Predicting Changes in Investor Behavior

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How do you respond when someone asks if an asset class is over, under, or fairly valued today? If you're like us, your first response is to ask, "over what time horizon?" We view financial markets as a complex adaptive system, in which asset prices are, in the long term, attracted to their fundamental values (itself a metric which can only be estimated with uncertainty). In the short term, however, asset prices are much more strongly influenced by collective investor behavior. We are the first to admit that this isn't exactly a new view - after all, in the 1934 edition of his classic book Security Analysis, Ben Graham famously noted that "in the short run, the market is a voting machine, but in the long run itâ€™s a weighing machine." However, this quote, and the view of financial market dynamics that underlies it, raises two critical questions. How do you estimate fundamental value? And how do you forecast investor behavior? Over the past ten years, we have written many articles and employed many methodologies to address the first question, with the latter principally focused on the relationship between the returns an asset class is expected to supply (e.g., in the case of equities, the current dividend yield plus the expected dividend growth rate) and the returns an investor should demand in normal conditions, when the attraction to equilibrium is strongest. We express this as the current return on real return (inflation indexed) bonds, plus an appropriate risk premium.

Unfortunately, experience has shown that asset class prices usually revert towards their fundamental values only over relatively long periods, and do so in a volatile manner that reflects the fact that fundamental value can only be estimated with some degree of uncertainty. For investors who are pursuing goals over shorter time horizons (e.g., a portfolio manager who is compensated on

annual results), analysis of fundamental valuation on its own provides insufficient information for making decisions. They also need ways to forecast short term investor behavior and its impact on asset prices. That is the subject of this article, which attempts to boil down a large amount of recent research in different areas into a useable framework for thinking about an issue that is very complex, challenging and critical.

We begin with the observation that collective investor behavior results from two main processes: the way individuals make decisions in the face of uncertainty, and the process that aggregates individual decisions into collective behavior that causes changes in the prices of index products that track the performance of broadly defined asset classes. At the individual level, our reading of various strands of research over the past ten years had led us to conclude that behavior results from the interplay of three constructs, which we call the investorâ€™s mental model, emotional model, and decision model.

Different writers ascribe different meanings to the term "mental model." For us, a mental model is a cognitive framework or system that enables us to extract meaning from the flood of information we confront each day. Mental models describe our understanding of the dynamic process that generates outcomes that are of interest to us, including the key variables involved and relationships between them. They typically include four broad sets of rules. The first entails rules for categorizing the meaning of information, which provides a quick and coarse means of ascribing meaning to it. The second is a set of cause and effect rules, which we use to explain the past and predict the future. A critical (but often overlooked) aspect of this rule set is assumptions about how other parties who are relevant to a given situation will behave.

The third set of rules in a mental model tells us where to allocate our relatively scarce attention, given the flood of information we confront each day. At least three forces contribute to this process. The first are deeply rooted tendencies that helped our ancestors to survive eons ago on the East African savannah. These

involve changes that are large, rapid, and/or surprising, that could signal a threat to our wellbeing (e.g., why was it that the Lehman bankruptcy set off such a large cascade in 2008, while the Bear Stearns rescue did not?). The second driver of attention allocation is the cause/effect relationships that populate our current mental model of an issue or situation, which tell us which information about it is important. Some writers have referred to the resulting tendency to automatically allocate scarce attention to information that reinforces our current mental model as the "confirmation bias." To be sure, the scientific method is based on seeking information that disproves our current views; however, this also leads to a situation in which all mental models are only tentatively held, in the sense that the best we can say in their defense is that they have yet to be disproven. Depending on the circumstances, this may be an insufficient basis for taking action. Hence, one can argue that the confirmation bias serves an evolutionary purpose, in that by reinforcing existing beliefs it enabled our ancestors (and us today) to generalize, and to take purposeful action to achieve important goals on the basis of those inductions. The third force that affects the allocation of our attention is our observation of the information that other people consider to be important. Again, the evolutionary basis for this seems clear, as it enables both imitation (an efficient form of learning) and the coordination of group action, both of which were undoubtedly advantageous to our ancestors.

