

## Behavioral Anatomy of the Financial Crisis

by

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### Abstract

In view of the challenges facing the neoclassical paradigm of economy, behavioral finance which offers an alternative way of looking at the processes taking place in capital markets is growing in importance. By referring to psychology and pointing out the imperfections of a human mind, it reveals mistakes committed by both individual and professional investors. In the 2008 financial crisis, behavioral inclinations affected not only the investors but also market-supporting entities and regulatory institutions. This article presents a brief macroeconomic background and then focuses on the behavioral aspects of the recent market turbulence. The findings of the paper may help avoid psychological traps associated with investing and are important for both investors and regulatory institutions responsible for securing the stability of financial systems.

*Keywords:* behavioral finance, psychology of capital markets, financial crisis, inclinations of investors

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### Introduction

The year 2008 abounded with financial markets events on a scale and scope often compared to the Great Depression that took place in the 1930s. Global problems in the financial sector, the loss of liquidity by institutions considered credible, the drastic devaluation of assets, and a significant growth in the volatility of the stock and commodity markets all give rise to questions that are very often difficult to answer with neoclassical financial theory.

The direct reason for the 2008 financial crisis was the burst of the price bubble in the U.S. real estate market. The collapse of the real estate market caused difficulties related to the financial liquidity of financial institutions operating in the mortgage market. An increasing number of financial institutions were forced to increase reserves due to the drop in the value of mortgage-based assets. The scale and range of trouble were magnified because of the popularity of derivative instruments and a high degree of financial leverage. The capital market reacted with a rapid price drop in the stocks of the financial sector. A while later, the crisis spread onto the real economy and on a global scale.

First, this paper indicates briefly the macroeconomic and fundamental background of the 2008 market turbulences. Then, the discussion focuses on those human behavioral aspects that demonstrated themselves on that occasion and may have contributed to the financial crisis. The findings of the paper may help avoid psychological traps associated with investing and are important both for investors and for regulatory institutions responsible for securing the stability of financial systems.

## **Macroeconomic Background**

The crisis can be associated with a number of macroeconomic issues and growing imbalances in the global economy. During the period 1991-2005, the U.S. economy was developing faster than the entire world economy collectively and on average about three times faster per annum than the economies of the 15 states of the then European Union. The structure of the sector-specific sources of growth was dominated by household demand (current consumption and housing) whereas the demand of the business sector and that of governmental agencies ranked much lower.

One of the material ways in which the U.S. economy influenced the world economy was through its high import demand which led to an increasingly unfavorable external imbalance in trade relations. Such an imbalance always appears when consumption exceeds production in a country. Additionally, it was fostered by the long-term policy of China aimed at artificially maintaining the undervalued exchange rate of the RMB, the Chinese currency (Yuan). The deepening trade deficit of the U.S., the Chinese exchange rate policy, and, more particularly, the interventions in the foreign exchange market aimed at preventing the RMB appreciation resulted in the fact that significant foreign exchange reserves were accumulated in China, denominated mainly in U.S. dollars.

Apart from the increasing external account deficit, the U.S. economy was also threatened by a growing internal budget deficit. This budget deficit was caused not only by relatively lower revenues resulting from a temporary economic slowdown directly after the dotcom bubble burst and after the terrorist attacks of 9/11, but also by tax cuts introduced by G.W. Bush on two separate occasions. In addition, budget expenses were on a significant rise, partially due to financing the war in Iraq and the war on terror. Lewis (2004) and Chinn (2005) had warned against the impossibility of maintaining such a long-term twin deficit long before the crisis occurred.

Financing the American budget deficit required vast sales of treasury bills. Nevertheless, investors accepted low yields on American debt because of the credibility of the U.S. Treasury Department. This was mainly the case with Asian investors who, as a result of the lessons learned from the Asian crisis of 1997 and their culture-conditioned prudence, preferred to invest foreign exchange surpluses in U.S. treasury securities. Hence, it may generally be said that the capital that was flowing out of the United States to Asia as the result of the trade imbalance was coming back to the United States, financing its debt relatively cheaply. Warnock and Warnock (2005) estimated that the inflow of official foreign capital to the United States decreased the yield of 10-year treasury bills by about 150 basis points.

The expansive fiscal policy of the U.S. government had for a long time been (and still is) accompanied by the low interest rate Fed policy. The interest rates in the United States were significantly reduced after the dotcom bubble burst in 2000/2001. The reduction was to ensure the economy's soft landing after massive numbers of Americans lost their savings in the dotcom mania. The low interest rate policy was additionally reinforced by the 9/11 attacks on the World Trade Center. To avoid the negative economic consequences that could arise from the anxiety related to terrorist attacks, decisions were made to maintain cheap financing.

On the basis of a combination of the above-mentioned relaxed fiscal policy and low interest rates, the United States created a boom in the economy, much higher than that of the majority of other developed countries. However, the boom was mainly based on consumer demand and on the expenditure on housing which had been flourishing especially since 2006. The American society, with its traditionally low-saving tendencies, took advantage of the benefits of cheap money and continued to go deeper and deeper into debt. Life on credit became standard.

When the interest rates started rising again and reached their highest level in 2006, many households faced problems with debt servicing. At first, the problem affected Americans with the lowest credit worthiness, who had nevertheless been granted risky mortgages. Financial institutions were even willing to lend to people who could not demonstrate permanent employment, regular income, or any material assets. Such persons were referred to as NINJA (No Income No Job or Assets). This situation was based on securing the loans on properties whose prices had continued to grow during the previous years.

