Incentives, Behaviors and Cognitive Bias in the Risk Function

Approaching a more workable alignment between management rewards and risk-taking.

By Clifford Rossi

The financial crisis of 2008-2009 underscores the importance of risk governance and alignment of incentives for preserving the long-term viability of financial institutions. Widespread breakdowns in risk management of all types in the years leading up to the crisis have been well-documented. Despite significant advances in analytic capabilities that were supposed to improve the accuracy of risk assessment, fundamental breakdowns in risk management occurred, driven by poor corporate governance coupled with senior management cognitive biases.

These biases were manifest in poor executive compensation structures that failed to take risk management objectives into account and marginalization of risk management functions (both in terms of stature and financial support), leading to extremely poor identification, measurement and management of risks.

Under a weak corporate governance model, management may have greater opportunity to influence compensation structure with an eye toward maximizing their utility. Management cognitive biases may help shape performance objectives used in setting their compensation. In this process, risk management actions that reduce the chances of achieving target performance objectives may be resisted by management. Cognitive biases may then lead to management outcomes that marginalize the impact of risk managers to the business.

Legislative Mandate

The enactment of the Dodd-Frank Wall Street Reform and Consumer Protection Act has in part attempted to regulate improvements in risk management by requiring the establishment of risk committees of boards of banks with more than $10 billion in assets, and by requiring risk expertise on boards, among other changes, to bolster risk management. Cognitive biases of senior management are difficult to regulate if even possible, and thus a set of complementary actions are required to attack deeply rooted cultural-institutional attitudes toward excessive risk-taking.

A well-established body of literature exists on executive compensation, incentives and risk-taking. Another important strand of research explaining risk decisions under uncertainty is found in behavioral economics. Building on the work from these two areas, this article outlines a model describing the relationship between incentives and the effectiveness of risk management functions within the corporate structure. It shows how poorly designed executive compensation structures can lead management to marginalize risk management units, and how limitations in data and analytics facilitate this process. Understanding these behavioral effects provides insight into policies that may be useful in driving toward effective risk management outcomes.

Financial incentives for management to instill a strong risk

culture can be accomplished in several ways. For example, external groups critical to the firm's viability and ongoing operation, such as rating agencies, regulators and directors-and-officers liability insurers, could elevate the focus on risk management practices by reflecting them more effectively in ratings and premium structures, including risk-based deposit premiums. Adoption of risk-based performance metrics in executive compensation can also address incentive alignment issues between management and shareholders. Strengthening the ties of risk management to the board is also essential, as is raising the situational awareness of risk managers to assess and internalize both firm-specific risks and potential systemic risks facing the industry.

A Bank Risk Management Model

Risk management at financial institutions differs in large measure from that of nonfinancial companies in that risk is a primary ingredient in their development of products and services. For purposes of exposition, a distinction is made up front between risk management and business management. The former group is responsible for identifying and measuring risk and proposing and/or taking actions to mitigate risk. The latter group has responsibility for overall profitability and related objectives for a line of business. As a result, it is natural that business management will take an active interest in participating in risk discussions.

Complicating these discussions is the fact that risk management is largely an exercise in quantifying uncertainty and then working to find ways to mitigate risks outside the company's risk appetite. These two features of risk management — a deeply rooted connection between risk and product and uncertainty — give rise to a set of behaviors that can lead to significant breakdowns in risk management, potentially jeopardizing the health of the firm. So while much of risk management over the last decade or more has witnessed a remarkable evolution into a highly analytic-focused discipline, the fundamental drivers shaping risk-taking are rooted in more subtle behavioral characteristics.

Details of Failures

Following the demise of several major financial institutions during the crisis, a number of congressional inquiries and bankruptcy investigations identified risk management breakdowns. These included evidence that senior Lehman Brothers risk managers were marginalized during discussions of strategic business issues; and a lengthy history at Washington Mutual (WaMu) of limiting the involvement of risk management in critical areas of the business.[1] Affirmations by former risk managers at the subprime lender New Century Financial echoed these themes at larger companies.[2] What explains this behavior?

Research into behavioral responses to financial risk-taking and agency costs related to incentive conflicts among corporate stakeholders serves as a useful theoretical backdrop for developing a working model explaining drivers of business management biases toward risk management.

The academic literature tends to support the view that weak corporate governance structures open the door for managers to impose greater control over the design of their compensation packages.[3] If so, these incentive structures provide the vehicle through which firm risk-taking is defined: e.g., focus on short-term rewards, and on performance metrics that ignore or minimize the views of risk managers; then set the level of risk-taking for the firm accordingly. Bringing this concept together with work on cognitive biases from behavioral economics establishes the linkage between incentive compensation structures and risk governance.

