

ARTICLES

REGULATING SYSTEMIC RISK: TOWARDS AN ANALYTICAL FRAMEWORK

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The global financial crisis demonstrated the inability and unwillingness of financial market participants to safeguard the stability of the financial system. It also highlighted the enormous direct and indirect costs of addressing systemic crises after they have occurred, as opposed to attempting to prevent them from arising. Governments and international organizations are responding with measures intended to make the financial system more resilient to economic shocks, many of which will be implemented by regulatory bodies over time. These measures suffer, however, from the lack of a theoretical account of how systemic risk propagates within the financial system and why regulatory intervention is needed to disrupt it. In this Article, we address this deficiency by examining how systemic risk is transmitted. We then proceed to explain why,

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in the absence of regulation, market participants cannot be relied upon to disrupt or otherwise limit the transmission of systemic risk. Finally, we advance an analytical framework to inform systemic risk regulation.

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INTRODUCTION

Governments worldwide are struggling with the challenge of regulating financial systemic risk—the risk that a localized adverse shock, such as the collapse of a firm or market, will have repercussions that negatively impact the broader economy.¹ In the United States, legislators have enacted an array of measures intended to strengthen the financial system, many of which consist of broad delegations of authority to regulators who will need to implement them in the years ahead. These measures, however, are largely a response to the recent global financial crisis. None is situated within a general theoretical framework for understanding how systemic risk is transmitted or how regulation should address it. As a result, financial regulatory reform may succeed in addressing the specific problems that led to the recent financial crisis. Because economic shocks are generally unpredictable,² however, the measures enacted are unlikely to be effective against future financial crises.

This Article analyzes the potential for regulation to make the financial system more resilient to the risk of collapse. We begin, in Part I, by examining how systemic risk is transmitted. We posit that two otherwise independent correlations can combine to transmit localized economic shocks into broader systemic crises.³ The first is an intra-firm correlation between a firm’s financial integrity and its exposure to the risk of low-probability adverse events that either constitute or could lead to economic shocks.⁴ The second is an inter-institutional correlation among financial firms and markets (collectively, “institutions”).⁵ As we illustrate using four financial crises within the past century, these two correlations have at times combined histori-

1 Cf. Steven L. Schwarcz, *Systemic Risk*, 97 GEO. L.J. 193, 204 (2008) (defining systemic risk in terms of the consequences of economic shocks).

2 See *id.* at 216.

3 Correlations are at the heart of systemic risk. Uncorrelated or negatively correlated risk can be protected against through diversification. See RICHARD A. POSNER, *ECONOMIC ANALYSIS OF LAW* 446 (6th ed. 2003) (observing that for risk that is uncorrelated or negatively correlated with market risk, the randomly distributed movements of a diversified investment portfolio “would tend to cancel out, producing a riskless portfolio”).

4 In the interest of brevity, we refer in the remainder of this Article to this correlation as the correlation between low-probability risk and firm integrity.

5 Our use of the term “institution” in the remainder of this Article encompasses both firms and markets.

cally to potentiate the transmission of localized economic shocks throughout the financial system.⁶

After describing a transmission mechanism for systemic risk and demonstrating its operation, we examine, in Part II, whether market participants can be relied on to protect against systemic risk without regulatory intervention. We identify a series of market failures, in part caused by behavioral failures that make it unlikely that they will do so. These failures—which consist of conflicts of interest, complacency, complexity, and a type of tragedy of the commons—collectively obscure or motivate firms to ignore the impact of their risk-taking on systemic stability.

Because of these failures, regulation has an important role to play in managing systemic risk. To be effective, however, regulatory measures directed at enhancing the stability of the financial system must be designed in the context of an analytical framework that both captures the systemic transmission of economic shocks and explains the behavioral and other market failures that justify intervention. In Part III, we show that government can disrupt the transmission of systemic risk by addressing these failures. We then apply our analysis to the four financial crises discussed in Part I.

