

## Time Portals and Other Illusions: Some Common Trading Mistakes and Their Unhappy Consequences

**Y**OU NEVER KNOW who's swimming naked until the tide goes out." What corporate chieftain said this to CNBC and its viewers on March 13, 2007? As it happens, these were the words of Angelo Mozilo, CEO of mortgage giant Countrywide Financial, as he optimistically applied Warren Buffett's famous 2001 Chairman's Letter maxim to Countrywide's future prospects as the mortgage industry consolidated. We'll explore the irony of this in a bit.

First, though, the Buffett aphorism raises some uncomfortable questions. How did finance professionals get in the water naked without anyone noticing? What was their plan for getting out? Why did they stay in the water long enough for the tide to change? This *Market Insights* takes a closer look at some real-world examples of common investor mistakes like those that may have tripped up Mr. Mozilo's firm. By "investors," we mean all classes of market participant, whether amateur or professional and whether banker, hedge fund manager, insurance company executive, fund-of-funds operator, high-net-worth individual, or mutual fund investor.

We consider ourselves something of an authority on the subject of mistakes not only because we've seen others make them, but also because, over twenty-plus years, we've made our share. Our firm's investment process involves sourcing an investment idea and then trying to poke holes in it. We can't prove that a given trade idea is sound, so we instead try to *disprove* its soundness in as many ways as possible. The fewer apparent flaws, the better.

## Intuition versus Reason: Uncomfortable Companions

**B**efore we get into specific examples of investor error, it may be helpful to provide a little theoretical context. In his pioneering work in the field of behavioral finance, Nobel laureate psychologist Daniel Kahneman has distinguished between human *impressions* and *judgments*. Impressions are governed by the brain's ability to intuit based on immediate perception. Judgments, on the other hand, are conclusions drawn either from impressions alone (*intuitive judgments*) or the application of formal reasoning (*rational judgments*). Rationality is involved in both types of judgments, just in different ways: either the brain has developed an intuition and its reasoning side has implicitly approved the conclusion without further rational inquiry, or the brain has explicitly employed rational methods to confirm the initial insight.<sup>1</sup>

According to this framework, investors make two elemental types of mistake, one relating to faulty intuitive judgment and the other to faulty rational judgment. Errors of intuitive judgment occur when reason does not correct prior misperceptions or biased intuitions. So an investor may initially think, "Citi is at \$3! I can buy a share of Citi for less than a bottle of fancy water!", but it's likely that reason will soon kick in and demand that Citi's number of outstanding shares, its capital structure, and other factors also be considered. When this policing function does not happen, however, the result is a mistaken intuition left uncorrected by rational judgment. In other cases, rational judgment mistakes can stem from implementation errors in the machinery of reason itself, such as using an incorrect discount rate or performing a faulty regression. Through education, vigilance, and analytical rigor, an investor can reduce his or her exposure to both intuitive and rational judgment errors, although, sadly, perfection is probably unobtainable.

With the aid of these insights from theory, we can now outline a couple of specific categories of investor error that we've observed. The first mistake we'll discuss is what we call the *time-portal fallacy*. This error involves focusing excessively on the terminal outcome of a trade while focusing insufficiently on volatility and the potential paths of profits and losses

<sup>1</sup> See Daniel Kahneman, "Maps of Bounded Rationality: A Perspective on Intuitive Judgment and Choice," *Prize Lecture*, December 8, 2002, available at [http://nobelprize.org/nobel\\_prizes/economics/laureates/2002/kahnemann-lecture.pdf](http://nobelprize.org/nobel_prizes/economics/laureates/2002/kahnemann-lecture.pdf).

("PnL") along the way. The second mistake is an error that we call the *illusion of continuity*. This error arises when investors predict the effects of a change in the world using logic or assumptions that likely will no longer apply when that change occurs.