In their work, Bebchuk et al. outline differences between optimal contracting and the managerial power model for designing incentive compensation packages for executives. In an optimal contracting framework, the objective is to minimize agency costs between management and shareholders. The authors further contend that boards do not always act in an arm's length fashion with respect to senior management, and over time, for various reasons, may become captive or overly influenced by a powerful CEO. This allows management to maximize their own utility at the expense of shareholders by influencing the design of compensation contracts allowing them to extract rents.

Management cognitive biases regarding competitor behavior, risk-taking and their own priors regarding expected performance — operating in tandem with "managerial positional power" — form the basis for suboptimal risk governance outcomes.

Utility Functions

A critical contribution of the work to the expected utility-choice model can be found in the description of asymmetries between gains and losses affecting an individual's risk decision. Barberis, Huang and Santos leverage this work (as well as that of Thaler and Johnson) to show how an individual's risk-taking is dependent on prior financial outcomes.[4] Specifically, within

the standard utility model, Barberis et al. append a term representing utility that comes about from changes in the value of an investor's financial wealth. This is described formally as

$$\text{MAX } E\left[\sum_{t=0}^{\infty}\left(\rho^t \frac{C_t^{1-\gamma}}{1-\gamma}\right)+\beta_T \rho^{t+1} \upsilon\left(X_{t+1}, S_t, z_t\right)\right]$$

where the first term on the right-hand of the expression represents the standard relationship between consumption, C, and utility, ρ is the discount rate and *y* is a parameter governing the shape of the utility function with respect to C. For our purposes, the second term is of more interest.

The function $v(X_t,S_t,z_t)$ represents the amount of utility derived from changes in the investor's financial position. X_t in this term reflects the gain or loss in investment over some time period, S_t represents the actual financial holdings at time t, and a state variable z_t relates investment gains or losses in a previous time period to S_t.

The effect of prior financial performance is related to an historical benchmark in their model, designated as Z_t, such that $z_t = Z_t / S_t$. Should $S_t > Z_t$, the investor experiences gains sometime in the past. The significance of this outcome is that investors become less loss averse if prior financial performance has resulted in financial gains rather than losses. With this framework in place, it is possible to describe management risk-taking at financial institutions and how it relates to their risk management functions.

Business management at a financial institution faces a similar utility function as described by Barberis et al. for investors. In this example, the term v(…) is replaced with $\theta(I_t)$, where θ represents the contribution to management utility due to changes in firm financial performance and I_t represents management's incentive compensation structure, through which financial performance is measured.

Business and risk management biases at banks can be described leveraging the seminal work by Kahneman and Tversky on prospect theory, where they describe risk-taking behavior as well as their work on cognitive biases.[5] Management incentive contracts are later described to be a function of a set of cognitive biases that drive their risk-taking behavior.

Central to this model is the linkage of incentive compensation structure to changes in risk-taking. Incentive compensation, as mentioned earlier, is a function of the firm's corporate governance structure, with weaker governance exemplified under the managerial power framework permitting incentive compensation structures that allow for greater risk-taking. In that regard, changes in business management utility are related to θ in the following way: $\frac{\partial E[U]}{\partial \theta} > 0$, implying that as a firm's financial performance improves, it raises management utility.

Incentive contracts can lead to greater utility as a result of a set of performance measures that poorly reflect a longer-term view of performance adjusting for risk. Although the performance metrics of these contracts may lead to favorable compensation outcomes for management in the short term, they are illusory. The primary transmission mechanism for this relationship then is the incentive compensation structure. We further describe I_t as a function of several factors driving management's "view" of firm performance.

This view of performance is a reflection of the underlying performance metrics embedded in the incentive compensation arrangement. This might include, for example, measures of firm profitability, stock performance (such as price-earnings ratios) and market share, among other possible metrics. Performance metrics established in incentive contracts designed under conditions explained by the managerial power model are related to a set of management cognitive biases well-established in the behavioral economics literature.

Breaking Down Biases

One of these behaviors relates to *confirmation biases* that assign greater weight to information supporting a particular view.[6] This bias may be associated with the "house money effect," described by Thaler et al., where prior financial performance influences an individual's risk-taking. In this context, a prior period of sustained favorable financial performance would be a confirming event of future strong performance, thus reducing management's level of loss aversion. Kahneman also refers to an "illusion of validity" where overconfidence in a particular view or outcome is established merely by the coherence of a story and its conformance with a point of view.[7] Confirmation bias and the illusion of validity may be reinforcing biases for managers.