A primary lesson of the recent global financial crisis is that attempts to address systemic crises after they have occurred are enormously costly. They can also encourage moral hazard by financial firms that anticipate being rescued from public funds. Regulation can play an important role in limiting these costs. Effective systemic risk regulation should attempt to weaken correlations within the financial system that serve to transmit systemic risk. The task is urgent because increasing complexity within the financial system will make these correlations increasingly likely to arise, as well as to combine, in the future.

I. THE ROLE OF INTRA- AND INTER-INSTITUTIONAL CORRELATIONS IN THE TRANSMISSION OF LOCALIZED ECONOMIC SHOCKS TO THE FINANCIAL SYSTEM

Four financial crises within the past century—the Great Depression, the meltdown of Long-Term Capital Management (LTCM), the collapse of Enron, and the recent global financial crisis—illustrate that two seemingly independent correlations can combine to potentiate the transmission of localized economic shocks throughout the

6 In two of these crises the correlations led to systemic effects. In the other two, one of the correlations was either absent or was blocked by policymakers, and only localized harm occurred. *See infra* Part I.

financial system, amplifying them in the process. The first of these is a correlation between low-probability risk and firm financial integrity, and the second is a correlation among financial institutions. In Part I, we describe these two correlations and examine how they can combine. We then use the correlations to explain systemic risk transmission in the specific contexts of the foregoing crises.

We recognize that additional financial crises have occurred over the past century and longer, and that a complete study of all such crises might indicate additional correlations within the financial system. Nonetheless, the ability of the combination of these two correlations to potentiate the transmission of economic shocks makes them worthy of study even if other correlations exist.⁷

A. *The Correlations as Systemic Risk Transmission Mechanisms*

Our starting point is the definition of systemic risk proposed by one of us in his Georgetown Law Journal article, *Systemic Risk*.⁸ In that article, the author recognized that the term “systemic risk” has been used in various ways, sometimes inconsistently.⁹ Drawing on the importance of the dynamic relationships among institutions in the financial system, he advanced the following working definition of systemic risk:

[T]he risk that (i) an economic shock such as market or institutional failure triggers (through a panic or otherwise) either (X) the failure of a chain of markets or institutions or (Y) a chain of significant losses to financial institutions, (ii) resulting in increases in the cost of capital or decreases in its availability, often evidenced by substantial financial-market price volatility.¹⁰

7 It also should be noted that our identification of the correlations we describe arose in studying the four financial crises discussed in Part I. We did not select those crises to exemplify the correlations.

8 See Schwarcz, *supra* note 1, at 198.

9 See *id.* at 196–97.

10 *Id.* at 204. For our purposes, there are two features of this definition worth emphasizing. First, it does not distinguish among types of financial market participants. In other words, focus is not on the character of individual firms, but rather on their potential to affect capital markets. Any financial market participant to which other financial institutions are exposed, either directly or indirectly, theoretically poses systemic risk. Second, the definition contemplates a localized economic shock that sets in motion other failures or losses within the financial system. It is thus distinct from the concept of systematic risk, which affects all market participants concurrently. See Anton Korinek, *Systemic Risk-Taking: Amplification Effects, Externalities, and Regulatory Responses* 3 (Mar. 28, 2010) (unpublished research paper), available at <http://www.korinek.com/download/SystemicRisk.pdf> (describing “systematic” risk as risk that cannot be diversified away).

While the foregoing definition is helpful in establishing the nature and scope of the problem we are addressing, it does not identify the mechanisms by which an economic shock produces systemic consequences. By setting forth a description of the mechanisms by which shocks can travel from their points of origin to the rest of the financial system, we hope to shed light on the most promising avenues for regulatory policies directed at managing systemic risk.

