Experimental asset markets, behavioral economics, and their implications for financial stability

Michael Holz

Mainstream asset-pricing theorists only slowly bid farewell to the assumption of efficient markets, typifying divergences between theory and empirical results as anomalies. Against this, behavioral economists take a different view on human decision-making. We apply this psychological perspective (in the tradition of Kahneman) and develop an alternative explanation of investment choice under risk, regarding investors' mood and sentiment. This requires a new theory of utility (replacing homo oeconomicus), which combines the psychological concept of "core affect" with economic happiness research. These theoretical deliberations serve a more accurate description of real-world financial market behavior, leading to boom-bust-cycles times and again. In laboratory stock market experiments we demonstrate that even when market participants know fundamental asset values, bubbles can emerge. This leads to policy implications for fostering financial stability.

Keywords: stock market bubbles, prospect theory, core affect, financial stability

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1. Introduction: Economic theory versus experimental economics?

The current crisis in the US subprime mortgage market and its worldwide consequences have drastically reminded market participants, central bankers, and politicians of substantial investment risks, which have been present for some years, but were widely disregarded until recently. The occurrence of this renewed crisis, which is the first since asset markets started to recover from the collapse of the New Economy in spring 2003, seems to have the potential of shaking the global banking and financial system. Have there been early warning signals of an imminent crisis? And why were no counter-measures taken or at least not communicated to the public?

The origin of the near-collapse of German IKB bank lies in the US housing market, where house prices have been rising until recently at annual rates exceeding 10 %, which was a lucrative deal even for low-income US households, who could finance their home without putting equity in, but instead with mortgage loans at historically low interest rates disregarding a high risk of non-payment. Today, international financial markets are linked by the activities of global players in the banking sector and highly-leveraged institutional investors like hedge funds. They transform otherwise illiquid mortgage loans into normally quite liquid asset-backed securities, which are internationally tradable. This is just one prominent example how the international financial system is intertwined closer and closer in the era of globalization. The present-day situation of course calls for bringing back systemic risks and financial stability issues on the international agenda.

The aim of this paper is to present just a very small piece of this very complex global asset markets puzzle. Section 2 takes a psychological perspective on economics and therefore focuses on behavioral finance issues explaining real-world investor behavior, which quite often is totally opposed to what traditional efficient market asset-pricing theory is telling us. We search for new theoretical models allowing a more realistic description of motives for trading and perceptions of risks and forecasted returns. For this aim, we employ concepts of 2002 Nobel laureate Daniel Kahneman and develop them one step further towards an alternative explanation of choice under risk, experienced utility of participants in asset markets which takes their moods and sentiments into account, and finally resulting investors' happiness.

Section 3 shows results from asset market experiments in the tradition of Kahneman's co-laureate Vernon Smith. They demonstrate the emergence of boom-bust-cycles in stock markets, even when traders know fundamental values of stocks, and in addition have economic and financial knowledge. Evaluation of questionnaires

aims at rationalizing participants' behavior. The reasons for using experimental economics in order to learn more about empirical asset-pricing behavior are manifold, despite there is a good portion of skepticism on the side of traditional macroeconomists, regarding statistical (time-series) analysis as the only empirical tool fitted for verifying theoretical considerations.

Larry Samuelson has given a good overview of the main arguments for and against applying experiments to economic topics. The main question is how experiments may help to design tractable economic theories describing empirical behavior as realistic as possible, and which at the same time can be understood without higher academic degrees in mathematics. To start with, limitations of economic theory have to be considered. Theory may be inaccurate, because nobody knows the true model of the economy. It may be imprecise, when there is too much noise in empirical data, so that theoretical output maybe describes random results. Economic theory may be uninformative, when important information is missing from the output of this theory, because the model is too restricted, regarding only exceptional cases. Finally, it may be too complicated, when it is so burdensome to apply theory in practice that it turns out to be useless (Samuelson 2005: 75). These are the main problems facing efficient market asset-pricing theory as well; CAPM is outdated, but the new models are too complicated to be of any practical usefulness.

Nevertheless, economic theory is needed, not as a substitute, but as a complement to experimental work, because economic laboratory experiments may be inaccurate, imprecise, and uninformative as well; or they may be informative only at prohibitive cost (Samuelson 2005: 77). This owes to the fact that we do not know, if an experimental design brings the situation in the computer laboratory sufficiently close to real-world asset markets (criteria of external validity). In addition, experiments may incorrectly identify links between the virtual market situation participants are in and the trading results (criteria of internal validity). What is therefore needed is a cross-checking of theoretical, experimental, and preferably other empirical results:

> "Predicting behavior is not the only goal of economic theory, and so we cannot expect all theoretical exercises to be in a position to point to such behavior. We must also allow the possibility that making connections to behavior is a goal that theory will often not yet be sufficiently advanced to address. But at some point some connections must be made between theory and behavior if economic theory is not to fade into either philosophy or mathematics, and work that aspires to make this connection should be explicit about the implied behavior." (Samuelson 2005: 100)

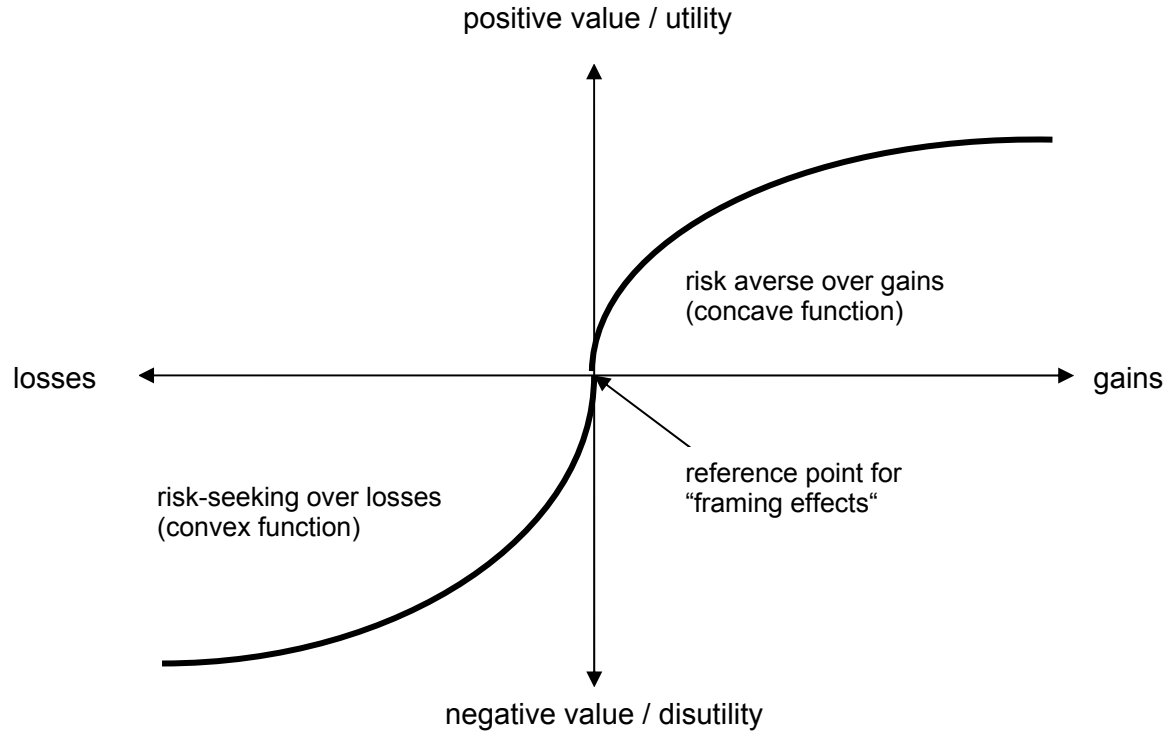
Section 4 presents conclusions and some implications for potential policy actions fostering financial stability.