While we'll reference Kahneman's work to highlight certain aspects of both types of errors, many of our observations about how these errors manifest themselves in actual investment and trading decisions do not snugly fit under one or another conceptual category. As with most real-world phenomena, actual investor behavior often defies a single convenient descriptor.

## The "Time-Portal" Fallacy

**I**n analyzing a particular trade, an investor would ideally consider all of the possible paths that the trade could take and what the consequences of those different paths might be at any given moment between the present time and the trade's terminus. In practice, most investors find this task far too complex and thus necessarily fall back on various simplifying heuristics or rules of thumb. These might include calculating expected return and volatility over some time frame or identifying a discrete set of scenarios as of a future date. These heuristics work well in most cases, but on occasion they may unfortunately cause investors to overlook important characteristics of a trade. With respect to scenario analysis in particular, we've observed that investors often behave as if they are trading with the benefit of a "time portal" that allows them to leap effortlessly to a future point in time. In reality, the path to the future may prove both long and bumpy in terms of mark-to-market volatility, which may be fine to ignore in many situations but could be highly dangerous in others.

### When "Can't Miss" Trades Miss

The time-portal effect is perhaps most evident when investors engage in faulty logic while thinking about financial cataclysm. Consider situations in which investors are tempted by trades they view as almost certain winners if held to maturity or likely to produce losses on an ultimate *realized* basis only in apocalyptic states of the financial world (where it seems like losing the amount of money at risk is a paltry concern). To illustrate the risk profile of a typical trade of this sort, let's take the simple hypothetical example of a virtually risk-free bond that is priced at 99, pays LIBOR, and will mature at 100 in five years. This is the kind of trade that

investors occasionally pile into, viewing it as a pure arbitrage that, in effect, generates “free money.” And if an investor levers that trade up 20 times, then it seems like a great deal of free money. But investors sometimes ignore mark-to-market volatility and the possibility of many different PnL paths on the way to collecting their (not quite) free money. If the price of the bond temporarily goes to 95, that could end up bankrupting a highly levered investor. In that case, attempting to collect this free money may not be such a good idea, even if the original thesis that the bond will go to 100 at maturity proved correct.

Investments in so-called “super-senior” tranches of investment-grade corporate credit offer a more concrete example of the dangers of the time-portal effect when investors engage in flawed “end-of-the-world” scenario analysis. Investors seeking exposure to the corporate credit market often take positions in credit derivative indices. These indices allow investors to buy or sell credit protection on a basket of companies. Many investors would consider a long risk investment in the CDX.NA.IG 5-year 30 - 100% tranche to be quite attractive. In this trade, investors earn a premium by selling protection, for a period of five years, on the highest-rated tranche of an index composed of North American investment-grade corporate credits. Assuming roughly a 30% recovery on defaulted credits, it would take defaults on the debt issued by more than 50 of the 125 companies in the index before the tranche representing that slice of the index would realize a loss. Presented with such an instrument, many investors over the last few years have been tempted to go long that risk, even when the premium paid to sellers of credit protection was as little as 1 basis point (see Figure 1). The justification for doing so has usually been along the lines of, “There’s no way that tranche is going to get hit. And if it does, we’re probably all dead anyway. It’s basically free money.” Similar sentiments have been voiced about selling credit protection on U.S. government debt. Collecting premia by selling credit default swaps (“CDS”) on the United States will result in a loss only if the U.S. government defaults on its debt obligations. Given that context, a trader might reason, “It’s virtually impossible that the U.S. government will default on its debt, and if it does, we’re all gonna be bankrupt anyway, so who cares?”