Herd behavior is another bias that has been introduced into this framework. Shiller, Banerjee and others describe a phenomenon where imperfect information regarding a group (e.g., a competitor) leads to decisions where management follow a competitor's strategy at the expense of their own based on limited information.[8] An example of this would be large mortgage originators such as Countrywide and WaMu following each other's product development movements, which were largely based on relaxed underwriting standards and increased risk layering of existing products. These firms viewed these

newer products as having greater expected profitability than existing products based upon formal disclosures of financial performance by competitors of these new products, as well as on informal information from recently hired employees of competitor firms and other market intelligence. This herd effect could be reinforced by confirmation bias supported by a period of recent past performance reflecting strong house price appreciation, low interest rates and low defaults.

The last bias introduced into this framework is related to the *ambiguity effect*.[9] This bias describes a phenomenon whereby individuals tend to favor decisions based on certain rather than uncertain outcomes. Frisch and Baron attribute this behavior to a general desire to avoid alternatives where information may be incomplete.[10]

In the context of risk management, the ambiguity effect has a particular role in defining the effectiveness of risk management. First, since forward-looking estimates of firm risk are probabilistic in nature, this introduces uncertainty into management decisionmaking and performance benchmarks used in incentive contracts. Riskier views could reduce the attractiveness of certain products, and potentially lower the performance of the firm and management compensation in the process.

An example of this would be differences in performance between prime and subprime mortgages. Let's define a firm's return on equity as net income divided by book, or regulatory capital where net income equals interest and noninterest revenues less interest and non-interest expenses (of which credit losses are a component). On an ROE basis, applying a 4 percent regulatory capital charge to each loan, and assuming prime and subprime net income of .5% and 2%, respectively, the obvious choice would be to originate subprime loans carrying a 50% ROE over a prime loan with an ROE of 12.5%. However, if risk management offers a more appropriate performance metric, adjusting for the risk of each product relying on risk capital rather than on regulatory capital, a different result emerges.

Based on the underlying risk characteristics of the borrower, loan, property and other factors, let's assume that risk management finds that the amount of risk capital that should be deployed against prime loans is 2% and against subprime loans is 10%. Using the net income figures from before, the decision would reverse with prime loans preferred (25% risk-adjusted return) over subprime (20% risk-adjusted return). Importantly, the overall profitability of the decision declines from before it is presumably reflected in the bonus outcomes of management.

Compounding the ambiguity effect are data and analytical limitations that at times can reinforce management decisions to adopt riskier products. This can occur through data and modeling errors, rendering risk estimates of limited value in the view of management.

Furthermore, confirmation bias and herd effects can also reinforce the ambiguity effect. In the previous example, if risk management establishes that subprime loans have significantly higher risk than previous historical performance suggests, and if other competitors continue to originate such products successfully in large volumes, weak governance leading to poor incentive structures augmented by these cognitive biases can neutralize the effectiveness of risk management.

To illustrate these concepts more concretely, consider a manager with a utility function (as described earlier) such that changes in utility are related to outcomes determined by the incentive compensation structure of that manager, $\theta(I_t)$. Extending the discussion by Barberis et al. that managers are more sensitive to reductions in compensation (as might be exemplified by low bonus payouts and option grants) than to increases, reflecting their degree of loss aversion, the relationship of interest is as follows:

$$\theta(I_t) = \begin{cases} \Pi_{t+1} \; for \; \Pi_{t+1} \geq 0 \\ \delta \Pi_{t+1} \; for \; \Pi_{t+1} < 0 \end{cases}$$

where Π_{t+1} represents the gain or loss in firm profitability as described in the incentive compensation contract, and $\delta > 1$, reflecting the manager's greater sensitivity to losses than gains generally.