2. Behavioral Finance: A psychological perspective on economics

2.1. Prospect theory: A model of choice under risk

For a long time, there has been a disciplinary divide between psychology and economics. It was the upcoming of a behavioral approach to economics, which attempted to bridge this gap by questioning three central assumptions of *homo oeconomicus* models: selfishness, rationality, and unchanging tastes. Instead, the new discipline formulated the concepts of a human propensity for reciprocity, satisficing behavior, bounded rationality, and prospect theory (Kahneman 2003a: 162). It is especially this last concept, that became influential in explaining investors' preferences and their trading behavior in asset markets, which systematically violates the predictions of economists' expected utility framework: "Prospect theory (Kahneman/Tversky 1979) was offered as a descriptive model of risky choices in which the carriers of utility are not states of wealth, but gains and losses relative to a neutral reference point." (Kahneman 2003a: 164)

Figure 1: A schematic value function for financial gains and losses



Source: based on Kahneman/Tversky (1979: 279)

This definition of utility over gains and losses was the most important new feature. The consequences are so-called “framing effects”, i.e. an investment decision depends on the way it is presented to the decision maker. Because the value function (transferring the monetary gains or losses into respective utility values) is S-shaped, these effects are quite substantial. In the domain of gains, the value function is concave; in the domain of losses it is convex. This means that investors are risk averse over gains, but risk-seeking in the case of experienced losses, despite their overall loss-aversion (Barberis/Thaler 2003: 1069-72). Figure 1 reproduces the proposed value function.

Another theoretical piece was added later with “Advances in Prospect Theory”. The empirical fact that small probabilities are overweighted explains e.g. the popularity of lotteries and insurances. This finally results in “a distinctive fourfold pattern of risk attitudes: risk aversion for gains and risk seeking for losses of high probability; risk seeking for gains and risk aversion for losses of low probability” (Kahneman/Tversky 1992: 297).

With the help of prospect theory researchers might try to find explanations for otherwise seemingly irrational investor behavior in asset markets. One has to bear in mind that Kahneman and Tversky described “risky gambles”, whereas in everyday life we have to decide under uncertainty, i.e. the probabilities of different outcomes are rarely objectively known. Peoples’ dislike of such situations leads to “ambiguity aversion” and a “preference for the familiar” (Barberis/Thaler 2003: 1074-5). Therefore, investment behavior has much to do with how competent people feel in assessing the objective probability distribution of gains and losses. Before starting a deeper analysis of asset pricing, some more psychological building-stones are needed describing cognitive systems, investors’ sentiment and emotion.

2.2. Kahneman’s concepts of cognition and experienced utility

In accordance with Keynesian theory, in real life financial market information most of the time is incomplete, asymmetrically distributed, and not costless. Peoples’ capacity to filter and process relevant information it is limited. Therefore, investment decisions are partly based on deliberate reasoning, but partly also on intuitive judgment. It is this special architecture of cognition, which Kahneman used in his Nobel lecture to present “Maps of Bounded Rationality” (Kahneman 2003b). He differentiates the two cognitive systems of “intuition” and “reasoning”, to define alternative ways how perceived information may be processed. Intuitive impressions are characterized as being fast, parallel, automatic, effortless, associative, and emotional, governed by

habit. On the other hand, the system of reasoning describes explicit and intentional judgments, which are characterized with attributes like slow, serial, controlled, effortful, rule-governed, and emotionally neutral. The intuitive judgments occupy a central position between perceptions and the system of reasoning (Kahneman 2003b: 1451-2). Thus, reasoning is involved in all judgments, but what substantially differs from investor to investor is the share of decisions originating from impressions / intuition or deliberate reasoning.

In addition to the nature of decision-making itself, the neoclassical concept of (lifetime) utility maximization is only adequate, if people know for sure what they aspire today and what they will like in the distant future. There are many biases and mispredictions, leading people to change preferences, so that the "wantability" of a good today, when a decision is made, may substantially differ from the hedonic experience of enjoyment when using this good in the future (Kahneman/Thaler 2006: 223). This leads to a new concept of utility, which differentiates along a timescale "decision utility", "predicted utility", "experienced utility", and last but not least "remembered utility". Decision utility resembles the usual economic utility concept, because it is inferred from observable human preferences. Predicted utility is the forward-looking element, which describes today's beliefs about future experienced utility. The news in this approach is that experienced utility has two variants: a moment-based and a memory-based. The moment-based experienced utility is a real-time measure, aggregating total utility over the temporal profile of enjoyment; whereas remembered utility (which is the terminus for memory-based experienced utility) is derived from a retrospective assessment of former episodes of life (Kahneman 2000: 17-8).

Given the fact that people are learning from the past, preferences and hedonic forecasts are influenced by measures of remembered utility, independent of the fact, if the personal memory is correct, or if new situations are really similar to those associated from past memories. This might explain the high degree of risk-aversion of German investors considering stock market investments, despite the extraordinary performance of German stocks since 2003, because they remember their experiences in the boom-bust-cycle of the New Economy 1996-2002. Reformulated as a general description of people's effort to maximize utility: "The conclusion from this body of research is that people are systematically wrong in their expectations about the life circumstances that will increase or decrease their happiness, which in turn implies that life choices that people make in their pursuit of happiness are also likely to be wrong." (Kahneman/Thaler 2006: 231)

There are effects of the current emotional state, the context of choice, learning from the past, and mispredicting one's own ability of adaptation to changing circumstances, rendering the traditional concept of measuring and maximizing utility useless. What is therefore needed is an enhanced behavioral asset pricing theory, which combines objective measures of risk and return with economic concepts of investors' "risk appetite" (e.g. Gai/Vause 2004), psychological models of decision-making as well as results from happiness research.