However, in the end, the property prices began to fall, which also meant that the value of mortgages granted by banks was also decreasing. In case of a borrower's insolvency, banks could not fully recover the extended loans and had to write off reserves for bad or uncollectible debt. To obtain the capital required to increase its lending, banks very often borrowed money from other institutions or issued special securities based on the portfolio of the previously extended mortgages. At that point, they too were in danger of insolvency because borrowers found it difficult to make their current mortgage payments. Banks suddenly had trouble with servicing their own indebtedness which, to a large extent, was to be synchronized with the payments received from customers.

Another factor was the dynamic development of the derivatives market. Derivatives have been more and more frequently used for speculative purposes rather than risk hedging, which was their primary purpose. The volume of trade in the derivatives markets became even 10 times higher than the volume in the markets of their underlying assets. There were two primary reasons underlying this effect. First, the development of the derivatives market was driven by a chase after profits accompanied by a simultaneous growing tolerance for risk. Various derivatives with built-in leverage mechanism were needed, which, though highly risky, were able to generate the high rates of return expected by investors. Second, a high supply of cheap money facilitated asset monetarization, and new derivative products made it possible to trade new asset categories in the financial markets. The most spectacular and, as it later turned out, the most fateful type of asset monetarization was the creation of derivatives whose value was associated with a mortgage portfolio.

Two kinds of financial products are of particular interest in this case: collateralized debt obligations (CDOs) and the so-called credit risk swaps (CRS). Issuing CDOs helped credit institutions acquire new lending funds from the market on the basis of their previous lending portfolio. It was assumed that the funds to service CDOs; that is, to cover current coupon payments and to buy out the bonds in the future, would come from the cash flowing from the underlying mortgages. The bonds based on diversified and collateralized mortgage portfolios were placed in the market as relatively safe instruments. They constituted a source of cheap capital for lenders and encouraged them to continue credit expansion.

Alternatively, a CRS made it possible to transfer the risk of borrowers' insolvency within a given claim portfolio from a borrower onto another entity. The ease with which new lending funds could be obtained and the possibility of transferring the risk over to another entity prompted lending institutions to accept applications from clients with increasingly low credit scores. Lenders were interested in maximizing their credit sales, as they earned profits primarily on credit service commissions and on the differences between the credit cost and their own financing cost.

The development of the global derivatives market and, in particular, the development of CRS contracts, the securitization of credit portfolios, and issuing CDOs on the basis of such portfolios did not cause the crisis directly but determined its scale. These two transaction types were among the factors contributing to the fact that mortgage-related risk became widespread throughout the entire financial sector, both in the United States and globally, even among financial institutions that did not have operations in the United States at all or which did not offer financing directly in the mortgage market. Mortgage-based derivatives became the main cause of the unbelievably strong domino effect that characterized this crisis.

The last component worth mentioning with regard to the genesis of the global crisis is the pricing of commodities, particularly crude oil prices. From the beginning of 2002, there was a dynamic price growth in commodity markets which reached its peak in mid-2008. Initially, it seemed that the growth was justified in the context of an intensified demand for commodities from fast-developing economies. However, the growth dynamics of commodity prices was much higher than the accompanying increase in global demand. A significant portion of raw material appreciation was caused by investors' speculations. They started treating crude oil or copper, for example, as ordinary financial assets they could invest in with their surpluses of cheap money and the expected further growth in demand; hence, prices increased.

In 2006, oil exporting countries became the biggest source of capital in the world. An inflow of petrodollars resulted both from a rapid increase in oil prices and from the rising volumes of oil export. Contrary to classic foreign exchange reserves of central banks, which are usually conservatively in-

vested in safe governmental debt securities, petrodollars also funded higher-risk investment in various segments of the capital market. A significant portion of that capital found its way to the world markets through independent investment funds, governmental agencies, state-controlled investment companies, and individual wealthy investors. The McKinsey Global Institute (2008) estimated that in 2006, only 200 billion petrodollars went towards global stock markets, 100 billion USD were invested in debt securities, and about 40 billion USD were fed into private equity funds. The capital was mostly allocated in the United States and Europe, which contributed not only to the drop in profitability of debt securities, but also to the reduced cost of equity and to maintaining favorable trading on stock exchanges and in the commercial properties market.

## **Behavioral and Psychological Biases**

### **Greed of Investors and Managers**

According to the behavioral portfolio theory, people are guided by two kinds of emotions when investing: fear and greed (Shefrin & Statman, 2000). Because of the fear of a drop in consumption below their existing standard of living, they are inclined to keep a portion of their savings in very safe securities designed mostly to preserve the real value of money in time (e.g. treasury bonds). Greed, in turn, arouses hope for a rapid growth in consumption and a fast jump to a higher standard of living. Because of greed, investors fail to properly diversify their investment and accept often unnecessary high risk in the hope of gaining high profits, often betting on investments in selected financial instruments as if on lottery numbers.

Including both very safe and high risk instruments in a portfolio without consideration for the correlation between the two is closely related to the narrow framing effect. Narrow framing consists in analyzing problems in separation from a broader context or even in an extremely isolated manner (Kahneman & Lovallo, 1993; Kahneman & Tversky, 1984; Read, Loewenstein, & Rabin, 1999).