For this example, δ is fixed across scenarios at 1.5, with no loss of generality to the model. In addition, θ is set in three scenarios — at .5, 1 and 1.5 — that differentially impact the manager's utility. In turn, reflecting the relative positional power of management according to the managerial power concept, the incentive structure is dependent upon the four cognitive biases: confirmation bias (denoted as X), herd behavior (H), ambiguity bias (A) and the house effect (HE), along with the strength of the firm's governance structure (G). The complete relationship of these cognitive biases to incentive structures can be written formally as

$$I_t = g(X_t, \overline{H_t}, A_t, \overline{HE_t}, G_t)$$

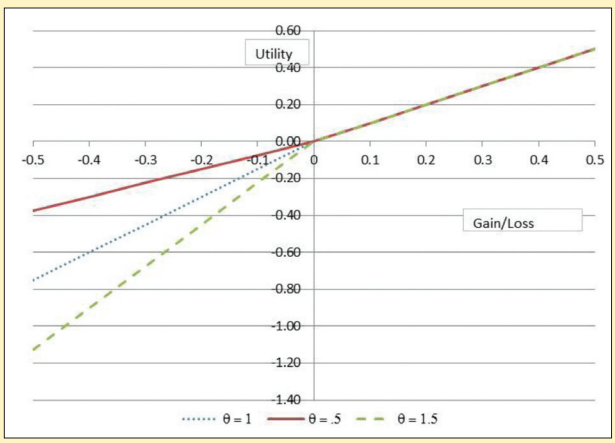
The ambiguity effect in this model focuses on the estimates of risk presented by the risk management team. Furthermore,

management takes previous financial performance into account (the house effect) by referencing the current performance (e.g., stock price) Π_t against an historical benchmark level Π^*. Thus, cases where $\Pi^*>\Pi_t$ signify situations where past performance has been strong, and vice versa.

We define this relationship as $\frac{\Pi^*}{\Pi_t}=\overline{HE}_t$ in the model, with $\overline{HE}_t>1$ signifying cases where prior performance has been good, thus lowering the manager's loss aversion. In a similar fashion, we can relate the firm's performance in a given period to a benchmark of performance of other competitors, reflected by a composite performance index of Π_t^C, as follows: $\overline{H}_t\frac{\Pi_t^C}{\Pi_t}$. In cases where $\overline{H}_t>1$, the manager engages in herd behavior.

Finally, we assume that firm profitability (ROE) ranges from +50% to -50% over the general period of interest. Figure 1 presents a summary depiction of the three scenarios across each ROE outcome and utility.

Figure 1: Management Cognitive Bias Influences Loss Aversion



This figure illustrates how negative return events differentially affect the manager's utility outcomes, dependent upon management cognitive biases that affect the level of loss aversion. Consider the baseline scenario where θ=1. The line segment, as in all three scenarios, is kinked at 0. This scenario illustrates that losses have a greater effect on the manager than gains. In scenario 2, where θ=.5, the manager exhibits less sensitivity to losses than in scenario 1, as cognitive biases and weak corporate governance have lowered the manager's loss aversion.

By contrast, in scenario 3 (θ=1.5), the manager exhibits greater loss aversion than the other two scenarios. This outcome could be attributed to a combination of strong governance practices and controls that limit the manager's ability to influence their incentive compensation arrangements, supported by cognitive abilities that limit the potential for herd behavior, the house money effect and ambiguity bias.

Interacting with Risk Management

Having described the general relationships between governance, incentives and cognitive bias on risk-taking, it is possible to examine how these factors interact with the firm's risk management function. Of particular interest is how data and analytics enter into the process; how the stature and structure of the risk management organization can affect and be affected by management cognitive biases (particularly the case of confirmation bias in the presence of risk management views that are seemingly more conservative than historical performance); and how marginalization of risk management views can affect firm and management outcomes.

Data and analytics are used to construct forward-looking estimates of risk by the risk management team. In the model, these views enter via the ambiguity effect. Formally, this can be expressed as the following:

$$A_t = f(D_t|S_t, M_t|S_t, \frac{E_t}{E_{t+n}}|S_t)$$

where D_t represents the quality of the firm's risk data warehouse, M_t is the quality (accuracy) of the models and analytics deployed to estimate risk, and E_t/E_{t+n} reflects the degree to which forward-looking estimates of risk (E_{t+n}) deviate from actual historical risk outcomes (E_t). This relationship is meant to capture the degree to which risk management estimates of future risk outcomes differ from previous experience.

In situations where actual historical performance is significantly better than what the risk management team projects going forward, it raises the potential for ambiguity bias and, in the presence of confirmation bias and the house effect, can have a reinforcing negative effect on risk management.

It is expected that both errors and deficiencies in data and models reduce the accuracy of risk estimates — and, consequently, reduce management's confidence in those projections — further raising the ambiguity effect.

Each of the variables affecting ambiguity bias is conditional on the level of stature in the risk organization, S_t. Stature is defined as the level of impact, value and perceived effectiveness of the risk team by management.