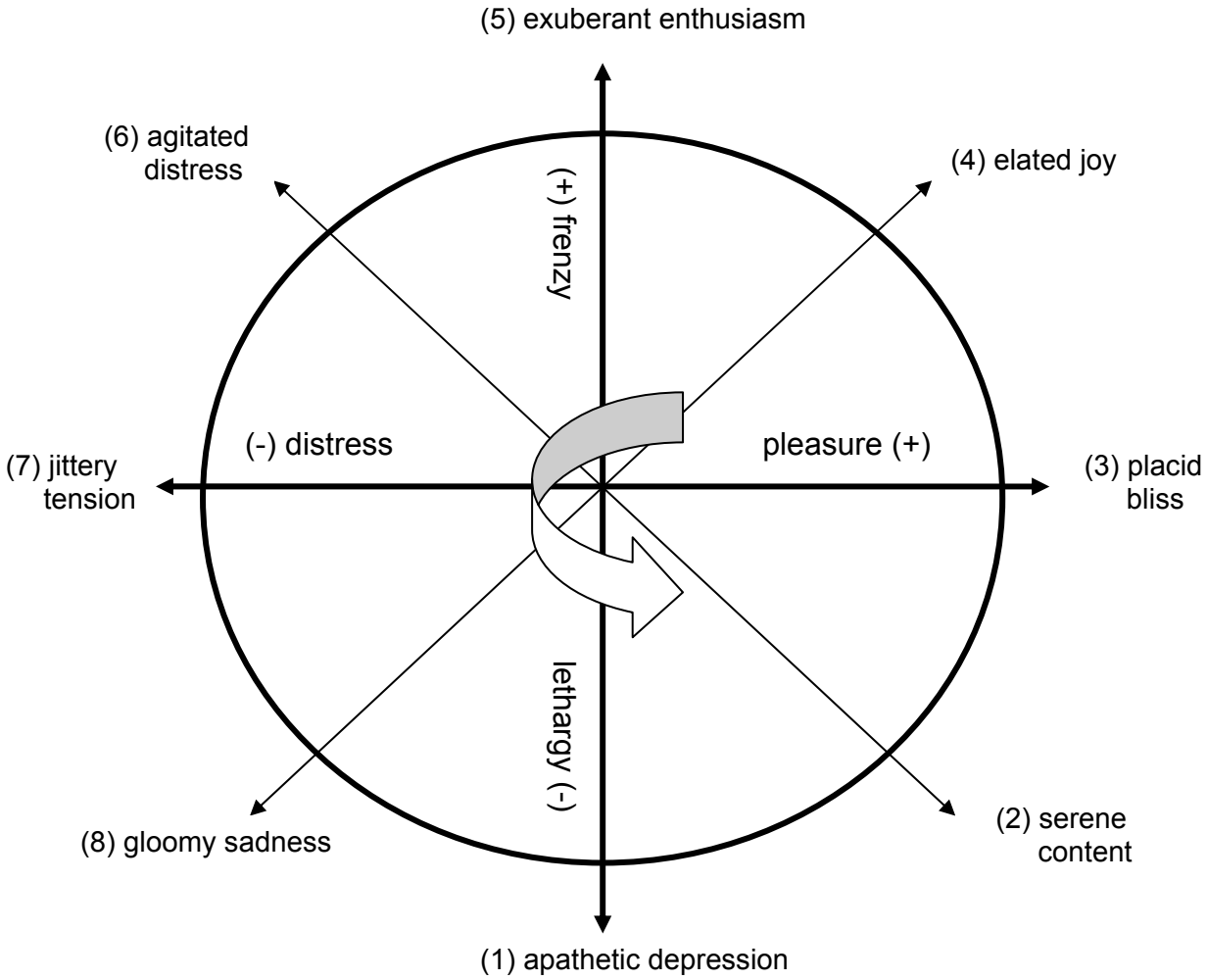
2.3. Core affect, emotion, and investors' happiness

There are several proposals in the literature how to measure subjective well-being and objective happiness. A vast majority of these approaches concentrates on quite general measures of economic welfare (GDP per capita, personal income, unemployment, inflation, state benefits, and so on). The work of authors such as Easterlin (1974, 2001), Frey/Stutzer (2004) or Di Tella/MacCulloch/Oswald (2003) therefore sure has merits, but it doesn't contribute to a unified socio-economic-behavioral theory of asset pricing, which helps to understand the repeated emergence of bubbles and crashes. What we try in this paper is to give hints how to integrate some prominent elements from psychology, which are rarely recognized by economists, into a realistic description of investors' behavior. For this aim, we modify the "representation of (human) affective space" in Kahneman (2000), to sketch the foundation of a behavioral asset pricing theory, which will afterwards be checked with the help of experimental asset markets in the laboratory.

The concept of "core affect" was laid down and later refined in articles by Russell (1980, 2003). His aim of a psychological construction of emotions, which influence human decision-making, experienced utility, and ultimately personal happiness, leads him to trace back each human feeling, mood or "affective state" to two dimensions: hedonic valence (pleasure / displeasure) and arousal (activation / deactivation). By specifying the position in this two-dimensional space, a prototype of each specific emotion is generated (Russell 2003: 145-52). This inspired Kahneman to use Russell's concept in order to make a distinction between two forms of positive and negative affect, which he integrated in his concept of objective happiness. The positive affective states are named "joyful enthusiasm" (pleasure + high activation) and "serene pleasure" (pleasure + low activation). The negative states are "agitated distress" (displeasure + high activation) and "apathetic depression" (displeasure + low activation). This description is comparative-static (Kahneman 2000: 10-11); we therefore try to transform it into a dynamic model.

Kahneman himself used this concept to develop a measure of society's well-being: the U-Index. The U stands for "unpleasant" or "undesirable". "The U-Index measures the proportion of time an individual spends in an unpleasant state." (Kahneman/Krueger 2006: 19) With the help of this index, the net affect of activities like working, shopping, childcare or socializing after work can be measured, and these activities can be ranked. Opposed to this, in order to use Kahneman's concept as a representation of investors' happiness, we introduce a time dimension, which transfers this two-dimensional space into an asset market boom-bust-cycle. We are interested in investors' moods and feelings at each stage of the cycle to deduct assumptions about asset pricing behavior; whereas the time spent in a single stage is of minor importance here. A graphical illustration is shown in figure 2.

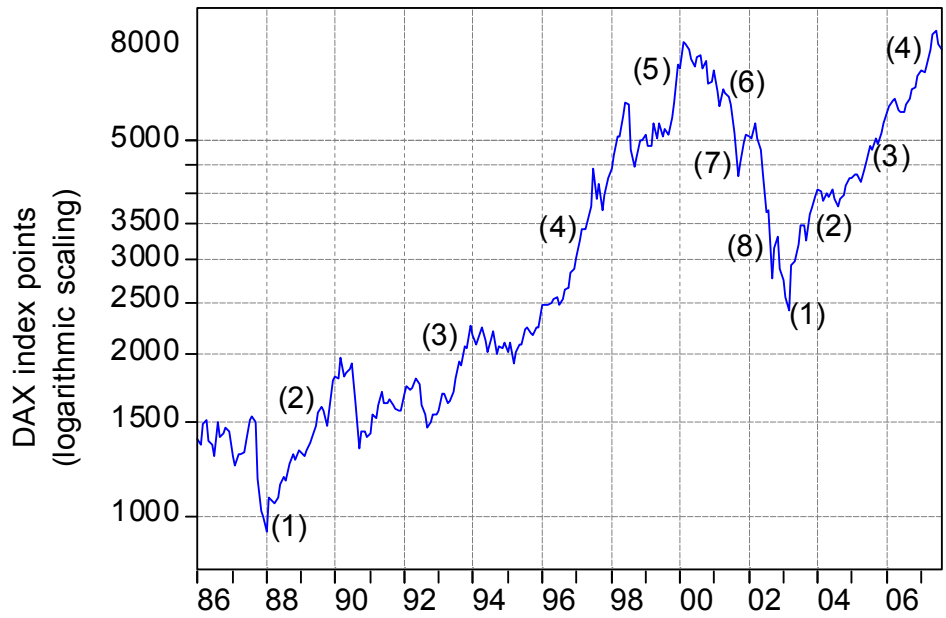
Figure 2: The concept of "core affect": a representation of the affective space



Source: based on Kahneman (2000: 683) and Russell (2003: 148)

The two dimensional continuum of the “asset market wheel” ranges on the horizontal axis from pleasure over a neutral level (the adaptation level) to distress. On the vertical axis, where arousal is depicted, the spectrum ranges from lethargy over a neutral activity level to frenzy. All in all, eight different investor moods / affective states are characterizing the stages of the cycle. They may represent the last 20 years of stock market development starting just after the 1987 crash in a mood of “apathetic depression”, when stock prices had stabilized at a very low level. This stage was followed by some years of “serene content” and “placid bliss” with volatile, but overall rising stock prices until 1996, and then superseded by the early and late stage of the New Economy boom characterized as “elated joy” and “exuberant enthusiasm” until spring 2000. Afterwards stock prices started to fall in two stages - separated by the events of September 11, 2001 - of “agitated distress” and “jittery tension” until the end of 2002, when prices gained ground and started stabilizing again. This was the last stage characterized as “gloomy sadness”, which was followed by “apathetic depression” until the summer of 2003, completing this cycle and starting a new one, that until July 2007 was in its fourth stage of “elated joy” with a new all-time high of the German DAX (see figure 3).

