreaction, rational and irrational herding, rational and irrational bubbles, fads, and other strange things received an attention they did not have in financial literature since the fifties. At that time it was common to speak about *stock market psychology* and related topics; ‘modern finance theory’, however, wiped out all these soft facts and replaced them with ‘hard science’. Perhaps finance became a bit too hard. Now we are afraid that after a long period where finance shifted from economics to mathematics, we will get a shift from mathematics to psychology. I would strongly prefer, however, that the previously discussed problems were solved in a rational decision making framework, that is with purely *economic* reasoning! Yet, 'rational' has nothing to do with this omniscient and never failing *homo economicus* whom to assume sometimes may be necessary for certain types of economic modelling, but who has nothing to do with people in the real world. In Austrian economics a 'rational man' is allowed to have just limited information, he may have limited memory and limited cognitive capacities, he decides with the information he really has, that is with his very personal beliefs, even if in an objective sense they may be false (subjectivism); but, and this is what makes him different from his a-rational counterpart in some behavioural approaches, in his decisions he makes no *systematic* mistakes which could possibly be anticipated by others.

In such an understanding the Austrian approach allows us to address the main shortcomings of equilibrium and efficient markets theory without necessarily switching from rational to a-rational behaviour of the market participants.

*Reflexivity of human action*: If there is any important difference between social and natural sciences it is that natural sciences have basically no game theoretical problems to solve. For social sciences, especially for economics and finance, the interaction among people, however, becomes central. In the last years game theory has become the leading approach in microeconomics. Despite its obvious Austrian roots (*Oskar Morgenstern* belonged to the famous *Wiener Kreis* and was a scholar in *Mises' Privatseminar*), game theory for a long time has been neglected by the Austrian school of thought, preliminary because of its high mathematical sophistication and its strong focus on perfect information. Recently, however, things seem to change: *Nicolai Foss* pointed out, that "game theory allows what seems to the Austrian to be the natural procedure: *first* we specify the behaviour of agents and *then* we examine the interaction of those behaviours. Thus, disequilibrium situations are given to a formal treatment." (*Foss*, 50).

That the shift from classic decision theory (decisions against nature) to game theory is not just gradual, but dramatic, can easily be shown looking to information economics, another favorite topic of Austrian economics. As long as we are considering decisions against nature, there is no doubt about the well-known non-negativity-theorem of information: the better you are informed the better will be the quality of your decisions. As it is the case for an option, the value of an information cannot be negative.Either I use the information because its advantageous for me (the information is in the money), or I don't (the information is out of the money), but as long as I do not have to pay for it, I will never suffer from being informed! If, however, we consider decisions against rational decision makers, just the opposite may be true: "having more information (or, more precisely, having it known to the other players that one has more information) can make a player worse off" (*Gibbons*, 63). Look at the following example, where a decision problem against nature is mixed up with one in a game theoretical setting. There are two actors, A and B, each of which can choose between two alternatives: $A_1$ or $A_2$ and $B_1$ or $B_2$, respectively. Uncertainty is given with respect to the matrices x and y: A and B do not know which one is played, they only know that each of both has the same probability of being selected by nature. The payoff-notation is **A** / **B**.

| | *Matrix x* | | | *Matrix y* | |
|---|---|---|---|---|---|
| | $B_1$ | $B_2$ | | $B_1$ | $B_2$ |
| $A_1$ | **2 / 6** | **5 / 7** | $A_1$ | **9 / 7** | **3 / 5** |
| $A_2$ | **8 / 3** | **6 / 9** | $A_2$ | **2 / 9** | **1 / 2** |

Both players have dominant strategies in expected gains:

- For player A strategy $A_1$ is dominant: if B chooses $B_1$, his expected gain with $A_1$ will be (2+9)/2=5.5 and with $A_2$ only (8+2)/2=5.0; if instead B chooses $B_2$, his expected gain with $A_1$ will be (5+3)/2=4.0 and with $A_2$ only (6+1)/2=3.5
- For player B strategy $B_1$ is dominant: if A chooses $A_1$, his expected gain with $B_1$ will be (6+7)/2=6.5 and with $B_2$ only (7+5)/2=6.0; if instead A chooses $A_2$, his expected gain with $B_1$ will be (3+9)/2=6.0 and with $B_2$ only (9+2)/2=5.5.

Thus, there is a Nash equilibrium and the mean value of the game is 5.5 for A and 6.5 for B respectively.

Consider now the case that, prior to his decision, *A gets private information* about the matrix that will be played. As B doesn't know that A is informed he sticks to his decision of choosing $B_1$. A knows this and chooses $A_2$ in case of matrix x and $A_1$ in case of matrix y. The value of the game is (8+9)/2=8,5 for A and (3+7)/2=5.0 for B. To be better informed was useful (+3.0 for A), to be worse informed was hazardous (-1.5 for B).