This sort of reasoning may be fairly sound with respect to the likely ultimate outcome. If an insurance company could sell a policy that pays off only in states of the world where no one is around to collect or even file a claim, that would be a good business proposition at any price. But there’s an important

difference: this hypothetical insurance policy wouldn’t need to be marked-to-market, while CDS trades do. And while it seems difficult to imagine the CDX.NA.IG 5-year 30 - 100% tranche suffering a realized loss or the U.S. government defaulting on its debt, it’s not too hard to imagine the market temporarily implying a significant chance of either happening. In all likelihood, this wouldn’t be because the consensus probability of an actual default is high, but instead because large risk premia or unusual technical forces—what academics call “noise-trader risk”—affect the market’s current level. The proposition that markets can temporarily behave in strange ways is not new—in 1936, John Maynard Keynes famously noted that “the market can stay irrational longer than you can stay solvent”—but that point is overlooked from time to time, with potentially dire consequences.

Many investors do not consider that if the market were to price in even a relatively small increase in the implied probability of future financial calamity, they’d immediately experience unrealized losses and have to post variation margin equal to many multiples of what they had hoped to make on the trade. And, of course, investors often must lever such end-of-the-world credit-protection trades to make any real money, thus intensifying the pain. AIG is perhaps the paradigmatic recent example of an institution that forgot this lesson. The firm freely sold credit protection on highly-rated securities, apparently in the belief that such contracts would ultimately (on the other side of the mythical time portal) amount to free money, while ignoring mark-to-market risk.

### Selling “End-of-My-World” Puts

Sometimes the time-portal error, through apparent disregard for the abrupt appearance of end-of-the-world risk, can take a more narcissistic form in which investors initiate “end-of-my-world” trades while being similarly oblivious to path dependency. A common example involves financial institutions selling the equivalent of put options struck on their own credit rating. Why would institutions do this? It’s possible that the return they receive is sufficiently valuable to justify it. It also may be that they can manage this risk with extreme care. Finally, it’s possible that this is a subtle form of fraudulent conveyance, leaving losses for a different class of investors who will be left holding the bag in the worst-case scenario, and earning money for current investors in the normal state. But whatever the reason, and even if all predictions *ultimately* prove correct, certain paths could lead to the disastrous exercise of these sorts of implicit “puts.”



Again, AIG presents perhaps the most striking recent example of this behavior. It's widely known that AIG sold protection on collateralized debt obligations ("CDOs"). Somewhat less well known is that, in certain instances, AIG structured these contracts such that the AAA-rated firm would not need to pay out variation margin on mark-to-market losses but would have to make substantial payments to the counterparty if its credit rating fell below a certain threshold. Although AIG management's repeated claims that the portfolio of CDS contracts they had written on CDOs was fine on a held-to-maturity basis may not have been fully genuine, most observers could probably appreciate that AIG focused far more on held-to-maturity forecasts than on the potential volatility on the way to maturity. In AIG's earnings call for the first quarter of 2008, for example, management indicated that "although the fair value of the CDS under GAAP is our best estimate of the fair value of the underlying CDOs, the substantial risk that AFP [AIG Financial Products] covers for the CDO investors is the risk of suffering actual realized losses, not the variance in fair value of the CDOs."<sup>2</sup> That may have been narrowly true of the risk that AIG was

underwriting, but it was not true of the more general risk to which the firm itself was exposed. Mark-to-market losses could lead others to question the creditworthiness of the firm and ultimately result in a ratings downgrade, thereby causing real harm to the company, which, of course, is exactly what happened to AIG. As credit markets melted down, mark-to-market losses on the swap portfolio and ratings triggers helped push AIG to the brink of bankruptcy. In other words, selling puts on oneself is particularly pernicious because it effectively creates the conditions for an ugly self-fulfilling prophecy. It may be a productive strategy for market participants in certain situations, but it must be managed very carefully with a view not just to the terminal outcome, but also to possible paths to that outcome.