Figure 3: Exemplifying “core affect” of investors in the German stock market (1987-2007)



Of course, this representation of stock market cycles is schematic. Therefore, many observers in August 2007 would deny being in a state of “elated joy”, facing the fallout of the US subprime mortgage crisis. Maybe with hindsight, the immediate consequences for EMU stock markets will turn out to be less severe than currently ex-

pected, containing welfare losses to the US economy, if the Federal Reserve behaves wisely. There are always smaller setbacks in an asset market boom with corrections of a magnitude of 10 or 15 %, like in spring 2006. If long-time stock-owners stay invested, these short run corrections don't really matter. This brings us back to the concept of "remembered utility", which is memory-based, and therefore differs from moment-based negative "experienced utility" just when a correction takes place.

2.4. "NeuroEconomics": The somatic marker hypothesis

Different scientific disciplines show alternative ways for testing hypotheses explaining real-life investor behavior. Besides the experimental asset markets presented in section 3, there is the relatively young discipline of "NeuroEconomics", which presents another promising attempt to introduce psychological and medical research into economic analysis. The functioning of the human brain and the influence of emotions on decision-making is examined with the help of neuroimaging techniques, like e.g. the functional magnetic resonance tomography. The bulk of empirical research in "NeuroEconomics" so far centered on marketing questions, e.g. how buying decisions are stimulated by conscious or unconscious processes in the brain. But maybe in the future there will be more applications allowing understanding investors' trading behavior. One of the theoretical foundations of neuroeconomic research is once again Kahneman's (2003b) concept of the two alternative cognitive systems - intuition and reasoning -, which are used for analyzing topics like preferences, the rewarding system, and the "social brain" (concepts of fairness, altruism, trust). Therefore "neuroeconomics broadens the concept of behavioral economics by means of neuroscientific tools. These tools enable economic research on brain processes, which in economic research have so far been looked upon as a black box." (Kenning/Plassmann 2005: 352)

An additional theoretical foundation for a neural theory of economic decision-making is the "somatic marker hypothesis" (Bechara/Damasio 2005). The phenomena to be addressed are e.g. why choices under uncertainty versus certainty engage different neural circuits in the brain, and why investment choices differ when taken in a mood of optimism versus pessimism? Therefore, refining "a somatic marker model for predicting investors' choices" (Bechara/Damasio 2005: 362-8) is one of the main tasks for future neuroeconomic research.

In a nutshell, the basic idea is that in taking investment decisions people react to so-called "primary inducers", which are market news, and to "secondary inducers", i.e. reasoning about what to do next. In general, the "primary inducers" are innate or

learned stimuli causing pleasurable or aversive states, whereas the "secondary inducers" are thoughts or memories of "primary inducers", generated by recalling past emotional events. The human brain discriminates between positive and negative somatic signals. Peoples' attitudes towards risk and their risk appetite are shaped by background somatic markers (primary inducers), which bias expectations. So it is the interplay of the personal somatic state of each investor and a general somatic background emotion dominating asset markets, which shapes investment behavior. When market conditions are stable and uneventful, a majority of traders is supposed to be in a neutral or optimistic mood. On the other hand, when market conditions are discomfortable and a majority of traders share this feeling of pessimism, crashes may be triggered and amplified. Bechara/Damasio conclude: "Thus in accordance with the Prospect theory model, our Somatic marker model predicts that risk seeking in the face of sure losses is enhanced when the background is negative." (Bechara/Damasio 2005: 367)

So there are alternative ways for testing behavioral assumptions concerning people's investment choices. Neuroeconomics so far haven't much experience in testing the somatic marker model with the help of neuroimaging techniques; but empirical tests in experimental asset markets reach back to the seminal work of Vernon Smith et al. (1988). We therefore present some results from such laboratory experiments exemplifying investor behavior.

3. Asset market experiments

3.1. The experimental setup

All experiments were programmed and conducted with the software z-Tree (Fischbacher 2007). Our treatment for trading stocks in an experimental asset market resembles very much those of Porter/Smith (2003) or Caginalp/Porter/Smith (2001, with the experimental instructions reproduced in the appendix). Therefore, we give only a very short description of its basic features. There is only one kind of stock, which is traded for 15 subsequent periods. Each trading period lasts three minutes. At the end of each period, a dividend is paid to all stock-owners. The dividend amount per stock may be 0, 8, 28, or 60 guilder (the experimental currency). Each dividend amount is equally likely (p = 25 %) and generated by random draws of the computer; on average participants can expect a dividend of 24 guilder.

The "fair" or "fundamental value" of the stock can easily be calculated for each period by multiplying the expected dividend with the number of remaining trading periods, e.g. at the beginning of the first period the expected fundamental value is 15 * 24 =

360 guilder per stock. At the beginning of the period 15 (the last one), fundamental value is 24 guilder, because at the end of the experiment all stocks are worthless. This may be explained with the example of a gold mine, which is exploited over 15 years, thereafter no gold is left, so the project is terminated. Participants of the experiment receive a table, which shows the fundamental stock value for each of the 15 trading periods. They are instructed that values are based on expected average dividends, which are not secure or risk-less, but drawn from a random distribution.

There were 14 participants in the first and 16 in the second experiment, all students of economics from the University of Trier. At the start, each participant receives his basic endowment for trading, which comprises three stocks (each valued at 360 guilder) and 720 guilder in cash, summing up to a total initial wealth of 1.800 guilder. With 14 (16) participants, there are 42 (48) stocks, which can be traded on the experimental asset market. In each period, every participant can submit orders, i.e. “bids” to buy stocks from other participants or “asks” to sell. There is no market maker or auctioneer bundling bids and asks, instead every trader looks into an “open order book” (where all bids and asks are displayed publicly) and can continuously buy (sell) stocks by marking an unfilled selling (buying) order and clicking a button.