A particular case of narrow framing takes the form of mental accounting; that is, an isolated perception of aspects of decisions made with regard to finances (Thaler, 1985, 1990, 1999). In their consciousness, people create separate accounts for various types of expenses or income, very often associating specific categories of proceeds and expenditures with each. For example, it is easier for them to spend money won in a lottery whereas they will give their hard-earned savings more consideration, although the economic value of a dollar won in a lottery is objectively the same as the value of a dollar earned at work. They will put aside emergency savings in one account, savings to purchase an apartment will be banked in another account, but, simultaneously, a car loan will be paid from yet another account. From a financial point of view, it is irrational to simultaneously work with low-interest deposits, yet draw payments from more expensive accounts. From a psychological point of view, such a choice could seem justified, since savings are usually for a different purpose (they are registered in a separate account) from the purpose for which a loan was taken.

Shefrin & Statman (2000) refer mental accounting to their behavioral portfolio theory. They argue that because of this effect, improperly diversified investment portfolios are created and kept, comprising separately registered safe investment for incidental needs and high-risk investment focused on earning the highest possible profits that would make it possible to rapidly transfer oneself onto a higher consumption level.

During a period of long-lasting prosperity, the fear of a drop in consumption weakens; consequently, an increasingly small portion of people's investment is mentally accounted as security for incidental needs. Greed comes forward and motivates people to make increasingly risky investments. It seems that greed was the main driving factor of investors' behaviors at least several years before the financial crisis occurred. Encouraged by the long-lasting market boom, investors exerted pressure on both corporate managers and on investment fund managers, demanding high returns. In turn, corporate and asset managers adopted more and more risky business and financial strategies to meet these expectations.

The main strategy that made it possible to ensure return on equity (ROE) at a level significantly higher than that resulting from the natural pace of economic development was to apply financial leverage to a greater and greater extent. In the case of corporations, this strategy was most frequently

reflected in an increased share of debt in the financing of operations whereas financial asset managers increasingly used derivatives along with traditional credit lines. It is characteristic of most derivative transactions that the entire amount corresponding to the value of a given instrument is not required to be paid when entering into the transaction: it suffices to pay the required margin. In other words, when using derivatives, investors can enter into high-value transactions although they have to deposit only a fraction of that value.

The high share of debt in corporate financing makes it possible to obtain a return on equity (ROE) significantly exceeding the total return on assets (ROA). Financial risk related to the debt actually increases, but in times of cheap and commonly available capital, investors seemed not to notice that risk. As a result, high profitability of equity was one of the factors that drove and seemingly fundamentally justified the high market price of shares.

Asset managers also used increasingly complex derivatives. Because of financial leverage, a rise in the price of underlying assets by several percentage points often made it possible to obtain a double digit return on investment in derivatives. Unfortunately, many people forgot that this mechanism works both ways: if the value of underlying assets falls, losses on investment in derivatives can also be many times higher.

The greed that pushed investors and managers towards riskier and riskier investment strategies did not directly contribute to the financial crisis whose sources should be sought in the global macroeconomic imbalance; rather, it determined its scale, arising from the material leveraging of business operations and involvement in derivatives.

### **Underestimation of Risk**

As greed blinded investors and managers, risk was often forgotten in the midst of the chase after higher and higher rates of return. Several strong behavioral inclinations, mostly related to overconfidence, were also conducive to underestimating risk (Szyszka, 2010). The literature distinguishes between four general manifestations of overconfidence: above-average effect, calibration effect, illusion of control, and unrealistic optimism (Barber & Odean, 2000; Glaser & Weber, 2007; Odean 1998a).

First, when making assessments and developing convictions about their surrounding reality, people tend to overestimate their knowledge and skills. They believe that they are better in a given field than the average person. In various polls, 60% to 90% of respondents claimed that they had above-average driving ability, a sense of humor greater than others, or that their chances of going down with a specific disease were lower than average, that they were less likely than average to become a victim of a robbery, and so on (Barberis & Thaler, 2003; Svenson, 1981; Weinstein, 1980). However, if the entire human population was to be split in the middle according to each of these criteria, the number of those who are better than average could not be higher than 50%. Hence, a significant number of people overestimate their predispositions.

Overconfidence is also reflected in the calibration effect (Keren, 1991; Lichtenstein, Fischhoff, & Phillips, 1982; Yates, 1990). When asked for information or estimates that are not precise but stated within a certain range of confidence, people very often indicate overconfidence with regard to the breadth of knowledge they possess. Alpert and Raiffa (1982) demonstrated that responses given by respondents with an alleged 98% certainty actually turn out to be correct only in about 60% of cases. People also wrongly assess the probability of occurrence of events, usually assessing the chances of occurrence of a given incident too strongly. Fischhoff, Slovic, and Lichtenstein (1977) showed that events that respondents claimed would certainly occur in reality took place in only 80% of cases on average whereas events classified as impossible occurred in 20% of cases.

De Bondt (1998) confirmed the existence of the calibration error among stock exchange investors. In certain cases, expertise or experience are helpful for the right calibration (Oskamp, 1962; Sieber, 1974; however, experts who are aware of their know-how in a given field may often fall into the trap of overconfidence to a much higher degree than nonexperts (Lichtenstein & Fischhoff, 1977). Overconfidence is a characteristic of representatives of numerous professions, including physicians (Christensen-

Szalanski & Bushyhead, 1981), psychologists (Oskamp, 1982; Taft, 1955), engineers (Kidd, 1970), negotiators (Neale & Bazerman, 1990), and financial analysts (von Holstein, 1972).