Finally, the fourth set of rules that one should (but too often don't) find in a mental model are those governing self-evaluation and adaptation, that answer the questions "when do I need to change my mental model?" and "how do I go about doing that?"

Let us now move on to our emotional model. In recent years, researchers have moved from a view of reason and emotion as competing, if not antithetical systems, to one that sees them as complementary processes that generate the meaning we ascribe to different combinations of sensory and information inputs. Our concept of an "emotional model" is based on findings from psychology and neurobiology. In the case of the former, our starting point is Dietrich Dorner's Psi

Theory, which posits a group of basic human desires (similar to those put forth in a more hierarchical structure by Abraham Maslow). These include self and species preservation, certainty (predictability), competence (i.e., the ability to satisfy one's needs) and affiliation. Complementing and reinforcing this view are recent findings from neurobiology, about which we have previously written. In the realm of investment management and changes in investor behavior, we have focused in particular on the role of the amygdala, and circumstances that trigger physiological fear reactions, and on those circumstances that elevate dopamine levels, and trigger feelings of pleasure. The former include the experience of loss (at the individual level, of resources, and at the social level of relative standing in a hierarchy), social isolation, and especially an increase in uncertainty. It is also important to note the interconnection between these fear-related effects, particularly the increased fear of social isolation in the presence of heightened uncertainty. There is also evidence of a feedback channel to our mental model, with an elevated amygdala response predisposing one to higher levels of pessimism about the meaning of new information. In contrast, it has been shown (e.g., by Coates and Herbert, in "Endogenous Steroids and Financial Risk Taking on a London Trading Floor") that trading success is associated with elevated testosterone and dopamine levels, and greater willingness to take risk, and, one suspects, with higher levels of optimism and/or overconfidence and willingness to dismiss or underweight negative information.

The interaction of outside stimuli with our mental and emotional models produces a mix of understanding, meaning (which encompasses both rational and emotional aspects), and intention -- a desire to take action to satisfy cognitive and emotional needs produced by a given situation. The next step on the path to individual behavior is the processing of understanding, meaning and intention through a normative or decision model, which recalls or devises possible actions and evaluates them against a set of criteria. The first key aspect of an individual's normative model is the richness and variety of his or her previous experience. One marker of expertise is the ability to rapidly recognize and choose an action that is an appropriate response to a given situation. An expert can draw on a

range of possible action plans that have produced desired results in the past, and can be executed with ease. On the other hand, this is another way in which the development of expertise often sows the seeds of its own demise, by making experts overconfident about their understanding of a situation, and prone to excessively anchor their behavior on what has worked for them in the past.

However, an equally important aspect of the normative model is the decision criteria that people use to select the action to execute. As we reviewed in our June 2009 issue, regret aversion has a powerful influence on human decision-making. Specifically, they prefer to avoid errors of commission (such taking an action at odds with the conventional wisdom/majority view and being wrong), even if that raises the probability of making errors of omission (not taking an action at odds with the conventional wisdom, when it later proves to be correct). And this is in spite of the fact that some studies have found that errors of omission are much more costly than errors of commission. Or as Keynes noted back in the 1930s, most people would prefer to fail conventionally than to be unconventionally right. Why is this, when we have previously noted how our neurobiology clearly associates loss with heightened fear? The answer, we believe, lies in the observation that many decisions have social as well as purely economic aspects. For example, in a recent paper ("Interdependent Utilities: How Social Ranking Affects Choice Behavior"), Bault, Coricelli, and Rustichini find that "the relative weight of gains and losses is the opposite in the private and social domain." When the results aren't observable by others, losses hurt about twice as much as gains feel good, just as Prospect Theory predicts. As a result, under these circumstances, human decision makers are usually willing to take more risk in order to reverse losses, but less risk when seeking to conserve gains. However, when others can observe the results of our decisions, losses run the risk of reducing our status in a social hierarchy. In this case, our strong aversion to loss of social status, and desire for increased social status, tends to make people more risk averse in the presence of losses, and less risk averse in the presence of gains. As the authors note, "social emotions [like envy] have stronger effects than their private counterparts, [and] they operate