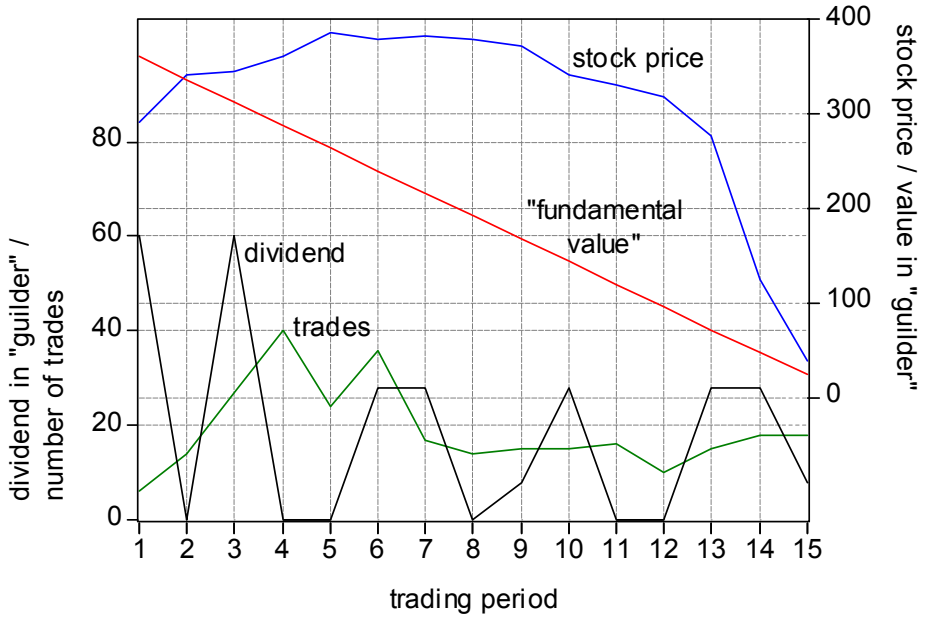
There is no credit granted to traders, and no short selling is allowed, i.e. traders can only sell a stock they actually own and they can only buy a stock, if their cash holdings are sufficient to pay the indicated stock price. At the end of each trading period, the participants see a result screen, displaying the dividends earned, the number of stocks owned, and their cash holdings. The incentives for participation and active trading in order to be one of the best traders in the market, i.e. which has the highest final wealth at the end of the experiment, were gifts in form of original decorative German stock certificates, which are still traded at the stock exchange. Right after the last round of trading, participants were asked to fill out a questionnaire asking for personal characteristics, which are linked to categories of emotion and core affect.

3.2. Trading results: Bubbles and crashes

The aim of experimental asset markets is copying empirically observable behavior of stock traders in the computer laboratory. Researchers are interested in questions like why and under which circumstances financial bubbles emerge, and how long they can survive until a crash sets in. Of course, not all experiments show bubble building tendencies; but like in real life they occur times and again. We present results of three of our own experiments and then compare them with those of Vernon Smith and his colleagues. The participants in our experiments were undergraduate students

of Economics at the University of Trier, who already had attended the introductory courses in micro-/macroeconomics and entrepreneurship/finance. They were participants of a regular course “Economics put into practice” dealing with asset pricing topics, that extends over one year (two terms). The experiments were carried out some weeks before the end of the second term, in July 2006 and June 2007; so these students had caught an idea of financial markets in theory and practice. Nevertheless, the 14 participants in the first experiment produced a full-fledged stock market bubble, which resembles the one seen during the New Economy boom (see figure 4).

Figure 4: Stock prices, trading volume, and dividends in the first experiment



In the first period, trading started slow and subdued with only six trades, which was the lowest number of all 15 periods. The average price of 292 guilder lay about 19 % below the indicated “fundamental value” of 360 guilder; the dividend of 60 guilder then was a positive surprise. Beginning with the second period, the number of trades multiplied, reaching 40 in the fourth and 36 in the sixth period. In parallel, prices started to rise, not only in relation to fundamental value, but also in absolute terms, despite each period’s dividend payment reduces fundamental value. In periods 5 to 9 the average price stabilized between 372 and 385 guilder, and thereafter fell only moderately to 276 guilder in period 13, which - compared with a fundamental value of 72 guilder - was an overvaluation of 284 %. The “crash” set in as late as periods 14 and 15. Stock prices fell from 276 over 124 to 39 guilder, reducing overvaluation to 158 % and 63 %. So, a bubble emerged and then grew bigger and bigger, while the overall evolution of dividend payments was not very promising and considerably fell short of what could have been expected; the sum of all dividends over the 15 periods was just 276 guilder, whereas the expected sum was 15 * 24 = 360 guilder.

Figure 5: A stock market bubble and the subsequent crash in the first experiment

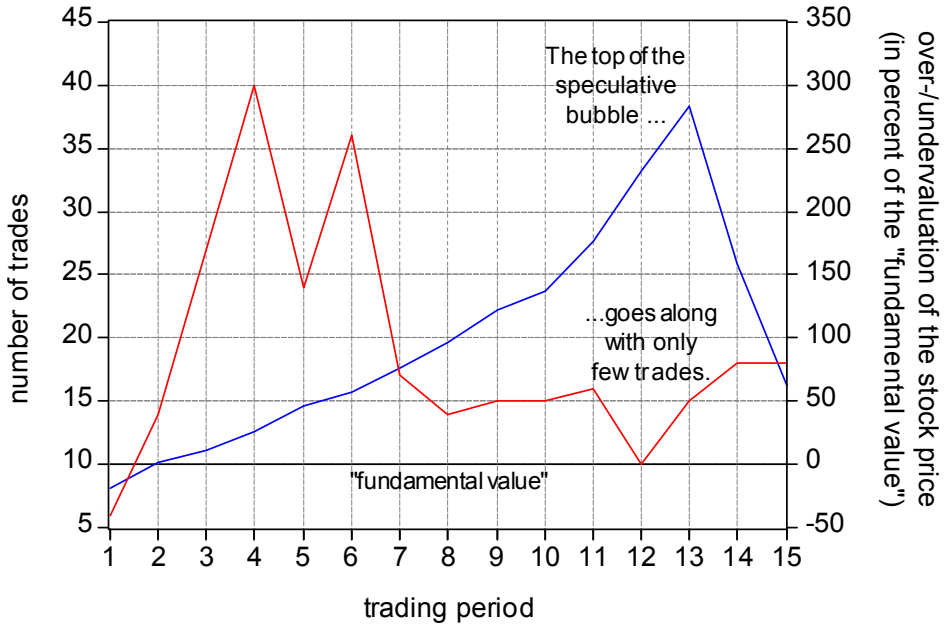


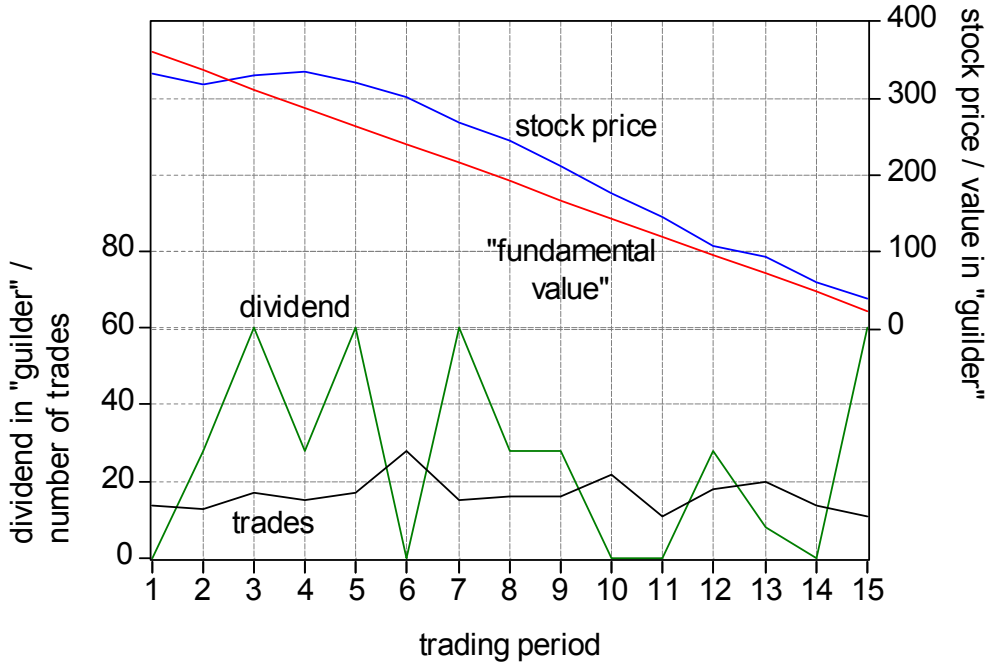
Figure 5 compares the degree of under-/overvaluation over the full experiment with the number of trades per period. Especially remarkable is the fact that the market top with an overvaluation surpassing 250 % occurred at a time, when trading activity was moderate (with only 10 trades in period 12). This reproduces the empirical facts and events of spring 2000, when EMU stock markets reached their all-time highs, but turnover was quite low, and only a handful of stocks pushed each market.