The first correlation that we identify describes the relationship between low-probability risk and firm integrity. By “low-probability,” we do not mean an occurrence that is unforeseeable. Such events, referred to as “black swans” by Nassim Taleb, cannot be identified *ex ante*.¹¹ Rather, we are addressing what Taleb calls “gray swans”—events that are rare but nevertheless predictable.¹² The latter events, unlike the former, are susceptible to measurement and prediction.¹³

Managing the risk to which a business is exposed is the domain of corporate risk managers.¹⁴ Corporate risk managers address risk by engaging in prudent risk-taking and using financial hedging instruments as risk-management tools. In these ways, managers are able to pursue strategies for increasing firm value that would otherwise exceed the firm’s tolerance for risk. In managing risk, however, we believe that managers of financial firms systematically underestimate the likelihood of encountering low-probability adverse events. In Part II.A.1, we theorize that this tendency results from managerial conflicts of interest, undue complacency when forecasting low-probability adverse events, and increased financial complexity which makes risk harder to assess. Together, these factors cause financial firms to charge too little for bearing low-probability risks. Financial integrity is thereby eroded at the individual firm level.

Focusing on individual financial firms does not capture the full impact on the financial system of underestimating low-probability

11 NASSIM NICHOLAS TALEB, *THE BLACK SWAN* 18 (2007).

12 *Id.* at 37. There are several species of swan, including the Mute Swan (the common white swan) and the Black Swan. The rarest of the swan species is the Trumpeter Swan. Other than the Black Swan and the Black-necked Swan, all swans are entirely white (except during their first year when most are gray). E-mail from Dr. Mel Levine, Vice Chairman of the Bd. of the Sylvan Heights Waterfowl Park and Eco-Center, to Steven L. Schwarcz (Feb. 11, 2010, 07:59 EST) (on file with authors).

13 See FRANK H. KNIGHT, *RISK, UNCERTAINTY, AND PROFIT* 197–232 (Cosimo 2006) (1921) (distinguishing between risk and uncertainty).

14 Risk management is concerned with “identifying and managing a firm’s exposure to financial risk where financial risk is defined as the variability in cash flows and market values caused by unpredictable [macroeconomic] changes.” Fred R. Kaen, *Risk Management, Corporate Governance and the Public Corporation*, in *RISK MANAGEMENT* 423, 423 (Michael Frenkel et al. eds., 2d ed. 2005).

adverse events, however. There is a broader impact of a firm's risk-bearing decisions arising out of the financial system's interconnectivity. The financial system is comprised of institutions that are highly interrelated. In this sense, it is a "network."¹⁵ The transmission of risk through a network can serve to absorb shocks, dispersing risk among members.¹⁶ But it can also amplify shocks, potentially leading to systemic collapse.¹⁷ Our second correlation—the correlation among financial institutions—attempts to capture this effect.

As we explain in greater detail in Part II.A.2, financial firms generally underappreciate interconnectivity when making business decisions. This implicates risk-taking in two ways. First, firms fail to fully internalize the direct costs that their risky activities impose on other financial firms with whom they have relationships. Reduced creditworthiness at one financial firm, for example, compromises the financial condition of the counterparties with which it is intertwined through a wide range of possible dealings. Yet, firms tend to take insufficient account of the potential impact of their own financial condition on other firms.¹⁸ Firms also fail to fully internalize the indirect costs that their risky activities impose on financial markets. For example, asset values can decline when a firm must sell substantial assets rapidly due to liquidity needs. When such "fire" sales depress the prices of the assets being sold, the financial condition of other firms that hold the same or similar assets deteriorates.¹⁹ Some of these other firms will consequently face liquidity needs of their own and be forced to sell assets, further depressing asset prices, which produces a positive feedback loop. Market dynamics can thus serve to transmit and amplify an individual firm's distress. In under-appreciating their interconnections to other institutions, financial market participants take on socially excessive risk levels that increase the fragility of the financial system.