If instead *B gets private information* about the matrix that will be played the result is quite different. B knows that A will choose $A_1$ and thus selects $B_2$ in case of matrix x and $B_1$ in case of matrix y. The value of the game is now (5+9)/2=7.0 for A and (7+7)/2=7.0 for B. Not the higher, but the lower informed player made the better deal. The results are +1.5 for A and just +0.5 for B. For B it would even pay to make his private information public (in this case he would get 8.0 instead of 7.0)!

Let us have a look at a last case: *A gets private information and B knows it*. B knows that A will select his dominant alternatives $A_2$ in the case of matrix x and $A_1$ in the case of matrix y; so he calculates an expected gain of (3+7)/2=5.0 with $B_1$ and (9+5)/2=7.0 with $B_2$ and chooses the latter. This leads to a negative value for A, who will get either 6 (matrix x) or 3 (matrix y). With respect to his prior situation (5.5) player A lost money from the privilege of being better informed (now: 4.5); he would be willing to pay for not being informed!

As far as we proceed from classical decision theory to interactive decision models as games or markets, a lot of things change; the most important thing, in our view, seems to be the fact that the non-negativity-axiom of information is no longer valid! A neo-classical economy being in perfect equilibrium makes the buyer/seller to be a price-taker who does not interfere in the price mechanisms as such; his decisions are model-led as if they were decisions against nature and he were something exogeneous to the market itself. In the Austrian approach, however, people are always elements of the market, they are actors rather than reactors. Human *action* always means human *inter-action*: "attention is immediately focused on the interaction process as such", as it is in game theory (*Buchanan* 1997, 71).

*Assymmetry of information*: In speculative markets trading occurs only and only if tra-ders have diverse information or diverse beliefs based on the same information. This is so basic that one really wonders why in so much economic market models (as e.g. in the CAPM) the crucial assumption of homogeneous beliefs is made. Homogeneous beliefs mean that people dispose of the same set of information *and* that they interpret this information in the same way. If this assumption were given we necessarily fall in the no-trade-gap: Apart from liquidity needs, there is no reason for anybody to buy or to sell.

But, if we look to markets with heterogeneously informed traders it is, as we have seen before, not necessarily the better informed market participant who is advantaged in re-spect to his less informed partner/adversary. In the outmost of the finance literature, however, there is no doubt of the non-negativity of information. The better one is informed, the better the quality of his decisions is expected to be. With this belief in mind, there a lot of models with heterogeneous information have been created. Most of them follow a similar approach: markets are analysed where two distinct types of actors (informed and non-informed; good informed and bad informed) trade (*Grossman/Stiglitz, 1980; Diamond/Verrecchia, 1981; Hellwig, 1982; Kyle, 1989*) . The typical result is that the efforts the better informed have to pay for, in equilibrium must be offset by higher gross returns, so that in terms of net returns there will be no difference between informed and not informed market participants (with the usual non-Austrian result: there is no longer an incentive to act). A major weakness of these papers is that information usually has only two levels of precision, whereas in the real world we are confronted with disparate information: There are roughly as many levels of information as traders. As the problem of disparate information cannot be addressed in a two-information-level equilibrium model (*Foster/Viswanathan 1996*), and as the analytical solution of a multi-person setting seems to be very difficult, we adopted a different, extremely powerful, but very simple approach: agent-based simulation.

## 3) A simple simulation model of a financial market

The use of computer simulation has a long tradition in natural sciences, particularly in physics. Complex systems with a big number of interacting elements are often not tractable with the traditional tools of closed-form mathematical models. Even if the same is true for economics –*Holland* sees in the economy an example par excellence for a complex adaptive system (*Waldrop*, 145) – simulation techniques for a long time have been regarded as unscientific: It was widely shared that they were for people who couldn't think analytically and for people who wanted to show whatever they wanted to show just by modelling the problem in an appropriate way. That's why *Brian Arthur* stated: “So computer simulation got a very bad name in social science and especially in economics. It was kind of the resort of the scoundrel” (*Waldrup*, 268).

Things have changed since the first glorious days of the Santa Fe Institute. Today computer simulation has become a standard tool in Finance. Commenting on the book of *Levy/Levy/Solomon* on ‘Microscopic Simulation of Financial Markets’ (2000), already a reference text for simulations in Finance, *Harry Markowitz* even wrote that this book “points us towards the future of financial economics. If we restrict ourselves to models which can be solved analytically, we will be modelling for our mutual entertainment, not to maximize explanatory or predictive power."