To sum up, this first experiment has demonstrated that even when fundamental values of stocks are known (which in practice seems to be an exception, not the rule) and traders are familiar with economic and financial theory, stock market bubbles can emerge and grow, until they finally bust. Even in period 15, with an expected dividend of 24 guilder and stocks being worthless afterwards, the average price was still 39 guilder and 18 trades were carried out.

In contrast to this, figure 6 shows the results of a second identical experiment, conducted one year later with another group of 16 students, who also visited my course “Economics put into practice” and therefore had a comparable background of knowledge. At first sight, average trading prices resembled fundamental values much closer than in the first experiment. Trading activity was much more equally distributed, showing between 11 and 20 trades in most periods, with an exception of 28 trades in period 6. Chance was on the side of the traders in this experiment, because the sum of distributed dividends was 388 guilder per stock, compared with the fundamental value of 360, and an actual value of only 276 guilder in the first experiment.

In periods 1 and 2 trading started just around 7 % below fundamental value. After a dividend of 60 guilder paid out at the end of period 3, from period 4 onwards stock prices started to move hand in hand with fundamental value, but they declined more slowly, so that a constant overvaluation of about 20 % emerged, which was astonishingly stable between period 4 and 14. In real asset markets, this resembles a situation of good stable market fundamentals and very low volatility, which reduces risk premia and therefore allows constantly higher prices compared with the long-term average market valuation (e.g. in terms of required returns, dividend yields, or price/earning ratios).

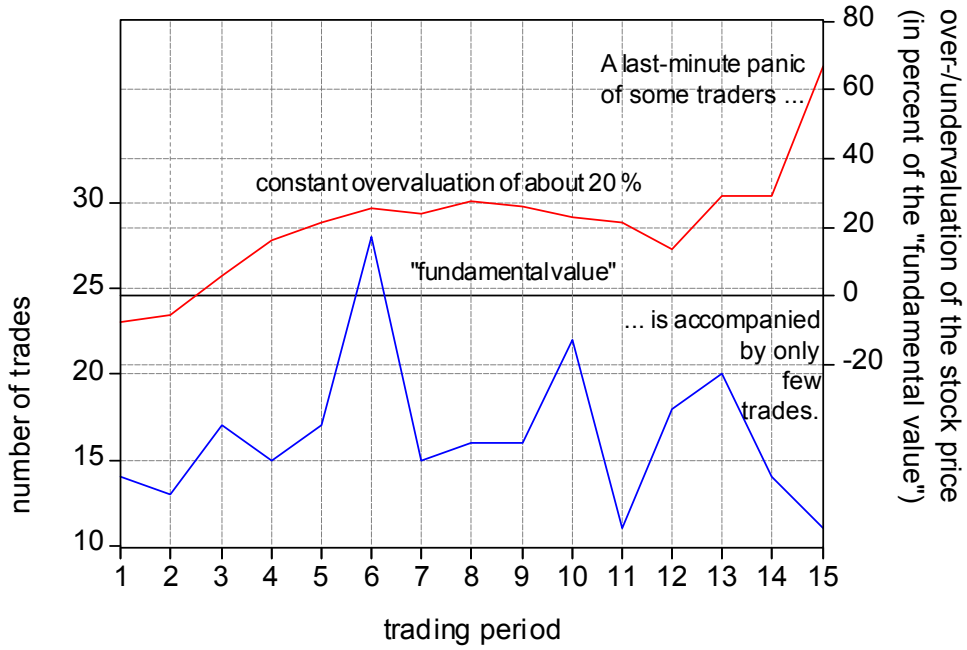
Figure 6: Stock prices, trading volume, and dividends in the second experiment



As figure 7 points out, it was only in period 15, when a last-minute panic of a few traders produced a deviation of 66 % from fundamental value. With the goal of winning the experimental competition against their classmates, they started the theoretically well-known “gamble for resurrection” in order to outperform just on the finishing line. There were only 11 trades, which was the all-period low, and the average price was 40 guilder, which with hindsight turned out to have been a lucrative gamble, because a dividend of 60 guilder was paid. This fact of course was unknown to all traders before, so their risk appetite was extraordinary high in this last period. The last result inspired us to carry out a supplementary third experiment with the same group of students, which was conducted right after finishing the one just described above. The experimental design of Smith was varied in one important way: Because the dividend paid out at the end of each trading period is the only “news” that enters the

market, happening at a time when the market is “closed”, we informed participants that for the following ten trading periods the dividend would be announced by the experimenter around the middle of each period (after 80 seconds of trading, so that 100 seconds remained to utilize the “dividend news” for trading stock prices up or down).

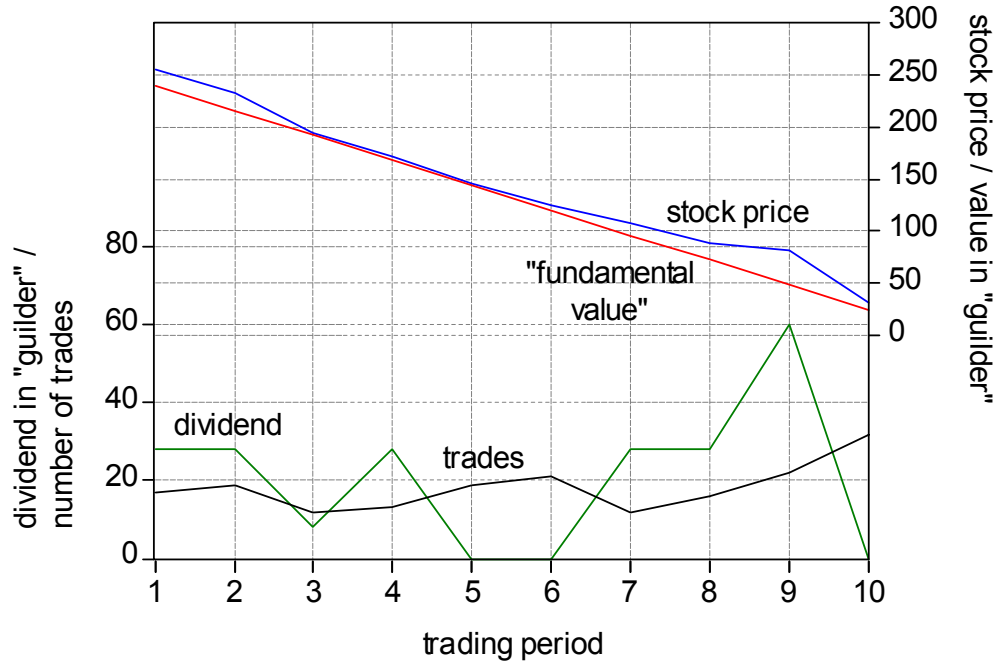
Figure 7: Constant overvaluation of stock prices in the second experiment



Results are presented in figure 8. As we would have expected, average trading prices in each period come even closer to fundamentals than it has been the case before (see again figure 6). The exception was period 9, which was the only one where a dividend of 60 guilder was announced. The average trading price was 81 guilder, while the fundamental value has been 48 guilder; but there was another period left, in which traders could hope for one more positive dividend surprise, which then unfortunately didn’t materialize (zero dividends).