differently...social gains have a much stronger emotional affect than social losses -- in other words, in social contexts, people like winning more than they dislike losing." Moreover, the experience of past social gains is associated with increased willingness to take risk in the future. The authors conclude, "In private environments, losses are particularly harmful because they can bring an individual closer to a critical level in terms of survival. Hence losses have to be avoided more than gains. In social environments, rewards are frequently assigned on the basis of a winner-takes-all rule [or something close thereto].... Hence, [in social environments] behavior is more driven by the prospect of winning than the prospect of losing."

With respect decision criteria in the world of delegated investment management, four other points are relevant. First, in virtually all asset classes, the majority of trading (and therefore price setting) is done by managers acting on behalf of principals whose money they manage. Second, these managers' performance is typically evaluated at regular intervals, most often at year end. Third, this performance evaluation often involves comparison to external benchmarks which contain, particularly in rising markets, a strong momentum component (which is reinforced as the market share of market capitalization based index funds rises). Fourth, professional investment managers usually face asymmetric incentives, with the rewards for superior performance substantially greater than the penalties for poor performance.

Let us now turn to the process by which individual behavior is aggregated into the collective behavior that drives changes in asset prices. As Duncan Watts notes in "The Collective Dynamics of Belief", "when individuals make decisions partially or fully in response to decisions of other people, the relationship between individual preferences and collective action breaks down... The collective outcome is determined by the interaction of chains of sequential decisions, where nobody is aware of the full chain...When collective behavior arises from a stochastic, non-linear aggregation process causation becomes diffuse and uncertainty arises." Indeed, multiple researchers have shown how in

markets where people make decisions in part based social considerations (whether observation of or input from others), prices can depart from fundamental values, by substantial amounts and for long periods of time (e.g., see "The Reality Game" by Cherkashin, Farmer, and Lloyd; "Leading the Herd Astray" by Salganik and Watts; and any number of papers by Blake LeBaron and Cars Hommes). Across a range of disciplines, the manner in which social networks evolve and generate collective behavior is a very popular topic of study today. For our purposes, some of the most important findings from this research are that network fragility (i.e., susceptibility to so-called "punctuated equilibrium events") increases non-linearly with the size of a network, and density of connections within it (note too that in this context both high leverage and derivative use can be seen as a means of increasing network interconnectedness); that rising uncertainty increases people's desire for social affiliation, and hence network density; and that substantial changes in collective behavior are as likely to be driven by the transfer of information between relatively uninformed and sparsely connected individuals as they are by changes in behavior by highly connected and well informed individuals (so-called "influentials"). Regarding the latter phenomenon, it isn't so much the person telling you a story that matters, but rather the quality of the story (or "meme") itself that drives the spread of new information and collective behavior changes. This is reminiscent of one of Richard Nixon's famous sayings that a person should only run for office, "when you have something different to say and the people are ready to hear it."

So where does this leave us, when it comes to the challenge of predicting short term collective investor behavior? Our starting point is that the default assumption should be that the current trend will continue. This is consistent with a range of factors across our mental, emotional, decision and network models. These include the confirmation bias, our basic needs for predictability and competence, our strong aversion to errors of commission (deviating from the prevailing conventional wisdom and being proven wrong), the nature of the incentives facing many professional investment managers (asymmetric upside

compensation, based on performance relative to benchmarks which have, especially in rising markets, a strong momentum component) and the observation that low uncertainty should hold down the relative size and density of social networks.