In this section I will present some basic results from an extremely simple agent-based simulation model. Simulation was used because this technique “does not force one to make simplifying assumptions for the sake of tractability. Thus, virtually any system with heterogeneous elements... can be investigated” (*Levy/Levy/Solomon*, xiii). It may be an open question whether, in order to derive these results, it was really necessary to use simulation. I think it is, as the heterogenity of information and the ambiguity of information-values make the problem to resolve so complex, that it does not allow analytical solutions (see *Arthur/Holland/LeBaron/Palmer/Tayler*, 1997). Nevertheless: perhaps what we did was just breaking a butterfly on the wheel. I do not know.

### a) The design of the study

The basic question is straightforward: What happens if in a closed market several traders, being more or less rational, trade aginst other traders, being more or less rational; all traders are assumed to have diverse information (and beliefs) and to choose the best information strategy available to them. Can we derive a solution, where nobody has anymore an incentive to change his strategy?

We simulated a very simple market with only one asset. In the market trade eight independent traders, each of which has a different level of information, which is given exogeneously. A one-period pure exchange economy is assumed and, like in the market for derivatives, the net-supply of the security is zero. The security's intrinsic value, V, is the sum of eight Laplace-coins (showing one or zero with equal probability) and thus a random variable, drawn from a binomial distribution from 0 to 8. The structure is a call-market, where traders place their orders (market orders or limit orders) without observing the orders of the other traders and without communicating with them.

The market-clearing-price is the price which allows for the highest possible market volume. Every trader is a risk neutral expected wealth maximizer who trades exactly one security. Information is exogenously given, cost-free, not transferable, but not distributed equally. Before trading, each trader n knows the position of a certain number of coins (his information level $IL_n$). Information is cumulative, so that each information level implies all information levels being lower; as in real markets, we suppose that what the badly informed traders know should be known by the better informed traders as well.

In a first step all traders are assumed to be information processors in the sense of fundamental financial analysis. As if they had to make a decision against nature they base their decisions upon the information they actually have. That is what usually textbooks in financial analysis sugest, even if, as we will see, it may not be rational to do so. As trader n knows n coins, of which $x_n$ show up one ($n-x_n$ show up zero), he estimates the security's value to be

$$E_n(V) = x_n + (8-n)/2 + \varepsilon_n,$$

the sum of (i) what he knows [$x_n$] and (ii) the expected value of what he doesn't know [(8-n)/2] and (iii) a small, equally distributed 16-digit-error term [$\varepsilon_n$] which allows for some "irrationalities" in the decisions and which rules out that two traders may make exactly the same estimation. As there are no transaction cost and all traders are assumed to be strictly risk-neutral, they are willing to buy the security at any price P if $P<E_n(V)$ and to sell it at any price P if $E_n(V)<P$. In the first case trader n expects the security to be underpriced, in the second case he expects it to be overpriced.

In each simulated market run, we calculate the gain/loss $G_n$ for each trader. In the case of P<V (underpricing) the buyers win $G_{buy}=V-P$ and the sellers lose $G_{sell}=P-V$; in the case of P>V (overpricing) the buyers lose $G_{buy}=V-P$ and the sellers win $G_{sell}=P-V$ (similar *Jackson*, 1991).

**Example**: Let us have a look at a possible run of the simulation with the true value of the security being V=5 (position of the coins: 10111001). With a price [=median of $E_{1...8}(V)$] of 4.78 the security is quite underpriced: thus, all traders

- whose estimate was lower than 4.78 sold the security and made a loss of 0.22 each
- whose estimate was higher than 4.78 bought the security and made a gain of 0.22 each

| *Trader n* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* |
|---|---|---|---|---|---|---|---|---|
| $x_n$ (coins showing 1) | 1 | 1 | 2 | 3 | 4 | 4 | 4 | 5 |
| $\varepsilon_n$ | 0.08 | -0.04 | -0.04 | 0.11 | 0.07 | -0.02 | -0.10 | 0.08 |
| $E_n(V) = x_n + 4.5 - n/2 + \varepsilon_t$ | 4.58 | 3.96 | 4.46 | 5.11 | 5.57 | 4.98 | 4.40 | 5.08 |
| **B**uyer/**S**eller at P = 4.78 | **S** | **S** | **S** | **B** | **B** | **B** | **S** | **B** |

**Table 1**

In a thin market like this, traders are not price-takers; the two marginal traders around the median make the price! As we want to study a market which tends to equilibrium (here: informational efficiency), but has not yet reached it, this is no default but welcome and will drive most of the major results. As there are $2^8 = 256$ possibilities for the eight coins to be distributed (table 1 showed one of those) we calculated the expected gain/loss for each trader as average of all 256 possibilities; in order to rule out casual effects by $\varepsilon_n$ we repeated this procedure ten times and in the following we report the average result as $G_n$.