It is interesting to have a closer look at intra-period trading activity, when dividend payments are announced after 80 seconds. Most of all periods, the dividend was 28 guilder, which came fairly close to the expected average value of 24 guilder. So we concentrate on those periods, where dividend announcements were perceived as “positive news” (dividend of 60 guilder) or “negative news” (zero dividends). As mentioned above, period 9 was the only one with “positive dividend news”. During the first 80 seconds of period 9, there have been only six trades, the last of which settled at a price of 65 guilder. Then, after the dividend announcement of 60 guilder, there was a pause of 30 seconds without any trade. Thereafter stock prices jumped to a new level of about 90 guilder; 16 trades were carried out during the remaining time.

Figure 8: A third stock market experiment with dividend announcement



On the other hand, in periods 5, 6 and 10 there was “negative dividend news”, with no dividend paid at all. After the announcement, in period 5 prices fell from about 150 guilder to 125; in period 6 they fell from about 140 to 100 guilder. There have been 19 (21) trades, which nearly split into half for the time span before and after the news was announced. Period 10 is special, because after this last round of trading, the stocks are worthless, and the experiment is finished. This period saw a record number of 32 trades, of which 27 took place before the zero dividend was announced. Prices varied widely between 30 and 50 guilder. After the final dividend announcement, just five trades were settled, stock prices crashed to 4 and 6 guilder in the last two trades.

We have demonstrated to what extent experimental asset markets are able to replicate real-life stock market trading, leading to bubbles and crashes times and again. This backs our statement in the introduction, that experimental economics are a useful tool, which should be used complementary to economic theory and statistical time-series analysis. In what follows, we present results from a questionnaire filled out by the participants in the above experiments. With their help, we try to test some of the theoretical assumptions presented in section 2, dealing with investor psychology and Kahneman’s model of “core affect”, which may explain human characteristic traits leading to excessive risk-taking in asset markets, when the overall mood and sentiment are markedly positive.

3.3. Questionnaire: Representation of core affect

There are special features and peculiarities of each human's personality, which shape our behavior in different areas of everyday life. The concept of questionnaires to investigate these personality characteristics is the domain of sociological and psychological research. We used a standard questionnaire asking participants right after the stock market experiments to characterize themselves (on a scale from 1 to 7), giving them 33 pairs of terms describing personal characteristics. They were e.g. asked, if they would describe themselves as being rather "quick-tempered" or rather "disciplined". A participant being indecisive between the two would mark a score of 4, another with near iron discipline would mark a 6 or 7, and someone lacking self-control chooses a score of 1 or 2. With reference to Kahneman's concept of "core affect", we select ten pairs of terms out of these 33, of which five are deemed to be good representatives for measuring the dimension of "arousal", and another five giving information on "valence". We calculated the average scores of all participants in our first and second experiment, ordered them from highest to lowest score, and then compared the scores of both experiments (see table 1).

Table 1: Personality characteristics of participants in stock market experiments as indicators of "core affect"

indicator no.	denotation for lowest score (1)	denotation for highest score (7)	average score in second experiment	average score in first experiment	difference in scores
arousal 1	shy	go-ahead fellow	**6,00**	5,79	0,21
arousal 2	quick-tempered	disciplined	**5,88**	5,71	0,17
arousal 3	well-balanced	irritable	**5,81**	5,63	0,18
arousal 4	carefree	conscientious	**5,63**	5,76	-0,13
arousal 5	realistic	dreamy	**5,63**	5,54	0,08
valence 1	mentally robust	psychologically weak	**5,25**	5,09	0,16
valence 2	distressed	calm	**5,13**	4,79	0,33
valence 3	anxious / alarmed	light-hearted	**4,75**	4,34	0,41
valence 4	bona fide	suspicious	**3,56**	3,83	-0,26
valence 5	dependent on others	independent	**3,44**	3,67	-0,24

It is interesting to recognize that the five indicators of "arousal" all show higher scores than the five indicators of "valence". On the applied scale from 1 to 7, the average stock market trader in our experiment describes himself being a "go-ahead fellow" (score of 6.0 in the second experiment), who is "disciplined" and "conscientious", but sometimes also "irritable" and "dreamy". This sketches a picture of our average participant being most of the time in a stable mood, which practitioners deem to be a

prerequisite for investing in stocks successfully; but when bubbles and crashes occur, these market participants may be in a more “dreamy” than ”realistic” mood during the boom, and thereafter more “irritable” than “well-balanced” in the bust.

When regarding the indicators of “valence” most average scores lie around their “neutral” value of 4. Our experimental traders describe themselves being at least sometimes “psychologically weak” (average score of 5.25), but in general rather “calm” than “distressed”. Concerning the further indicators, they confess to be rather “light-hearted”, “bona fide”, and “dependent on others”. This seems to match the attitudes of many real-world traders, who entered the stock market for the first time in the late phase of the New Economy boom in 1999/2000, hoping to get rich by simply following the hot tips of self-declared stock market gurus. Unfortunately, both experimental groups were too small (16 and 14 participants) to discriminate average answers of male and female traders, in order to test assumptions about different attitudes towards risk and diverging self-characterizations of being “light-hearted” and “bona fide” or the opposite of “anxious” and “suspicious” about the materialization of gains and losses in their portfolios.

What we can do instead is comparing the average answers of participants in the first experiment, which produced a boom-bust-cycle, and in the second one, where stock prices never lost touch with fundamental value. The last column of table 1 shows differences in average scores for arousal and valence categories. Of course, results cannot be more than tentative, and care is needed in interpreting these data. Concerning “arousal” the first two indicators hint towards a slightly higher level of “discipline” and participants being stronger “go-ahead fellows” in the second experiment without a bubble. On the other hand, regarding “valence” the biggest differences in scores are found for indicators 2 to 4, where participants in the second experiment said to be more “calm”, but at the same time more “light-hearted” and “bona fide” than those in the first experiment. There are two possible explanations: Their mood might be better, because they have better personal stock market knowledge and are therefore more self-confident (more students already had own real stock market experience in the second group), or their mood was simply better, because when answering the questionnaire they hadn’t just experienced a laboratory stock market crash, like it happened in the last stage of our first experiment.