Our analysis also points to the conditions which raise the probability that a substantial change in investor behavior will occur. In the realm of mental models, we look for increasing evidence that is at odds with the "conventional wisdom", or prevailing model that people use to explain and forecast events. Due to the confirmation bias, these anomalies are likely to be underweighted by the majority of investors; hence we also look for changes in the amount of attention given to them by popular commentators. We also distinguish between rising doubts about the structure of the model itself (e.g., "do we really understand what is going on?") from the normal level of debate about the correct values for variables in the existing model ("unlike your firm, we're projecting capacity utilization will be 86% next month"). Uncertainty spikes when confidence in the current model collapses with no consensus about what should take its place. We also look for small spikes in volatility (the VIX index) that quickly disappear, that are akin to tremors that precede an earthquake in a geologic system under extreme stress. We also look for the appearance of substantial gaps between prices and our estimates of fundamental values, and for strong activity by a public policy player in an asset class (e.g., the financing of the U.S. current account deficit in 2007 and 2008 by foreign central banks; China's ongoing undervaluation of its currency, or today's policy actions by Western central banks intended to hold down government bond yields).

At the emotional level, we seek to quantitatively and qualitatively monitor the level of uncertainty felt by investors, as well as what we call the uncertainty versus envy balance. With respect to quantitative metrics, the VIX is most widely used, though S&P has recently issued a whitepaper describing a new (but as yet uninvestable) index designed to track a broader range of investment sentiment indicators. We also publish our own mix of indicators designed to track the

market's evolving views on the probability that different regimes will develop, including the one we term "High Uncertainty." In terms of qualitative indicators, we believe that in recent years the combination of widening income gaps, increased conspicuous consumption by those at the top, and easy access to credit have tilted the uncertainty/envy balance more strongly in favor of the latter as a driver of investor behavior. In the runup to the crash of 2008, this shift undoubtedly prolonged price rises in many asset classes, and led to more extreme levels of overvaluation. Following the crash, we believe that envy remains a potent force, causing levels of thus far mostly repressed anger to rise in many segments of the population. We believe that as long as it is unresolved (e.g., either by reduced unemployment and renewed wage growth, or by much higher taxes on the affluent) this tension will remain a potent source of future behavior changes that could be both sudden and substantial. We also believe that this potent emotional tension is only being strengthened by the growing gap between the apparent recovery in financial markets and continuing weak conditions in the real economy.

In terms of decision models, we believe that, given the nature of the compensation system facing delegated asset managers who dominate trading volume, all else being equal, the probability of downside moves decreases relative to upside moves the closer we get to year end performance evaluations and bonus determinations. On the other hand, when other variables in the system indicate an elevated probability of substantial asset price changes, the game among professional investment managers changes to what Keynes called "beat the gun" -- or the excruciating tension between staying invested long enough to achieve top quartile performance, and the risk of not being able to get out ahead of a potential rout. In another famous analogy, Keynes likened this to a game in which the objective was to guess the average of what the other players' guesses would be (research has shown that in such games, most people reason at most two steps ahead). We believe that this tension helps to give rise to the short spikes in volatility that can occur during such periods (when managers are hyper sensitive to news items that they believe might trigger a major market

move), and which often precede a substantial collapse in asset prices.

Finally, when it comes to indicators of heightened network size, connectedness, and communications intensity, we look to measures like short term correlations (or overlayed short-term asset class price charts), the phase change/asset class alignment metric we have started to publish each month, as well as our rolling three month returns for asset classes that perform relatively best under conditions of high uncertainty.

In sum, forecasting collective investor behavior over the short-term remains a very difficult challenge. Yet it is one that investors ignore at their peril, as sharp downside moves will always be mathematically devastating to investors' ability to achieve their long-term goals. Rather like weather forecasting, identifying turning points in investor behavior requires the ability to integrate multiple indicators that measure the state of the financial markets system, and use them to draw inferences about the probability that severe storms may occur in the near future. And when that probability rises to a high enough level, it requires the willingness to buck conventional wisdom, and issue clear warnings to investors, as we did in May 2007.