We'll offer a last example to illustrate the time-portal fallacy as it applies to end-of-my-world trades. Consider a CDS dealer that believes selling CDS protection on its own firm is free money because, if the CDS triggers, the firm will be bankrupt and won't have to make any payments. As a topic of frequent discussion within the trading community, this example is more of an illustration of how some traders think than a real-world case. But it does underscore some of the dangers of selling implied puts on oneself under the intoxicating influence of the time-portal potion. Far from capturing free money, a CDS dealer that's short protection on itself and ultimately goes bankrupt very likely *would* have to make payments before going out of business. And

<sup>2</sup> AIG made similar statements in its 2Q08 earnings call, before the implosion: "Despite the marks taken, the portfolio of CDOs is showing resilience. We have not yet incurred any realized credit losses in the portfolio. Further, the level of defaulted assets in the underlying collateral of CDOs is very low compared to the weighted average attachment points in those structures."

conversely, the buyer of the CDS protection would likely receive some payments rather than go completely uncompensated.

To see how this works in simple terms, let's ignore our old friend (from our previous *Market Insights*) cash-CDS basis and assume that the pricing on CDS contracts has a perfectly inverse relationship with the value of bonds. Envision a scenario in which a dealer sells CDS protection on itself to a client when the dealer's bonds are at 100. The dealer then suffers some form of financial distress, and its bonds fall to 70. When that happens, the dealer must pay out 30 points of cash to the client to cover the mark-to-market loss on the CDS. If the bonds drop another 15 points to 55, the dealer pays out an additional 15 points. On the day that the dealer actually defaults, those bonds might fall another 20 points or so. The associated 20-point margin payment probably will not be made then but rather will be claimed by the client in bankruptcy court. So while it's true that the realized loss occurs after the dealer defaults, in this example the dealer actually made prior cash payments of 45 points in variation margin. In pursuing a supposedly free-money trade, our hypothetical CDS dealer faces significant losses because of, not despite, the effects of mark-to-market volatility. The pain is amplified by the self-reinforcing quality of these trades: ironically, far from producing losses only in scenarios in which one doesn't care at all about losses, end-of-my-world trades actually lose in scenarios in which one cares the most about losses.

Why do investors make this type of time-portal mistake? Applying Kahneman's framework, perhaps it is because the ultimate outcome of these trades intuitively seems so apparent and certain, while the rational calculation required to analyze and truly understand the trades is much more nuanced. The proper prescription for combating such thinking may be to force oneself to consider the subtleties by performing scenario analysis over different time horizons, not just to the date when the trade is guaranteed to have converged.

### Illusions of Continuity

Let's put aside the time-portal analogy and move to another category of investor mistake we see. Kahneman and others have observed the prevalence of *anchoring* and *narrow framing* biases in experimental settings. The general idea is that human thinking can often fall under what we call "illusions of continuity." "Anchoring"

is the tendency of individuals to base estimates or predictions on previously perceived baseline states. For example, researchers have conducted experiments that involved asking real estate agents to appraise a property. The agents were given information on the size of the property and its specific features, prices of similar properties recently sold, and asking prices for similar properties on the market, as well as a listing price. Some agents were given a listing price that was 12% above an independent appraisal value, and some were shown a listing price that was 12% below the appraisal. The researchers found that agents in each group appraised the property's value by anchoring to the listing price they were given rather than considering the other data.<sup>3</sup> Likewise, investors often anchor to the current state of the world. We intimately know the current state of the world, and it's hard for us to adjust our perspective enough when thinking about a new state.

"Narrow framing" is the tendency of individuals to isolate a decision or choice from the rest of the world or from the broader class of phenomena to which that decision or choice belongs. It's an extreme version of anchoring to the current state of the world, in that individuals eliminate altogether some directly relevant issues from their calculations. Take the basic example of life insurance. Some people may be tempted to think, "I feel pretty good right now, so I don't think I need life insurance. If I get sick, then I'll take out a policy." The flaw in this reasoning, of course, is that if one gets sick, it's much harder and costlier to get a policy. Ignoring the effects of change—getting sick, in this case—when planning for the future reflects reasoning from assumptions that will no longer apply and thus leads to false conclusions. The life insurance example is obviously a simplistic one, and most people wouldn't fall prey to that "logic." But when situations become complex and the number of effects of a contemplated change begins to multiply (as in many real-world trading situations), a person is more likely to fall back on narrow framing. Investors can get into serious trouble when trying to predict the effects of a change in the market on the basis of logic or facts that likely will no longer apply in a world where that change has occurred.