Professionals are exposed to a particular risk of overconfidence if a specific task is vague and does not carry unambiguous premises that suggest the right solution (Griffin & Tversky, 1992). In such circumstances, they often follow patterns and stereotypes instead of processing the information and clarifying the problem. It is astonishing that having made the wrong assessment once, when subsequent information appears that gradually clarifies the problem, experts become increasingly convinced that they have examined the case properly, and they tend to not change their initial opinion. The conviction of being right increases despite the inflow of an increasing amount of data that indicate the contrary (Oskamp, 1982).

Confidence grows with the degree of difficulty of the tasks and if there are no prompt signals from the environment that confirm or negate previous information or previously made decisions (Einhorn, 1980; Griffin & Tversky, 1992; Lichtenstein & Fischhoff, 1977; Yates, 1990). People who are asked to predict how specific values are going to develop in the long run show more confidence than those asked for predictions in the short term (De Bondt, 1998). Gender is also a factor in the degree of people's self-confidence. Usually, men are more confident than women, although differences in this respect also depend on whether a specific task is perceived as a man's or woman's domain (Deaux & Emswiler, 1974; Lenney, 1977; Lundenberg, Fox, & Puncchohar, 1994).

Overconfidence also manifests itself in the illusion of control: people are frequently convinced that their actions may positively affect totally random incidents. For example, lottery players place a higher value on the tickets for which they themselves picked the numbers than on the tickets filled in by the quick-pick lottery machine (Langer, 1975).

Overconfidence also leads to ungrounded optimism and unrealistic wishful thinking. Various kinds of planning errors are also signs of excessive optimism. Buehler, Griffin and Ross (2002) have given numerous examples of the improper estimation of the time required to complete planned assignments. The problem concerns both plans related to large-scale public investment (e.g. construction of buildings, infrastructural projects) and matters of everyday life (e.g. shopping, car washing, writing another article). Moreover, it seems that people do not learn from previous mistakes. Although aware that previous forecasts were very often too optimistic, they still unrealistically believe that, next time, their predictions will actually prove to be accurate.

Montgomery (1997) collected macroeconomic forecasts about inflation, GDP growth, unemployment, and so on, estimated by various experts over many years. Then, he performed an ex post comparison of the forecasts with the values actually observed. Montgomery showed that the forecasts of unfavorable effects (e.g. inflation, unemployment) were systematically underestimated whereas predictions of positive effects were generally overestimated. Olsen (1997) similarly demonstrated excessive optimism among financial analysts.

Overconfidence is supported by the self-attribution bias which consists in people attributing successes (even random ones) to themselves and their capabilities while explaining failures by independent factors, such as bad luck or others' mistakes (Taylor & Brown, 1988). Lack of objectivity in the assessment of successes and failures limits people's ability to learn from their own mistakes and enables them to permanently display overconfidence.

When analyzing their convictions, people not only react too slowly to new information but, often, they show signs of what is known as the confirmation bias: they tend to seek information that would confirm their previously adopted hypothesis and simultaneously avoid confrontation with facts that could contradict their existing opinion or interfere with their previously adopted approach to a specific problem (Lord, Lepper, & Ross, 1979; Wason, 1966). When assessing the true cause-effect relationship between two variables (e.g. between the application of a specific investment strategy and the achieved results), people focus on cases where both variables were observed simultaneously (e.g. a specific rule was applied, and above-average outcome was achieved), and, simultaneously, they seem not to notice examples of situations in which only one variable occurred and the other did not (e.g. a given strategy did not bring about the expected outcome, or extraordinary results were achieved without the specific

rule being applied). As a result of this selective approach, decision makers may develop the illusion of validity; that is, cling to wrong convictions or even enforce them, demonstrating overconfidence at the same time (Einhorn & Hogarth, 1978).

In the years preceding the crisis, overconfidence and unrealistic optimism led to the underestimation of risk, and the confirmation bias prevented people from noticing certain warning signals that could have eroded investors' faith in the never-ending bull market. During the relatively long period of market prosperity, investors became used to easy and high profits. As a result of the self-attribution effect, many market players attributed the gained profits primarily to their own skills rather than to the general market situation. Investment successes intensified their confidence and encouraged them to take even higher risks.

Making an extrapolation error consists in attaching too much weight to past trends, particularly those observed during a relatively short period of time and in inadequately extending them onto subsequent future periods. An example of the extrapolation error is assuming the same sales or profits dynamics of a given corporation in long-term financial forecasts as that observed during the last several reporting periods, often without consideration for extraordinary events that could have affected the sales and profits levels only temporarily during the recent periods. Analysts should remember that an Excel spreadsheet is only a tool for forecast development and that it accepts all dynamic values that are entered into it. Extending a forecast onto several future periods with the assumption of a constant high pace of growth may lead to absurd results. Psychological grounds for the extrapolation error are related to the representativeness heuristic and, in particular, its variation referred to as the short-series bias which consists in premature conclusions and generalizing patterns from a limited amount of observations (Gilovich, Vallone, & Tversky, 1985).

During the last bull market period, people commonly committed the extrapolation error, claiming that since the prices had been growing for a long time, the same trend was expected to continue. A claim was often heard that some types of investment simply could not bring losses. This was the case for the property market where prices had been continuously growing for several decades. The situation was similar at the last stage of the economic boom in the commodity market. Many analysts argued publicly that the price rally was justified by the intensified demand on the part of the dynamically developing Asian economies and that a price drop could not be expected in view of the limited worldwide resources.