The metrics used to define performance play a critical role in shaping incentive contracts and firm and management per-

formance outcomes. Going back to the earlier example of prime versus subprime loan originations, reliance on ROE versus a risk-adjusted metric can lead to demonstrably different outcomes. In the current model then, we capture this effect in the house effect variable (HE) by expressing the general model under two alternative scenarios:

Scenario 1: Non-risk-adjusted $$HE_{t,NR} = \frac{\Pi^*_{t,NR}}{\Pi_{t,NR}} \text{ and,}$$

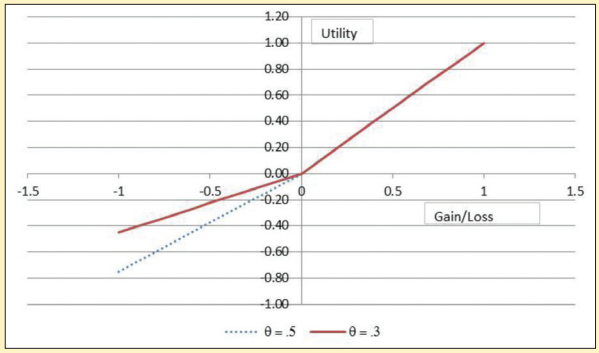
Scenario 2: Risk-adjusted $$HE_{t,R} = \frac{\Pi^*_{t,R}}{\Pi_{t,R}}$$

With these enhancements to the model in place, some general observations regarding the effect on risk management can be offered from some simple examples based upon the previously mentioned scenario 2 (θ =.5). Keeping the value of the parameter δ as 1.5, we assume that the stature of the risk management team is high and that it has an endowment of data and models that are of relatively good quality, such that D_t and M_t imply no change in θ due to A.

Recall that scenario 2 assumed a weak governance structure, and hence poor incentive structures leading to lower loss aversion, *ceteris paribus*. Compare that against a scenario in which the firm's data and models are poor and the stature of the group is low, such that together these deficiencies further diminish θ to the level of .3.

Figure 2 (below) compares the outcomes of these two scenarios, illustrating the point that the ambiguity effect, reinforced by a lack of stature of risk management, can amplify the manager's risk-taking posture. Stature might be able to limit the ambiguity effect attributed to poor data and modeling outcomes, particularly if such deficiencies have been rare.

Figure 2: Weak Governance and Risk Infrastructure Amplifies Risk-Taking Behavior



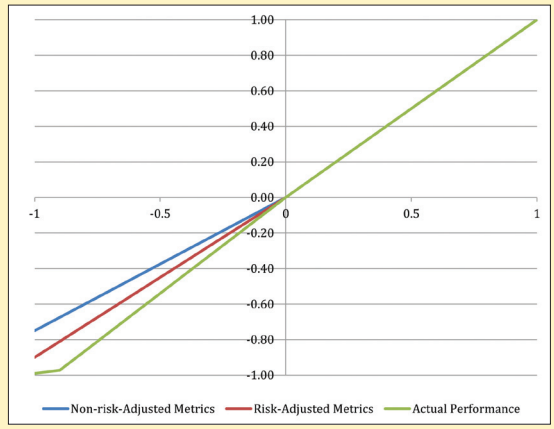
A similar outcome as depicted in Figure 2 could occur due to the actual-expected outcomes effect on A. That is, should $E_t/E_{t+n} < 1$, it raises A in the same relative manner as a deficiency in data and analytics, thus reinforcing and even amplifying the confirmation and house money effects.

Now consider the impact of applying different performance metrics in the manager's incentive compensation plan. We compare two scenarios: one where risk is not adjusted in the definition of performance (e.g., ROE), and another that applies a risk-adjusted metric of performance (e.g., using risk capital instead of regulatory or book capital in the ROE calculation).

Figure 3 (below) applies the original scenario 2 (θ =.5) and assumes that the manager applies an ROE metric while the risk team applies a risk-adjusted metric, which is closer to actual performance but still is measured with some error.

The results from this scenario suggest that when cognitive biases exist in the presence of weak governance, the tendency would be for management to underestimate risk, which is compounded by the application of metrics not adjusted for risk. However, risk-adjusted metrics are not fully accurate either, because they adjust for risk results in expected outcomes that are closer to actual performance than management's views.

Figure 3: Risk-Taking and Risk-Adjusted Performance Metrics



Summary and Implications

The financial crisis provides an opportunity to study the dynamics of risk governance at financial institutions. Specifically, the large number of failures across the industry, although anecdotal, bear a number of similarities. Most failures could be traced back to deficiencies in risk governance and risk

management.