<sup>3</sup> See Gregory B. Northcraft and Margaret A. Neale, "Experts, Amateurs, and Real Estate: An Anchoring-and-Adjustment Perspective on Property Pricing Decisions," *Organizational Behavior and Human Decision Processes*, Vol. 39, No. 1 (February 1987), pp. 84–97.

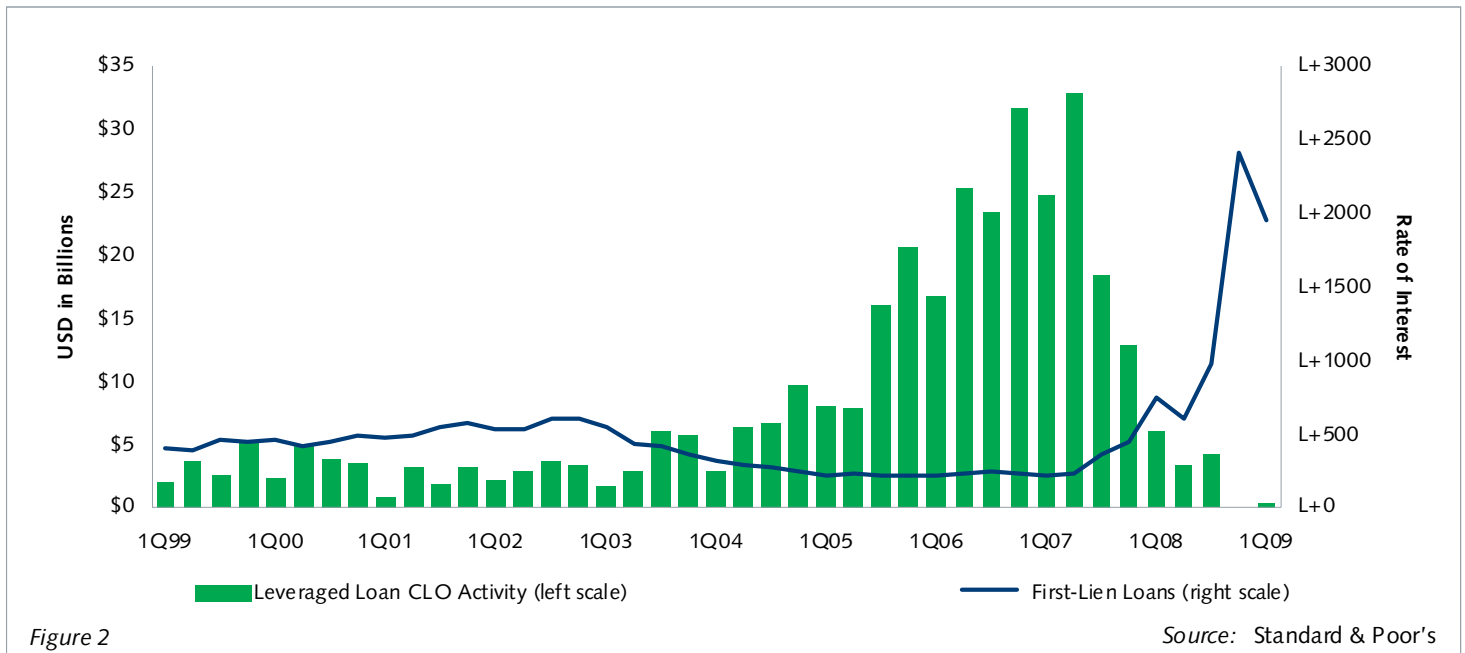
Consider the aforementioned statement of Countrywide's CEO in March 2007 in the context of anchoring and narrow framing. Beyond the obvious irony of Mr. Mozilo's quoting Buffett on swimming naked when Countrywide itself seems to have been skinny-dipping, his comment may have had substantive consequences for investors. In his remarks to CNBC, Mr. Mozilo stated that the meltdown in the subprime mortgage market "will be great for Countrywide because at the end of the day, all of the irrational competitors will be gone." While this may just have been a self-serving statement of the kind that CEOs sometimes make to the press, what if investors really believed it? Even if it were true that Countrywide had less subprime exposure than other lenders, investors buying Countrywide stock over the two or three months after Mozilo made these remarks very well may have assumed that little, if anything, had changed in the mortgage lending space except the forced exit of some key competitors. After Countrywide's stock slid from a high of \$45 in January 2007 to \$32 in March, it rebounded to \$40 in May. Investors may have found it difficult to imagine a world (*i.e.*, to move outside the assumptions of their anchor state) where the economy was so damaged that a company like Countrywide could suffer considerable losses.