**b) The value of information**

If all eight traders make their estimates and then their market orders as shown above, we get the result in table 2. The second row indicates the information level $IL_n$ of each trader n (till now exactly n); the third row shows $G_n$, the expected gains for each trader:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Trader n: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| $IL_t$: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| $G_n$: | -0.31 | -0.35 | -0.37 | -0.30 | 0.05 | 0.26 | 0.43 | 0.59 |

**Table 2**

The gains and losses have to sum up to zero. If there are investors who outperform the market there have to be others who underperform it. At first glance the results look strange. Only for $IL_4 \ldots IL_8$ are they in line with traditional theory. With increasing $IL_n$ the expected gains of the traders increase. From $IL_1 \ldots IL_3$, however, the utility of getting better informed is negative, a result which we already have seen in our game-theoretical considerations above: $Trader_3$ makes a higher loss as $Trader_1$ even if he knows three times as much!

This result can be explained if you consider that an improvement of information has two distinct and opposite consequences: there is a precision effect as well as a joint-error-effect. The higher $IL_n$ is, the more precise will be trader n's estimation of V (*Precision effect).* In decisions against nature that is the only thing which counts! If investing were a game against nature everything would be clear: Information was always a valuable thing.

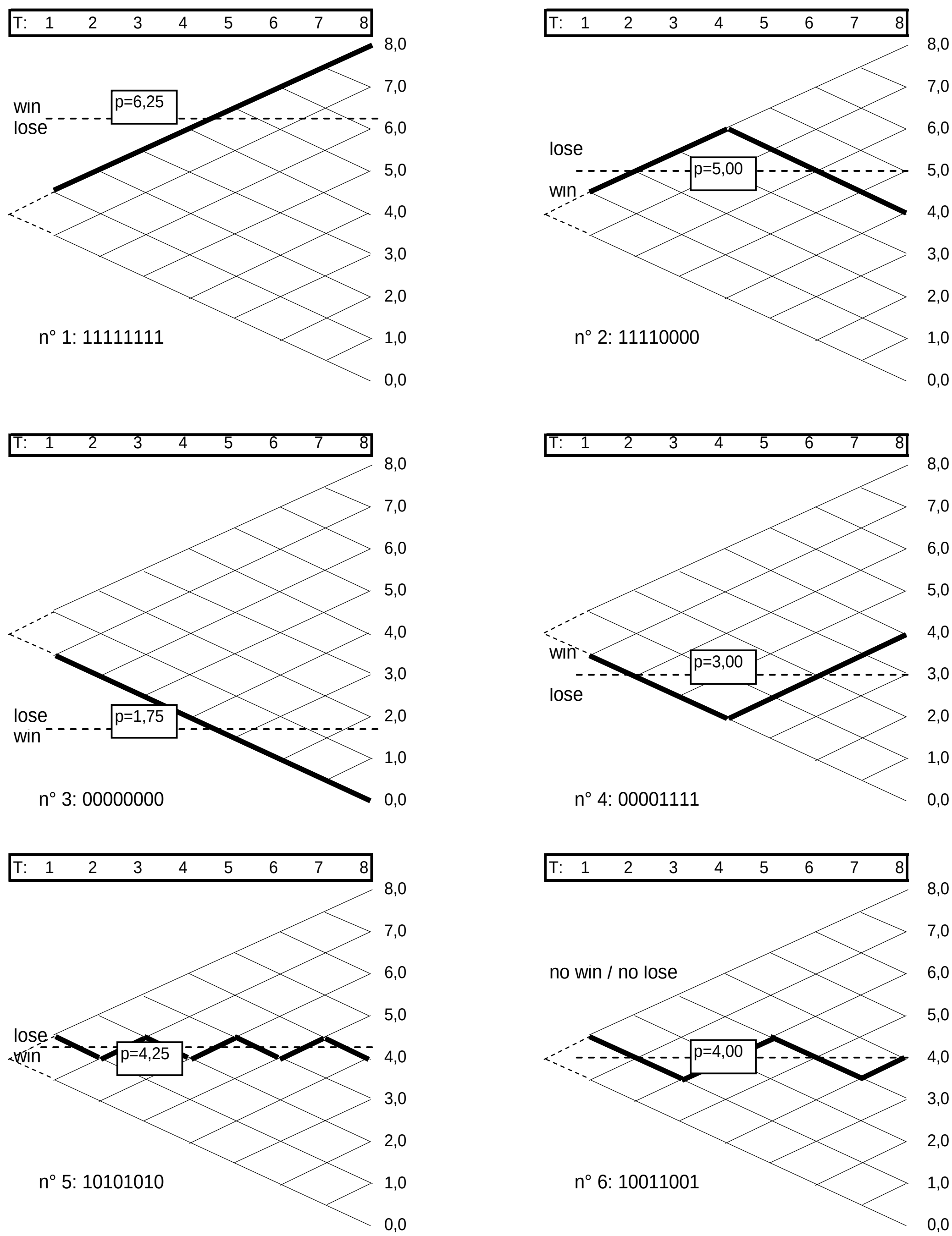
But it is not. In a market a trader is not interested in making a good estimate of V, even if according to most practitioners' books this seems to be the only purpose of financial analysis (how to make a good estimate of the 'true intrinsic value'). He is rather interested in finishing up on the right side of the market. If the security is overpriced, he would like to be in the sellers' party, if it's underpriced, he prefers to be in that of the buyers! That making a good estimate and making money are two quite different things, is shown in the following example:

> Let us assume in a market with traders $T_{1...8}$, a security with intrinsic value V=5.0 has been estimated 3.5 (by $T_1$ and $T_2$), 4.0 (by $T_3$ and $T_4$), 5.0 by $T_5$, 6.0 by $T_6$), 7.0 (by $T_7$ and $T_8$). As in our simulations, each trader puts a double-order in the market: he wants to buy when he takes the security for underpriced and he wants to sell if he takes it for overpriced. Therefore, its market price will be 4.5 (an undervaluation) and all traders who buy it ($T_5 \ldots T_8$) win, whereas all traders who sell it ($T_1 \ldots T_4$) lose. The average estimation error (with respect to the true value V=5.0) was 1.75 for the winners and 0.75 for the losers. It was much higher for the winners than for the losers!

To get on the right side of the market is not trivial. The overall probability of being on the right side is as high as that to be on the wrong side. If there is a group of very good informed investors, who succeed with higher probability to be on the right side, there is another group of investors who have to take the counterpart. They lose, even if, in absolute terms, they are good, but with respect to the first, somewhat less informed.

The community of skiing coaches may educate all their ski-racers to go faster, the community of finance trainers, however, will never succeed to make all investors get better returns. Even the contrary may be the case. The more investors are educated in doing financial analysis, the more likely they will draw the same conclusions from a given piece of information. If, what usually will be the case, the information they have is a somewhat biased subset of all available information, they will all tend to make the same mistakes. If that's the case, market mispricing will increase and the returns of those who caused it will decrease! (J*oint-error-effect*).

In order to understand this ambiguity of information a bit better let us have a look at the following figures. They show how heterogeneously informed investors who adopt classical fundamental analysis estimate the security's value. For reasons of simplicity and in contrast to the simulations before, the error term $e_n$ is removed.



The horizontal level of the nodes in the grids represent all possible estimations traders can make using the given decision rule: If there was a trader knowing nothing, his estimate always would be 4.0 (starting point of the grid); as the first trader, $T_1$, in our simulations knows the position of the first coin, his estimate will be 4.5 (if the first coin shows 1) or 3.5 (if the first coin shows 0); $T_2$, the second trader, will estimate 5.0 (if both coins he sees show 1), he will estimate 4.0 (if one shows 1, the other 0), or he will estimate 3.0 (if both coins he sees show 0) etc.; as trader $T_8$ has full information, his estimate always equals the intrinsic value of the security.

Any of the $2^8$=256 possible realisations of the eight coins is represented by a specific path through the grid. With a coin showing 1 the path is moving upwards, with a coin showing 0 the path is moving downwards. For each path the market clearing price is given where as many nodes are above as beyond the horizontal price line. All investors making a value-estimation being higher than the market price, will be buyers, and all investors making a value-estimation being lower than the market price, will be sellers. For the first at the given price the security seems to be undervalued (that’s why they buy), for the second the security is seen as undervalued (that’s why they sell).

The **first** (n° 1) path represents a monotonous sequence: 11111111. Therefore the traders’ estimations and gains/losses are:

| Trader | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Estimation | 4.50 | 5.00 | 5.50 | 6.00 | 6.50 | 7.00 | 7.50 | 8.00 |
| Gain/Loss | -1.75 | -1.75 | -1.75 | -1.75 | 1.75 | 1.75 | 1.75 | 1.75 |

With V=8.0 and P=6.25 the security is underpriced by 1.75. Those who buy it ($T_5$, $T_6$, $T_7$, $T_8$) win and those who sell it ($T_1$, $T_2$, $T_3$, $T_4$) lose. The better informed traders win, the less informed lose.