Underestimation of risk was also fostered by people's tendency to treat unlikely things as if they were completely impossible and to treat highly probable events as if these were certain to occur. Hence, no one accepted the notion that an unfortunate coincidence of several macroeconomic factors may ultimately lead to a sequence of negative events that individually seemed very unlikely. Similarly, people played down the risk of failure of positive developments that were assessed as highly probable and treated almost as a certainty. The reality showed that the coincidence of such almost impossible situations not only came true but also proved to have a colossal impact on the entire global economy.

Fischhoff et al. (1977) empirically documented people's inclination to exclude the possibility of occurrence of unlikely developments and, simultaneously, to treat highly probable scenarios as certain. Kahneman and Tversky (1979) theoretically accounted for this phenomenon in their prospect theory. According to the prospect theory, the total assessment of utility of a specific decision-making scenario is affected by two functions that are subjective for each decision maker: the S-shaped value function and the weighting function. Kahneman and Tversky argued that one of the properties of the weighing function is its discontinuity for the probability values close to zero and close to one. Figure 1 shows that the function assigns the value of zero to very low probability arguments, and the probability arguments close to one are assigned the value of one. This clearly demonstrates the investors' inclination to treat unlikely events as impossible and highly likely ones as absolutely certain.

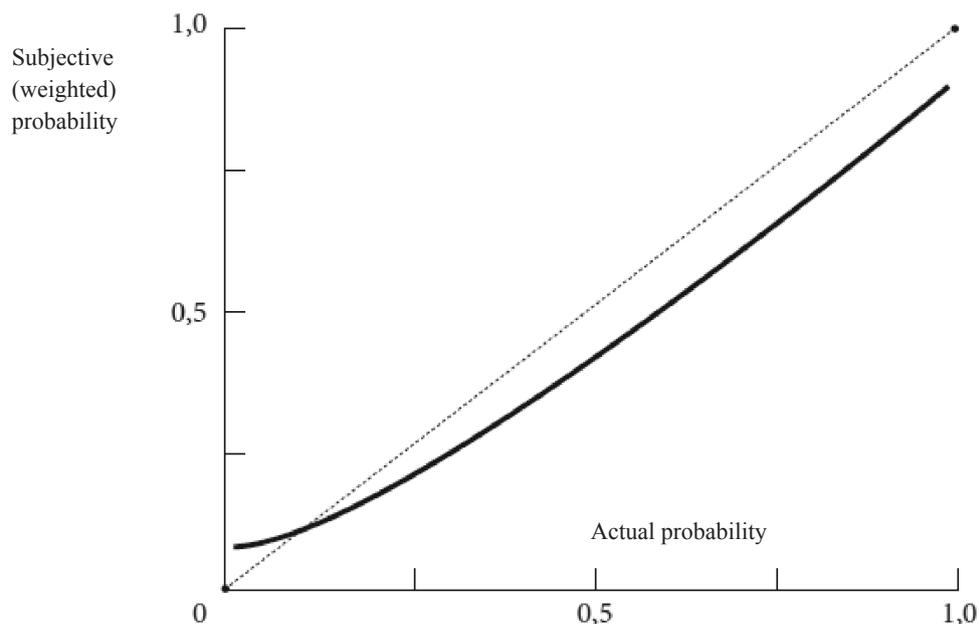


Figure 1. The probability weighting function.

Note. The actual probability is subjectively weighted and transformed into subjective probability. Events with high actual probability are treated as certain. Events with low probability are over-weighted or treated as impossible. The probability of events in-between is generally understated. Adapted from "Prospect Theory: An Analysis of Decision Under Risk," by D. Kahneman and A. Tversky, 1979, *Econometrica*, 47(2), p. 273.

## Herding

At the time of the rapid growth of property prices followed by the price rally in the stock and commodity markets, there clearly was a speculative bubble, significantly affected by the market participants' herd behavior. Herding may occur among both irrational and rational investors (Bikhchandani & Sharma, 2000; Devenow & Welch, 1996; Hirshleifer & Teoh, 2003). The analysis of herding constitutes one of the key elements of behavioral finance since only the mistakes of investors at the aggregate level may be reflected in the prices of assets. The behavior of one individual investor does not affect market prices at all. If investors did not act collectively and did not commit similar psychological mistakes at the same time, their actions would neutralize each other to a great extent, and the market would remain efficient.

During the period of the bull market, irrational players made decisions concerning the purchase of specific assets not on the basis of fundamental information but rather on the basis of observations of earlier increases in prices and by imitating the behaviors of others. They would decide to invest, expecting further increases and ignoring the fact that the assets were already relatively expensive. Their motivation and way of thinking may be more or less recreated as follows: the price of assets goes up because people invest in them. Since others are buying, they are certainly assuming that the prices will rise even higher and that profits can be made. Therefore, it is worth following the market and joining the game that bets on the continuation of the growth trend. This mechanism is referred to in the literature as feedback trading.

A relatively large group of similarly thinking investors triggered the mechanism to start working as a self-fulfilling prophecy. More and more new investors were joining the upward spiral, generating yet another demand impulse and raising prices to record levels. All this activity was fostered by the growing market euphoria and by the media publicizing a spectacular rise in prices and bullish comments by experts.