### Walls of Money

One of our favorite examples of the illusion of continuity is the *wall-of-money fallacy*. Investors often presume that demand for some asset class or type of trade will persist no matter what. If price is a function of fundamentals and random noise, this view of the world essentially assumes that prices only move on noise, and that fundamentals do not change. Take, for instance, recent dynamics in the market for leveraged loans. A little over two years ago, leveraged loans were regarded as well-secured and were gobbled up by collateralized loan obligations ("CLOs") and other pools of capital. To many observers, it seemed inconceivable that these loans could drop in price for long periods because there was huge demand—a "wall of money"—waiting to buy them if the price fell by just a small amount. The thinking was, "If these loans go to 90, there will be so many CLOs formed to buy them, and the returns on buying them with leverage will look so attractive, that the price will shoot right back up to 100." But in a world where those loans have dropped to 90, isn't it possible that something else has fundamentally changed? Will investors still want to invest in CLOs, and will leverage be available to investors purchasing them outright? With the benefit of hindsight, we know that

the world changed a lot. As the price of leveraged loans began to fall, investors declined to buy CLO liabilities, and banks not only stopped wanting to lend against those loans, but also became net sellers of the loans themselves. Figure 2 shows the relationship between CLO activity and pricing on leveraged loans in the past decade.

Traders occasionally trot out the wall-of-money argument when analyzing the convertible bond market, particularly during periods when converts are priced somewhat richly and yet market participants are not "fully invested." Let's suppose convert investors are 80% invested. In those circumstances, subscribers to the wall-of-money argument tend to view the 20% extra capacity as a huge amount of potential demand for convertibles were they to get cheaper for whatever reason. If there is a small down move in the asset class without much else changing in the world, then this capital very well could prevent the market from cheapening too much. But if the market falls precipitously, this sidelined capital may not be adequate to counteract the reduction in price because many of the following conditions are likely to be true: (1) investors have just lost a bunch of money on the down move, which will have used up much of the sidelined capital; (2) volatility and thus risk are higher, which reduces the desire for increased exposure to the asset class when it otherwise may look cheaper; (3) leverage is likely to be less available than before because volatility is higher, causing investors to want to hold more buffer capital or reduce leverage rather than increase the size of their portfolio; and (4) fund managers have set aside capital to pay anticipated redemptions. More often than not, the wall-of-money reasoning will apply to small moves that probably reflect noise trading because the amount of capital available is large relative to the size of the cheapening. But that reasoning is likely to be wrong with respect to large moves because they often result from more profound shifts, even if temporary, in financial tectonic plates, and the amount of capital on the sidelines may not be enough to reverse them. Consequently, using the wall-of-money argument as an investment thesis may actually be hazardous in practice because the investor, observing daily volatility that is modest given the operation of day-to-day supply and demand dynamics, may be tempted to use more leverage than he should after factoring in the possibility of a major change in fundamentals in the event of a crisis.