The **second** (n° 2) path represents a sequence which changes its direction in the mid: 11110000. The traders' estimations and gains/losses are:

| Trader | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Estimation | 4.50 | 5.00 | 5.50 | 6.00 | 5.50 | 5.00 | 4.50 | 4.00 |
| Gain/Loss | 1.00 | 0.00 | -1.00 | -1.00 | -1.00 | 0.00 | 1.00 | 1.00 |

With V=4.0 and P=5.0 the security is overpriced by 1.0. The winners (=sellers) are among the good informed ($T_7$, $T_8$) and the bad informed ($T_1$); the losers (=buyers) are among the medium informed ($T_3$, $T_4$, $T_5$). This is what we called the joint-error-effect: medium-informed traders are mislead by an information subset (three, four or five coins) which is biased with respect to the whole set. They all make the same mistakes and get victims of the mispricing they have created. The low informed $T_1$, however, knows too little to be captured. If you consider fourteen traders instead of eight (and a security with 14 coins showing 11111110000000) the winners will be $T_1$, $T_2$, $T_3$, $T_{11}$, $T_{12}$, $T_{13}$, $T_{14}$ whereas traders $T_4$, $T_5$, $T_6$, $T_7$, $T_8$, $T_9$, $T_{10}$ will lose money (*Schredelseker*, 1997).

The **third** (n° 3) path shows the opposite case with respect to figure 1. The sequence is monotonously moving downwards: 00000000. The traders' estimations and their gains and losses are:

| Trader | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Estimation | 3.50 | 3.00 | 2.50 | 2.00 | 1.50 | 1.00 | 0.50 | 0.00 |
| Gain/Loss | -1.75 | -1.75 | -1.75 | -1.75 | 1.75 | 1.75 | 1.75 | 1.75 |

With V=0.0 and P=1.75 the security is overpriced by 1.75. Those who sell it ($T_5$, $T_6$, $T_7$, $T_8$) win and those who buy it ($T_1$, $T_2$, $T_3$, $T_4$) lose. The better informed traders win, the less informed lose.

The **fourth** (n° 4) path shows the opposite case with respect to figure 2: the sequence begins falling and then changes its direction: 00001111. The traders' estimations and gains/losses are:

| Trader | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Estimation | 3.50 | 3.00 | 2.50 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 |
| Gain/Loss | 1.00 | 0.00 | -1.00 | -1.00 | -1.00 | 0.00 | 1.00 | 1.00 |

With V=4.0 and P=3.0 the security is underpriced by 1.0. As in the second case the winners (=buyers) are among the good informed ($T_7$, $T_8$) and the bad informed ($T_1$); the losers (=sellers) are among the medium informed ($T_3$, $T_4$, $T_5$). Here, too, we have the joint-error-effect: medium-informed traders are mislead by an information subset which is biased with respect to the whole set and become victims of the mispricing they have created. The low informed trader $T_1$, however, knows too little to be captured.

The **fifth** (n° 5) path represents an alternating and thus equilibrated sequence: 10101010. The traders' estimations and gains/losses are:

| Trader | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Estimation | 4.50 | 4.00 | 4.50 | 4.00 | 4.50 | 4.00 | 4.50 | 4.00 |
| Gain/Loss | -0.25 | 0.25 | -0.25 | 0.25 | -0.25 | 0.25 | -0.25 | 0.25 |

With V=4.0 and P=4.25 the security is slightly overpriced and the sellers ($T_2$, $T_4$, $T_6$, $T_8$) win, whereas the buyers ($T_1$, $T_3$, $T_5$, $T_7$) lose. There is little to win or to lose and the probability to be among the winners or among the losers is roughly the same for traders with high or with low levels of information.

The **sixth** (n° 6) path represents another sequence with small deviations from uniformity: 10011001. The traders' estimations and gains/losses are:

| Trader | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Estimation | 4.50 | 4.00 | 3.50 | 4.00 | 4.50 | 4.00 | 3.50 | 4.00 |
| Gain/Loss | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

With V=4.0 and P=4.00 the security is correctly priced and nobody makes a gain or a loss. It does not matter whether you are a buyer or a seller and it does not matter whether you are good informed or bad informed, the market price is informationally efficient.

If we take these six cases (all others are more or less similar) together we see that it may be the case that

- the better informed win and the less informed lose (n° 1 and 3)
- the bad and the good informed win whereas the medium informed lose (n° 2 and 4)
- there may be winners and losers in all levels of information (n° 5)
- the security is correctly priced and there are neither winners nor losers (n° 6).

Everything seems possible, the only thing which does not happen is that medium informed investors perform systematically better then their very low informed colleagues! But that's what traditional theory, based upon decisions against nature, says: "The effect of knowing more than others, ceteris paribus, .. is to be able to improve upon one's welfare at the expense of those who know less." (*Hakansson*, 15).