Owing to the fact that our sample of only three experiments is much smaller than the battery of laboratory asset markets created by Vernon Smith and his colleagues, some further results from the literature seem worth mentioning:

1. “Public information in intrinsic dividend (or net asset) value is not to induce common expectations and trading at fundamental value.” (Porter/Smith 2003: 9)
2. “In replicable laboratory experiments, experience, particularly common group experience, together with common information is sufficient to yield trading near fundamental value.” (Porter/Smith 2003: 9)
3. “Subjects have a strong early tendency to develop home-grown expectations of rising prices; their forecasts are adaptive and have a universal tendency to misprice jumps and turning points.” (Porter/Smith 2003: 11)
4. “Short-selling does not significantly diminish the amplitude and duration of bubbles, but the volume of trade is increased significantly.” (Porter/Smith 2003: 13)
5. “Price limit change rules do not prevent bubbles; if anything they are more pronounced.” (Porter/Smith 2003: 15)

The first two results confirm our own findings from the three experiments and the interpretation of the questionnaire. Despite participants knew the probability distribution of dividends and the fundamental stock value at every stage of the experiment, a bubble emerged in the first one. On the other hand, the experience from the second experiment together with the dividend announcement after 80 seconds in the third experiment yielded stock prices, which closely resembled fundamentals. The third result of Porter and Smith is clearly to be seen in figure 4 (first experiment), where prices started to rise and overvaluation grew stronger until the bubble finally burst.

The fourth and fifth results lead over to an additional aim of this paper: considering implications - of asset market experiments and real-world stock markets - for financial stability. In our own experiments, there was no short-selling allowed, and no credit was granted for financing stock market investments. On the other hand, it is the high leverage of institutional investors like e.g. hedge funds and their strategy to sell stocks short, which heightens market volatility and is times and again accused to initiate boom-bust-cycles. Regulatory restrictions on such short-selling don’t seem to be the first-best solution. The same is true for price limit change rules, which are supposed to halt trading when a predefined percental barrier is surpassed. What is needed instead of such micro-prudential market interventions, are macroeconomic considerations enhancing the functioning of the financial system under normal circumstances, and giving markets guidance in times of turmoil or distress.

4. Conclusion: Financial stability implications

> "In the muddled days before the rise of modern finance, some otherwise-reputable economists, such as Adam Smith, Irving Fisher, John Maynard Keynes, and Harry Markowitz, thought that individual psychology affects prices. What if the creators of asset-pricing theory had followed this thread? Picture a school of sociologists at the University of Chicago proposing the *Deficient Markets Hypothesis*: that prices inaccurately reflect all available information. A brilliant Stanford psychologist, call him Bill Blunte, invents the *Deranged Anticipation and Perception Model* (or *DAPM*), in which proxies for market misvaluation are used to predict security returns. Imagine the euphoria when researchers discovered that these mispricing proxies (such as book/market, earnings/price, and past returns) and mood indicators such as amount of sunlight, turned out to be strong predictors of future returns. At this point, it would seem that the deficient markets hypothesis was the best-confirmed theory in the social sciences." (Hirshleifer 2001: 1533-4)

Unfortunately, the theories of Keynes or today's heterodox economists don't dominate the debate on how assets - such as stocks or real estate - are priced, and which counter-measures this (mis)pricing behavior calls for in order to secure sustainable economic welfare. Nevertheless, it cannot be ignored that the recent rise in the global "liquidity glut" poses threats to global financial stability. It was fostered by the main central banks of the world when lowering interest rates substantially after the abrupt end of the New Economy boom and the terrible events of September 11, 2001.

What should be done in the areas of monetary policy, financial regulation, and international macroeconomic policy coordination to counteract these perils in due time? As Paul De Grauwe noted recently, "the eurozone is missing the point in its quest for stability" (De Grauwe 2007:10). Against the background of the current crisis in the US subprime mortgage market, triggering contagion effects in the global financial system, he points out that money growth has no longer an impact on consumer price inflation. The reason is twofold: Many big international banks have restructured the asset side of their balance sheets, e.g. by transforming illiquid assets such as mortgages into asset-backed securities. It is through this channel, that the US subprime mortgage crisis was felt drastically by German banks like IKB. In addition, banks have restructured their liabilities side as well by issuing debt securities instead of taking deposits from their private customers.

As a consequence, the ECB is watching the wrong indicator in forecasting overall eurozone liquidity: M3 money growth in part simply reflects the expanding business of banks. In addition, the liquidity creation of hedge funds and other institutional investors doesn't trickle down into consumer prices, which are central for the primary monetary policy goal of price stability. Instead, asset price inflation may set in, leading e.g. to US house prices, which have lost touch with economic fundamentals. This observation about liquidity creation, together with the fact that financial markets sometimes tend to misprice assets, calls for political activism:

> "Asset bubbles create optimism and euphoria, stimulating economic activity. The crashes that follow can lead to pessimism and downturns in economic activity. Thus, a central bank that, besides inflation, also cares about economic stability may want to monitor the activities of hedge funds." (De Grauwe 2007: 11)

This monitoring of course has to be embedded in a broader macroeconomic concept for securing price stability and financial stability as dual goals. As a prerequisite, we have to enhance our understanding how real human beings (not the homo oeconomicus) are behaving in financial markets. The psychological perspective on economics given in section 2 is supposed to be a fist step towards this aim. Meanwhile, there already exist proposals on how to render the international financial system more stress-resistant. Promising research is done at the BIS, especially by Claudio Borio and his colleagues. They present a less orthodox interpretation of our fast-evolving economic and financial environment:

> "In a nutshell, the changes in the financial and monetary regime may have potentially increased the scope for financial imbalances to grow during expansionary phases owing to a relaxation of financial and monetary constraints. In other words, *in the absence of compensating policy changes*, they may have raised the 'elasticity' of the economic system, making it more vulnerable to boom and bust cycles. In those expansions in which the imbalances did develop, they would both reflect and contribute to distortions in the real economy, thereby undermining the sustainability of the expansion. By the same token, they could saw the seeds of headwinds and financial stress during the subsequent downswing." (Borio/White 2004: 13)

Hence, safeguards are needed to profit from the surely existent benefits of financial liberalization, while minimizing its potentially enormous costs in terms of economic welfare lost when an asset bubble bursts. The policy implications are twofold, regarding prudential and monetary policy. Prudential oversight and regulation is key to developing a "new international financial architecture", which of course has to have a macro-prudential orientation. It has to focus on a system-wide perspective of financial risks, not on the possible failure of individual institutions (Borio/White 2004: 25-7). Until today, this macro-perspective isn't common knowledge in the scientific community of economists. There is a dangerous tendency towards procyclical behavior in our modern financial systems. Whenever economic circumstances are favorable and banks and investors are in a good mood, systemic and individual asset's risks seem to be minor and the willingness to take risk is high (strong risk appetite). This is a special form of "herd behavior", leading to contagion effects, which psychologists already recognized 30 years ago (e.g. Kahneman/Tversky 1979).

> From a monetary policy perspective, the role of central banks would be "to anchor the liquidity creation process and hence the availability of external finance; credit extension plays a key role here. The anchoring would help to reduce the elasticity of the economy, thereby providing critical support to prudential policy. The authorities could implement it by being prepared to lean against the build-up of financial imbalances by tightening policy, when necessary, even if near-term inflation pressures were not apparent." (Borio/White 2004: 27-8)

This applies to activities of hedge funds and other highly-leveraged institutional investors in stock markets, but is even truer in real estate and the mortgage markets, comprising markets for derivatives (like asset-backed securities on US subprime loans). A system of asset-based reserve requirements (ABRR) seems to be a promising approach towards reducing liquidity in overheated markets. It would force all banks and institutional investors to deposit a certain percentage share, levied on the current value of their asset holdings, as “minimum reserves” at the respective central bank, which together with other prudential regulators is competent for their oversight. These ABRR would function as automatic liquidity breaks, reducing asset returns, and generating rising, more risk-adequate interest rates for loans taken for speculation, which are backed by markedly overvalued assets (for details see Palley 2004 and Holz 2007).

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