**The Fixed-Price Myth and Happiness Hedging**

Another form of the illusion-of-continuity mistake occurs when an investor advances arguments such as, “If the stock price falls to \$x, I’m necessarily happy to buy,” or, “I sold some puts at \$x because either the put won’t get exercised and I’ll collect my premium, or the put will get exercised and I’m happy to own it there.” In either case, the investor is happy to pay \$x for the stock no matter what. Clearly, this investor is making an assumption that the world where the option is exercised is substantially similar to the world today. In other words, he believes that all price movements are just noise. That assumption may be correct in some cases—although our hypothetical investor ignores that even in those cases he could have bought the stock more cheaply had he not sold the put—but it can’t be right in all cases. What if company fraud is discovered? What if the economy goes into a tailspin and the company’s business prospects change for the foreseeable future?

Sometimes, investors rely on similar thinking when attempting to engage in what might be termed “happiness hedging.” They may tell themselves, “If this stock goes down to \$x, we’ll buy it and make a ton! But if it keeps going up, we’ll miss out. So we’ll hedge our happiness and lock in some future PnL by selling a few puts.” Investors that initiate such trades and overlook other changes or risks may be doing so under the influence of biases such as anchoring or narrow framing.

This error of thinking too little about how a large change in the world might have an impact on a specific asset or trade seems to persist even in the immediate aftermath of that change. Over the last year, it was not uncommon on a big down day in the equity markets to witness investors buying their favorite stock even though they did not think that the market overall was particularly cheap. There’s an inherent contradiction in this behavior since, after all, not all stocks can be cheap relative to the market. This slowness to adjust to new realities—consistent with anchoring or narrow framing—was also reflected during the past few quarters in frequent observations about how amazing the investment opportunity set seemed. But if one drilled a bit deeper, the conversation sometimes went along these lines:

**John:** Cash-CDS basis is at negative 600 bps! That’s totally unsustainable. What an opportunity!

**Jane:** So buy some.

**John:** I can’t because no one will finance it for me, and I have no cash.

Many perceived opportunities were beautiful in the abstract but infeasible in the real world.

**Hard-Won Reputations**

A final and pervasive example of the illusion of continuity can be seen in the assumption that reputational effects in business relationships will *always* persist. This contention has

shaped discussions over the past couple of years about whether private equity firms and other potential buyers would eventually close on committed deals. Conventional wisdom held that even if a deal were significantly underwater, private buyers wouldn't walk away because backing out would make it far harder for them to do future transactions. But it can reasonably be argued that private equity firms almost always closed on acquisitions not so much because reputational incentives were the overriding motivation, but instead because it also usually made sense from a near-term, profit-making standpoint to do the deal. At the same time, those firms may have occasionally closed on smaller deals that were marginally unprofitable to preserve their reputational capital for larger and more important deals. However, in a world where both the average deal is underwater and the larger financial system is suddenly a lot less hospitable to private transactions, the link between reputation and incentives to complete deals might not be as relevant.

Reputational and relationship effects are indeed real and generally play a predictably constructive role when market conditions are "normal." But reputation matters the most in those cases in which two parties expect to continue to do business with each other for a long time—"repeated games," in the parlance of game theory. If a private equity firm is unlikely to do another deal for a few years, then the reputational cost of walking away from a given deal may seem less significant, particularly if the savings the firm would achieve by breaking the deal is a multiple of what it would expect to earn on that deal.