### c) The rationale of passive trading

Let's go back to table 2. The reason why there are some traders who lose and others who win is that the market is a zero-sum-game and the overall probability to be on the right side cannot be higher than that to be on the wrong side of the market. If there are single investors who succeed in making their individual probability to be on the right side higher than 0.5, there will be others whose probability to be on the wrong side is higher than 0.5!

| Trader t: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| $IL_t$ : | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| $G_t$: | -0.31 | -0.35 | -0.37 | -0.30 | 0.05 | 0.26 | 0.43 | 0.59 |
| Probability to be on the right side | 35% | 34% | 25% | 37% | 46% | 64% | 68% | 91% |
| Probability to be on the wrong side | 65% | 66% | 75% | 63% | 54% | 36% | 32% | 9% |

**Table 3**

As can be seen in table 3 the highest probability to decide wrong is not assigned to the investors with the lowest level of information but to $T_3$, the one who is most affected by the joint-error-effect.

But let us look at $T_5$. His expected return is near zero and his probability to be on the right side of the market is close to 0.5. An investor who decides by flipping a coin (or looking to his dog's tail) whether to go long or to go short, will, as long as his orders do not affect prices, also have equal probability to be right or wrong. Obviously, to be as good as a dog requires that you have an already quite high information level. Why, if this is the case, do rational traders, whose information is rather scarce, accept having under-average returns? Why, instead of working hard on information, don't they simply observe their dogs, which make much better decisions by just swinging their tails?

The answer is simple: they do! Instead of looking at their dogs they adopt passive, indexed investment strategies. Index investment has, compared with a dog, the same expected return (=market average), but a better risk diversification. During the year 2000, *Vanguard 500*, a typical US index fund became the largest mutual fund in the world and it seems that nowadays more than fifty percent of the institutionalists' money is invested passively (you never will know exactly, because many portfolio managers don't admit it, even if they do it!). Usually, the justification for passive investment is based on market efficiency. If the stock market were fully efficient the gross returns

(returns before information and management cost) of any kind of investment are assumed to be the same. If that is the case the net return of passively managed mutual funds (which fired all their analysts, portfolio managers etc.) is, because of their lower cost, expected to be superior to those of actively run funds. If, instead, you allow for some market inefficiencies and thus for systematic winners and losers, passive investment becomes even more attractive. For the overwhelming majority of investors its gross return is higher as it were with an active use of information. Passive investment preserves you from getting systematically on the wrong side of the market (*Malkiel* 2003)! There is plenty of empirical evidence that, on average, actively managed mutual funds do not realise a gross return which matches the market: even without cost they are rather on the losers' than on the winners' side. An investor who gives his money to an index fund does not expect to beat the market, but he can be sure not to be beaten by the market! We are strongly convinced that for sophisticated investors the case of inefficient markets is a much stronger advertising argument for the providers of such kind of investment as the somewhat artificial efficiency paradigm.

But what happens if all losers adopt a passive strategy and the systematic losers and winners have to be found among the remaining active traders? Wouldn't it be rational, then, for the new losers among these active traders to switch to a passive strategy too and so on…? At the end would't there be nobody left who dares to be informed? Naturally this will not be the case. Any investment rule tends to weaken if it is adopted by too much people.

*Hayek* showed in his seminal paper *The Use of Knowledge in Society* (1945) that markets are excellent techniques of information-diffusion: the market price is a high-quality signal of scarcity, of changing tastes and demands, of profitabilities etc.

- If the stock market is informationally efficient this signal is perfect and, as we know, at the mean time useless: it does not allow the single investor to search for good investment opportunities
- If the market, as the Austrian view assumes, is highly but not fully efficient, the signal is of excellent but not of perfect quality. There still is an incentive for at least some investors to proceed information in order to beat the market; if their excess returns exceed their cost, they will be winners. All others should, in order of not being losers, adopt a passive strategy.
- If, however, there will be too many passive investors, the market prices will lose information quality and will not signal any more useful information; passive traders take a free-ride on the research activities of all active investors conveyed in the market price; if, because of excessive passive trading, there are no more research activities you cannot take anymore a free-ride: the price will simply be too noisy!

Let us look to our simulated stock in order to see what happens if more and more investors decide on a pure random basis instead of using their private information by doing fundamental analysis.

| Trader t: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| $IL_t$ : | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| $G_t$: | -0.31 | -0.35 | -0.37 | -0.30 | 0.05 | 0.26 | 0.43 | 0.59 |
| $IL_t$ : | pass | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| $G_t$: | -0,11 | -0,28 | -0,31 | -0,30 | -0,09 | 0,18 | 0,39 | 0,55 |
| $IL_t$ : | pass | pass | 3 | 4 | 5 | 6 | 7 | 8 |
| $G_t$: | -0,12 | -0,12 | -0,25 | -0,27 | -0,17 | 0,10 | 0,32 | 0,51 |
| $IL_t$ : | pass | pass | pass | 4 | 5 | 6 | 7 | 8 |
| $G_t$: | -0,14 | -0,14 | -0,14 | -0,20 | -0,13 | 0,02 | 0,26 | 0,46 |
| $IL_t$ : | pass | pass | pass | pass | 5 | 6 | 7 | 8 |
| $G_t$: | -0,39 | -0,39 | -0,39 | -0,39 | 0,16 | 0,28 | 0,45 | 0,68 |