Lax corporate governance practices enabled management teams to set incentive compensation arrangements that did not appropriately take risk into consideration. Compounding these problems were a number of cognitive biases so prevalent that they promoted an explosion in exotic mortgage products and synthetic derivative products with limited historical experience to form sound risk views.

Drawing from the extensive academic literature on corporate governance and executive compensation, and from behavioral economics work on cognitive biases, a model explaining how these factors can contribute to poor risk governance was presented.

Scenarios from this model illustrated how weak governance and incentive contracts can set in motion a series of behaviors predicated on certain strongly held views toward risk-taking. These include confirmation biases that cause management to weight specific outcomes more to align to a particular view; a house-money effect, where previous performance factors prominently in management loss-aversion; a herd effect, where management follows competitor actions based on imperfect information; and ambiguity bias that leads management toward outcomes having greater certainty.

Scenarios showed that in the presence of cognitive biases and poor governance, risk management can be marginalized and suboptimal outcomes realized.

To better incent management toward implementing effective risk management practices based on the model's structural relationships, a number of important policy solutions are put forward. These include financial incentives such as more rigorous assessment of risk governance and management structures at financial institutions by D&O insurers, rating agencies, and regulatory agencies, with assessments tied directly to supervisory outcomes, ratings and policy premiums.

The introduction of risk-based metrics into incentive compensation schemes is recommended, with particular emphasis on developing robust risk-data-warehouse capabilities that can support sophisticated risk-capital measurement.

Opportunities to strengthen risk governance include formalizing the reporting of the senior risk officer to the risk committee of the board, establishing a balanced scorecard taking risk heavily into account in incentive compensation structures, and raising the situational awareness of risk managers to build the stature of the risk management organization.

FOOTNOTES

1. Valukas, Anton R. "Lehman Brothers Holdings Inc. Chapter 11 Proceedings Examiner's Report," Volume 1, March 11, 2010, p. 46, and FDIC, Offices of Inspector General, Evaluation of Federal Regulatory Oversight of Washington Mutual Bank, Report No. EVAL-10-002, April 9, 2010, p. 12

2. Lindsay, Patricia, Former Vice President, Corporate Risk, New Century Financial Corporation. Testimony to the Financial Crisis Inquiry Commission, April 7, 2010.

3. Bebchuk, Lucien Ayre, Jesse M. Fried and David I. Walker. "Managerial Power and Rent Extraction in the Design of Executive Compensation," *The University of Chicago Law Review*, Vol. 69, 2002, pp.751-846.

4. Barberis, Nicholas, Ming Huang and Tano Santos. "Prospect Theory and Asset Prices," *The Quarterly Journal of Economics*, Vol. 116, No. 1, Feb. 2001, pp. 1-53. See, also, Thaler, Richard H. and Eric J. Johnson. "Gambling with the House Money and Trying to Break Even: The Effects of Prior Outcomes on Risky Choice," *Management Science*, XXXVI, 1990, pp. 643-660.

5. Kahneman, Daniel and Amos Tversky. "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, XLVII, 1979, 263-291.

6. Shefrin, Hersh. "Behavioral Corporate Finance," *Journal of Applied Corporate Finance*, Vol. 14, 2001, pp. 113-118.

7. Kahneman, Daniel. "Don't Blink! The Hazards of Confidence," *New York Times*, October 19, 2011.

8. Shiller, Robert J. "Conversation, Information and Herd Behavior," *American Economic Review*, Vol 85, No. 2, may 1995, pp. 181-185. See, also, Banerjee, Abhijit V. "A Simple Model of Herd Behavior," *Quarterly Journal of Economics*, August 1992, Vol. 107, No. 3, pp. 797-817.

9. Ellsberg, Daniel. "Risk, Ambiguity and the Savage Axioms," *Quarterly Journal of Economics*, Vol. 75, 1961, pp. 643-699.

10. Frisch, D. & J. Baron (1988). "Ambiguity and Rationality," *Journal of Behavioral Decision Making*, 1, 149-157.

Clifford Rossi (crossi@rhsmith.umd.edu) is an executive in residence and Tyser Teaching Fellow at the Robert H. Smith School of Business, University of Maryland. He served more than 25 years in banking and government, including as chief risk officer of Citigroup's consumer lending group, chief credit officer at Washington Mutual, CRO at Countrywide Bank, and senior risk management positions at Freddie Mac and Fannie Mae.