Cutler, Poterba, & Summers (1990) and DeLong et al. (1990) presented feedback trading models describing such behavior mechanisms as those of irrational players. Additionally, DeLong et al. (1990) suggested that rational players can anticipate the presence of feedback trading among irrational inves-

tors and deliberately destabilize the prices. In other words, by anticipating the behavior of irrational players, rational speculators could decide in advance to purchase a higher number of assets than would be dictated solely on fundamental grounds. Simultaneously, they would hope that later, when the herding of irrational investors results in an increasing divergence from the true asset value, they would have enough time to sell the assets with profit.

Very favorable forecasts of analysts and the comments of professional market players were also not without importance, although it is difficult to judge whether they gave in to the irrational mania or whether, in their own opinion, they were acting rationally. For example, Trueman (1994) argued that financial analysts, acting rationally in their own opinion, may aspire to publish forecasts and recommendations concurring with other analysts' predictions. Even rational professionals may tend to engage in herding. Their actions may be based on premises related to the fear of loss of reputation as the result of making claims that contradict the general market consensus (Sharfstein & Stein, 1990) or on specific remuneration or evaluation terms (e.g. bonuses on inflow of new money to the funds under their management, bonuses on achieved investment results, benchmarking of achieved results). Generally, a hypothesis may be formulated that during the bull market, professionals were much more motivated to undertake actions focused on the continuing price growth rather than bet on decreases, even if they were aware of the fact that prices of asset categories exceeded the levels that could be justified on fundamental grounds.

Finally, it is worth mentioning that herding resulting in asset mispricing could have also theoretically occurred even if all investors maintained complete rationality, as the result of the so-called information cascades. Banerjee (1992) and Bikhchandani, Hirshleifer & Welch (1992) presented models in which rational decision makers act in risky circumstances, apply the Bayes' rule correctly, and make decisions based on their own information and information signals deduced from the behaviors of others. Each investor observes a private information signal of quality, good (G) or bad (B), which, with  $p$  probability, indicates the positive or negative future development of the situation and either encourages or discourages the investment. Simultaneously, each investor observes the decisions of other investors but is not aware of their private information.

The first investor makes the decision based on his own signal. For example, the first investor observed (G) and invested. The second investor, watching this action, deduces that the first decision maker's private information must have been (G). If the private signal of the second investor is also (G), there is no conflict of information, and the second investor is even more convinced that he should invest. However, if the private signal of the second investor is (B), and both signals suggest the probability of occurrence of a specific scenario is the same, then, applying the Bayes' rule, the second investor will conclude that the probability of the positive or negative development of the situation is the same. If he or she decides to invest, the third investor, having at his disposal the signals arising from the behaviors of the first and second investor, will conclude that the first investor observed (G) and the second investor observed (G) with a higher probability than (B). The application of the Bayes' rule by the third investor in view of the two (G) signals arising from the observation of other investors and from one private signal will always encourage the investor to invest, regardless of the nature of the private signal observed by the third investor. Each subsequent observer will attach greater importance to the information indicated by the behaviors of other market players than to his own private signals. Hence, starting from the third investor, there is an information cascade.

The lesser the amount and precision of the information available to the decision makers, the greater their tendency will be to ignore private signals and to copy the behaviors of other players. The information cascade effect will not occur if the precision of private signals (i.e. the probability of occurrence of a specific scenario in consideration of the possessed knowledge) is much higher than the quality of the information coming from the behaviors of others. Thus, it appears that information cascades will occur much more often in the market segments where the availability of credible information is lower (e.g. small-cap stocks that analysts are less interested in or low-transparency corporations with high agency costs that do not apply corporate governance).

Accounting for the costs of acquisition and analysis of own information leads to the conclusion that the higher the costs, the more an individual decision maker tends to rely on the signals arising from the observation of the behaviors of other market players. Additionally, dispelling the assumption

of complete rationality of investors leads to the conclusion that the tendency to imitate the behavior of others will grow proportionally to the level of difficulty that a decision maker will have in processing all available information independently. In this context, the increase in complexity and degree of complication of available financial instruments, particularly in the derivatives market, could encourage the occurrence of information cascades.

Lee (1998) presented a model in which large quantities of cumulated private information, previously blocked as the result of a cascade, could suddenly appear in the market as a reaction to a relatively insignificant event, creating an unexpected information avalanche and leading to sudden price changes. The model, although developed a long time ago, seems to fit well with the sudden market breakdown that followed the burst of the Internet bubble in 2000 and to accurately describe the events that occurred in the markets in 2008.

### **Limited Rationality and Mistake Rating Agencies**

During the previous several-year period of global prosperity, there was a spectacular development of the derivatives market, with regard to not only the increasing volume of this type of transactions but also the degree of their complexity. Frequently, they constituted a complex and nonobvious combination of many classic derivatives. At the same time, the clarity of the underlying assets that constituted the basis for calculating a derivative's value was decreasing. Increasingly, the value of a derivative depended on a specific industry index with a complicated structure and ambiguous rules of inclusion or exclusion of components and their weights. Derivatives for which other derivatives acted as underlying assets were often also created. Securitized mortgage portfolios increasingly constituted a mixture of different quality debts, very difficult to evaluate by an external investor.

All these market facets led to a situation in which it was not clear what the potential pay-off structure was, and what factors actually affected a derivative's real value. Obviously, the human brain's perception ability and the ability to process numerous variables are limited (Gilovich, Griffin & Kahneman, 2002; Kahneman, Slovic, & Tversky, 1982; Kahneman & Tversky, 2000). Therefore, even professional investors had to apply specific heuristics and simplifications in evaluating individual financial products to a greater and greater degree. Many of them unquestioningly accepted recommendations and evaluations of rating agencies. It was also common to rely on the institutions that construed and defined parameters newly created indexes which constituted the basis for evaluating derivatives.