**Table 4**

The second row shows that it is worthwhile for $T_1$ not to do financial analysis, but to adopt a passive strategy: instead of losing 0,31 he just loses 0,11. With only eight traders the simulated market is very thin and each trader has a considerable impact upon prices. That's why the expected gain/loss of $T_1$ is not zero: if a trader buys, the price will be higher, if he sells, the price will be lower than it would be without him (if we do the same simulation with higher numbers of traders, the expected loss of a single passive trader approaches to zero)!

The following row shows that, under the condition that $T_1$ switched to a random decision making, for $T_2$ it is worthwhile to adopt such a strategy as well. Instead of losing 0,28 he just loses 0,12. The same holds for $T_3$: He is better off losing 0.14 with a passive strategy instead of 0.25 with an active one. But, as easily can be seen, the more traders adopting a passive strategy the smaller their advantage will be: $T_1$ was better off by 0.20, $T_2$ by 0.16, and $T_3$ by 0.11! The more passive traders there are in the market, the more 'noise' they will create; so, taking a free-ride on the research done by others becomes more and more obsolete. $T_4$ is better off with the good old fundamental analysis. If we restrict ourselves to just two different types of decision making, information-based and random-based, the situation showed in the third row could be considered as a Nash-equilibrium: nobody stil has an incentive to change his strategy. Doing a similar analysis with 14 traders, this equilibrium was reached with seven traders deciding by random and seven information-processors (*Schredelseker*, 1997).

In a market which is somewhat less than strong-form-efficient information has not necessarily positive value. If all traders decide rationally, some of them, even if they have considerable information, will not make use of it, but leave their decisions to chance! Note that we speak only about correct information, the recommendation not to use false information would be trivial. Even the information poorly informed traders have, is correct information: If they had to use it in order to estimate the intrinsic value of the security, more would always be better (=more precise) than less. But, as we have seen, the job of a trader in a financial market is not to estimate the intrinsic value, but rather to get on the right side of the market. That is a very different thing! If you have reasons to fear that your information is not clearly above average and of really outstanding quality it is better to ask your dog for a financial decision than to do in on your own.

But, one important question remains open if we accept that for Austrian economists any result has to be grounded on purposive human action. If the market is somewhat inefficient and we have it to do with winners and losers (may their decisions be information-based or random), why do the losers accept being losers? Why don't they continue to play the game? The only possible answer is, that there has to be an incentive that they do so. They have to be better off with losing than with non-participating! This is the case, if and only if the average return payed on risky securities contains a premium for informational disadvantage, an *information premium*. If you admit just two asset classes, a riskfree rate $R$ and a set of risky assets and allow for some badly informed traders, whose expected return in trading the the risky assets is $X$ percent lower than the market average, holds: Even if all traders are strictly risk-neutral, the average expected return of the risky asstes cannot be inferior to $R+X$ in order to keep the losers in the market. You may even go a step further. If there are several risky asstes with different volatilities, their expected return has to be a positive function of volatility. The higher the volatility, the more it pays to be informed and to be rather on the right than on the wrong side of the market; but, accordingly, the bigger will be the disadvantage of the badly informed traders and with that the information premium. Only in markets which are assumed to be strong-form-efficient there is no other reason than riskaversion, explaining why the returns of assets should differ according to their volatility; only in such markets the term ‘equity risk premium’ is correct. But, as far as we know, markets are not strong-form-efficient.

## 4) Conclusions

If we look at the financial markets though the eyeclasses of an Austrian economist, we have to consider at least two things: (1) individuals are heterogeneous with respect to their information and their beliefs, (2) any state of the world you speak about, may it be called an equilibrium or not, has to be the result of purposeful human action. A traditional weakness, however, of Austrian economic thinking has been, that an economy which fulfills these requirements is very complex; thus, modeling it in a closed, analytical manner, is very difficult.

Here simulation may help. It is a very simple and powerful methodology and it allows us to address topics we cannot resolve with standard economic tools. Allow me to let it open why I adopted this technique: may be that the problems are really to complex to be solved analytically or I’m simply too stupid to do it.

What seems sure, however, is: There has to be written a new textbook in finance. A book which is in accordance with practice (academic textbooks are not) and in accordance with logic (practitioner’s textbooks are not). We are convinced it has to be grounded upon an Austrian economic approach: allowing for diverse information, considering the reflexivity of market decisions (opposed to a simple decision-against-nature-approach), and avoiding simple equilibrium solutions which necessarily rule out any incentive for human action and thus for any market dynamics.

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