A strictly rational agent, unburdened by a sense of honor or altruism, will break its commitment if the reward for doing so exceeds the associated reputational damage. Clearly, when a deal is underwater, there is a short-term incentive to walk away from it. But historically, the potential longer-term damage to a firm's reputation that would result from walking away was a strong disincentive. Walking away meant that the firm would have a tougher time doing acquisitions in the future because the executives involved would be widely perceived as dishonest or lacking credibility. Over the past year, however, many deals were underwater at the same time and by a very large amount. The short-term incentives to walk away were therefore quite strong. Moreover, the fact that many firms were similarly situated lent credence to the view that this was a systemic event beyond anyone's control, so the reputational damage to individual firms was

greatly diminished given the protection of the herd. And what had been viewed as a repeated game now seemed less repeatable, as sluggish debt markets and dimmer fundraising prospects rendered future deals less important. The cost-benefit analysis changed as the deals became unglued. Because reputational effects tend to influence investment decisions in normal markets but not as much in periods of turmoil, a misplaced belief in the persistence of those effects may engender a degree of complacency as market conditions deteriorate and, paradoxically, increase the chances of a full-blown crisis.

A related but alternative way to view what happened is that investors such as merger arbitrage players and companies that are takeover targets failed to appreciate the extent to which all of these factors—the degree to which a deal is underwater, the likelihood of future mergers and acquisitions, and the importance of reputation—were highly correlated. If one assumes these considerations are independent, then the risk of a buyer walking away doesn't seem that large. To assign some loose numbers to this example: if deals are underwater 20% of the time and are underwater (relative to the takeover bid) by an average of \$100, and if firms are generally 10% likely to break commitments, then the risk (for merger arbs or owners of takeover targets) that acquirers will walk away would be  $20\% * 10\% * \$100 = \$2$ . But things are quite different if these factors move together. When a deal is materially underwater, it probably means that a private equity firm or other potential buyer will have a harder time doing future deals and will care less about reputation going forward. Perhaps such firms are 50% likely to break commitments in those circumstances, which raises the risk to  $20\% * 50\% * \$100 = \$10$ . The risk is probably higher than \$10 because in the previous calculations we used the average amount by which deals are underwater instead of the average amount by which *deals that break* are underwater. (On average, deals that break will be underwater by more than deals that don't break.) As we can see from the above analysis, the risk for investors or target companies that acquirers will walk away increases geometrically when we relax the assumption of independence. And while we've focused on private equity transactions, we believe this discussion of reputation applies to other financial and trading relationships.



## Conclusion

**T**he unusual number of self-defeating and value-destroying errors committed by market participants in recent years will be studied by financial practitioners and academics for a good while. This commentary has highlighted a small sample of mistakes that we've catalogued, and occasionally committed, over the years. We've obviously only scratched the surface of the broad topic of human decision-making frailty, so we may return to this subject in future *Market Insights*.

The literature on decision-making biases developed by psychologists over the past two decades has contributed significantly to a broader understanding of elemental investing errors of the sort identified in this commentary. Guarding against these errors requires extreme vigilance, and even that may not be enough. In particular, the modern financial system, with its vast scale and enormous complexity, poses a difficult test of our ability to make rational decisions. The decision-making heuristics that investors use seem to function well in "ordinary" times but may break down and result in considerable damage (for an individual market participant or an entire class of them) during extraordinary periods. The reason for this may be that as individuals we tend to ask ourselves, "*How often* is my model correct?" rather than, "*How broad* is the range of conditions under which my model may be successful?" Selling one-day out-of-the-money put options on the S&P 500 might seem a pleasing strategy because it would make money on almost every day, but it really makes money on only *one type of day*—days when the market doesn't crash. Similarly, many of our beliefs and heuristics become deeply engrained because they work on most days, but one should not overlook that "most days" actually falls within a narrow range of a broader set of possibilities.

At the D. E. Shaw group, we try to regulate our own investment decisions by following some basic principles. First, in our investment process, we make a conscious effort to identify and integrate awareness of the two types of error that we have discussed in this commentary. Second, we attempt to carefully segregate the risk exposures that we actively seek from those that are either undesired or unknown. Third, we question the assumptions that undergird our investment theses, and frequently revisit and retest those assumptions. These three considerations do not sum to a perfect science, and, given our past mistakes, we haven't always successfully implemented a regime that protects against these errors. But we do seek continual improvement in our work in these areas as we assimilate new information and gain additional experience in the markets that we trade.

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