The financial crisis confirmed the failure of rating agencies. They committed a number of mistakes, particularly with regard to the assessment of risk of mortgage-based financial products. Many of these mistakes might be explained on behavioral grounds.

By nature, mortgages are long-term liabilities. Meanwhile, to evaluate the worthiness of mortgage debt portfolios, rating agencies applied statistical analysis to a relatively short historical sample. While assessing the risk, the agencies wrongly concluded that since a small percentage of cases of failure to meet obligations had been observed in a given category of borrowers, the situation was going to be similar during the entire lending period. Rating agencies thus committed a type of short-series error.

Rating agencies also believed that major diversification of debt within a given portfolio could practically eliminate the insolvency risk of an individual borrower. Thus, a certain analogy to the Markowitz (1952) portfolio theory seems to have existed. Just as in a well diversified portfolio of stocks it is possible to eliminate the unique nonsystematic risk of an individual asset, in the case of a debt portfolio, it was assumed that the possible insolvency of one of several hundred borrowers would not have any material impact on the total value of a specific group of mortgages. Consequently, CDOs issued on the basis of securitized debt portfolios were assessed as safe and rated high.

At the same time, rating agencies committed the mistake of underestimating the systematic risk, as reflected in the fact that a major number of borrowers could simultaneously, as the result of the same factors, find themselves in financial trouble and stop paying off their liabilities. When the unexpected system risk factors affected a relatively numerous group of borrowers, this event certainly had an impact on the total value of even a well diversified mortgage portfolio. A coincidence of negative events that could materially affect the condition of numerous borrowers and shake the entire system was assessed

as very unlikely or simply impossible in the minds of many. Rating agencies thus fell victim to a psychological inclination consisting in treating events that are very unlikely as if they were not to take place at all, the previously mentioned discontinuity of the weighing function for low values of probability arguments in the prospect theory of Kahneman and Tversky (1979).

In their estimations, rating agencies also fell victim to the extrapolation error. Even if, while assessing the instruments issued on the basis of debt portfolios, they assumed that a certain percentage of borrowers could be insolvent (the estimation of that value was still understated as the result of the above-mentioned short series error effect), the final assessment of the portfolio quality was still based on the fact that the debt was secured by mortgages. It was commonly believed that a mortgage security is highly credible, as property prices could not go down. Therefore, for the purposes of risk assessment, it was assumed that, in the worst case scenario, temporary liquidity difficulties may occur if borrowers stopped making payments (although that element was to be eliminated by the debt diversification). Practically, however, the possibility of the ultimate loss of value of a portion of the debt was not assumed, since in the end it would always be possible to reach out to an actual security which the mortgage seemed to offer. The error of extrapolation of a long-term growth trend contributed to a belief that property prices would not decrease in the future.

### **Fear as Reason for Undervaluation**

Fear and greed are two types of emotions that have opposing effects on investors' behavior. Depending on whether fear dominates or greed wins at a given moment, there is an increase or decline in risk aversion. In times of a bear market, it is fear that prevails among the investors. During the initial phase of the 2008 financial crisis, fear turned into panic which intensified asset depreciation and fueled its extraordinary pace. Later, a slowdown in price drops followed several sellout waves, but the fear among investors with bitter experiences remained.

Fear caused an inflow of capital to the categories of assets that are commonly considered very safe although not high-profit yielding (such as treasury bills and safe bonds, gold) and an outflow of funds from more risky markets, including naturally the stock market. During certain periods, when the credibility of American banks was particularly strained, and the market was dominated by the fear of bankruptcy, a particular economic paradox even occurred, whereby yields for some of the American short-term treasury instruments were indicating negative values. In other words, investors were willing to buy securities guaranteed by the U.S. Fed, even assuming a slight loss, only to be able to safely invest their capital in these assets.

Kahneman and Tversky's (1979) prospect theory claims that decision makers show risk aversion when they make decisions regarding profits (e.g. whether to keep or sell an asset that has yielded profits since it was purchased), whereas with regard to losses (whether to keep or sell an asset whose price has dropped since it was purchased), they tend to show aversion to realize losses; in other words, a tendency to take further risk. The different approach to risk with regard to profits and losses, combined with the previously mentioned mental accounting effect, as the result of which investors mentally account their earned profits and incurred losses separately, is reflected in a higher tendency to keep the assets whose prices decreased since they were purchased in the portfolio rather than the stocks which, when sold, would generate capital gains. Shefrin and Statman (1985) called this the disposition effect, as shown in Figure 2.

Subsequent studies by Odean (1998b), Barber & Odean (2000), and Dhar & Zhu (2002) on a group of individual American investors confirmed the effect. Later, Grinblatt & Keloharju (2001) documented a similar effect in Finland, and Shapira & Venezia (2001) did the same in Israel. Ranguelova (2001) showed that the disposition effect is particularly visible in the case of the stock of low-capitalization corporations. The majority of the studies mentioned above analyzed data originating directly from broker accounts of individual investors, which made it possible to directly track the changes in their investment portfolios. Kaustia (2004) and Szyszka & Zielonka (2007) documented the existence of the disposition effect on the aggregated market level. Weber & Cramerer (1998) also confirmed the occurrence of that effect in controlled experiments simulating a market situation. The effect was identified among professional investors to a lesser degree, although Garvey & Murphy (2004) presented evidence of the disposition effect among a group of professional and very active market players.

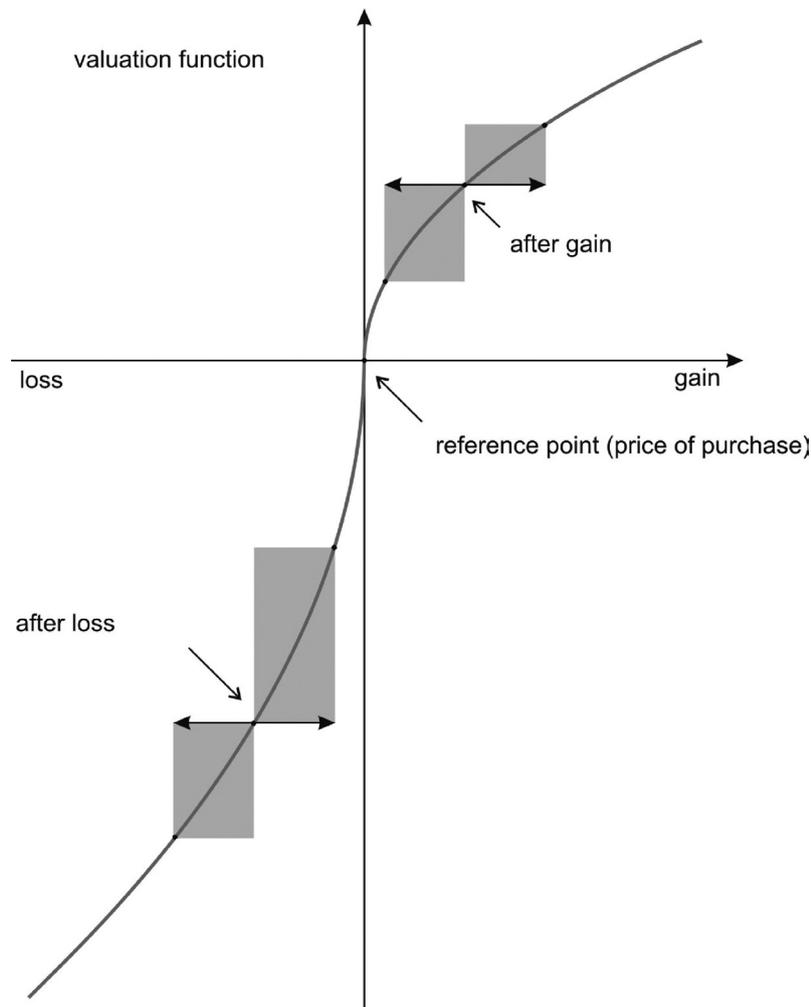


Figure 2. The disposition effect.

*Note.* The relative utility of the expected price increase and decrease differs. In the case of gain, the relative utility of the expected price increase is lower than the relative utility of the expected price decrease. In the case of loss, the relative utility of the expected price increase is higher than the relative utility of the expected price decrease. Adapted from “The disposition effect demonstrated on IPO trading volume” by A. Szyszka and P. Zielonka ICFI Journal of Behavioral Finance, 4(3), 2007, p. 41.

The disposition effect can often help explain the existence of short-term persistence of rates of return and the effectiveness of the so-called momentum strategy (Grinblatt & Han, 2005; Jegadeesh & Titman, 1993, 2002). In particular, aversion to realize losses may result in periodical limitation of supply and cause the fundamentally bad information to be reflected relatively slowly and gradually in the asset prices. Under normal circumstances in a relatively stable market, investors whose stocks went down would usually hope for the prices to go back up and are willing to wait rather than immediately sell the loss-incurring items. As a consequence, the market’s reaction to bad news is often spread over time, and the price drops are gentler.

However, it seems that during the 2008 financial crisis, the disposition effect gave way to a panic-driven sellout. This hypothesis has not been precisely verified empirically, but it is supported by the scale and pace of price drops. Investors’ emotions were dominated by fear and higher risk aversion which prompted them to sell value-losing securities as fast as possible; and that phenomenon added impetus to the drop spiral.

The panic phase was followed by the phase of stagnation, during which fear prevented investors from returning to the stock market even though valuations of numerous corporations had depreciated and could seem attractive. The second phase of a bear market typically witnesses not so much rapid

price drops as, rather, the gradual further decline of stock prices, interrupted from time to time by timid attempts at bouncing back. The characteristic feature of this phase is the relatively low volume of trading. Those investors who have managed to wait through the panic period and do not have to liquidate particular items for liquidity reasons are definitely less prone to sell stocks at very low prices. Hence, during the second phase of a bear market, the disposition effect comes to prominence again. However, demand is also still missing, as those investors who managed to save some cash have a high degree of risk aversion and fear to invest even if stock prices may look relatively attractive.

## Conclusions

Behavioral finance offers an alternative perception of the processes taking place in capital markets. By referring to psychology and pointing out the imperfections of the human mind, it reveals mistakes committed by individual and professional investors. Moreover, the 2008 financial crisis has shown that behavioral inclinations also affected market supporting entities (e.g. rating agencies) as well as regulatory institutions (e.g. central banks and financial supervision authorities in individual countries). The entities designed to protect the stability of the financial system and ensure its uninterrupted operation failed to properly assess the importance of psychological traps.

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