In combination, the foregoing correlations can be sufficient to transmit a localized adverse economic shock throughout the financial

15 Markus K. Brunnermeier, *Deciphering the Liquidity and Credit Crunch 2007–2008*, 23 J. ECON. PERSP. 77, 96 (2009) (describing the modern financial system as an "interwoven network of financial obligations"); see *infra* note 86 and accompanying text.

16 See Rob Nijskens & Wolf Wagner, *Credit Risk Transfer Activities and Systemic Risk: How Banks Became Less Risky Individually but Posed Greater Risks to the Financial System at the Same Time 2* (Dec. 23, 2008) (unpublished working paper), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1319689 (pointing out that the main rationale behind credit risk transfer activities by financial institutions is to diversify away concentrated risk exposures).

17 See *id.*

18 See *infra* notes 104–09 and accompanying text.

19 See *infra* notes 90–94 and accompanying text.

system, amplifying it in the process. Importantly, neither correlation, acting by itself, will potentiate a systemic crisis. For example, an intra-institutional correlation involving the failure of a financial firm will not, without more, impair the entire financial system. Similarly, the interconnectivity among financial institutions is not, by itself, a threat to the financial system without a firm or market failure that acts as a catalyst. Operating together, however, these correlations create a transmission mechanism that can allow even what might appear to be a modest localized adverse economic shock to generate severe systemic consequences.

B. *Using the Correlations to Explain Financial Crises*

In Part I.A, we presented an account of how economic shocks can be converted into systemic crises through the combined operation of the correlation between low-probability risk and firm integrity and the correlation among institutions. When both correlations are operative within a financial system, unforeseen economic shocks that begin as isolated phenomena can become systemically dangerous. In Part I.B, we show how the correlations can be applied to help explain the dynamics of four specific financial crises within the past century.

1. The Great Depression

Although the causes of the Great Depression are still being debated, the two correlations described above, working in combination, appear to have been causal factors. Prior to the Depression, many banks engaged in margin lending to risky borrowers, securing the loans by shares of stock that the borrowers purchased with the loan proceeds. The value of the stock collateral started out being at least equal to the amount of the loan, and banks assumed that the stock market, which had been continuously rising in value for some years,²⁰ would continue to rise, or at least not decline, in value.²¹

At the time, that assumption was viewed as reasonable.²² In August 1929, however, there was a (relatively) modest decline in stock

20 See Arthur E. Wilmarth Jr., *Did Universal Banks Play a Significant Role in the U.S. Economy's Boom-and-Bust Cycle of 1921-33? A Preliminary Assessment*, in 4 CURRENT DEVELOPMENTS IN MONETARY AND FINANCIAL LAW 559 (2005), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=838267.

21 See WILLIAM K. KLINGAMAN, 1929: THE YEAR OF THE GREAT CRASH 54, 58 (1989).

22 See *id.* at 57-58. This assumption was viewed as reasonable notwithstanding the fact that stock prices basically went sideways from 1900 until the early 1920s, with steep drops occurring in 1902-03, 1906-07, and 1916-17. See John Armour & Brian Cheffins, *Offensive Shareholder Activism in U.S. Public Companies, 1900-1949*, at 22

prices,²³ causing some of these margin loans to become under-collateralized.²⁴ Some banks that were heavily engaged in margin lending lost so much money on the loans that they became unable to pay their debts. This illustrates the intra-institutional correlation between low-probability risk—in this case, the risk that collateral value may become insufficient—and firm integrity. Bankers failed to appreciate this correlation.

The Depression also illustrates how the foregoing correlation, operating in combination with an inter-institutional correlation (in this case, an interconnectedness among banks), can potentiate the transmission of an economic shock into a broader systemic shock. As described above, some banks lost so much money in margin lending that they themselves became unable to pay their debts. These debts consisted not only of amounts due depositors but, more systemically significant, debts due to other banks. As a result, defaults by margin-lending banks on their obligations to other banks often adversely affected the other banks' ability to meet their obligations to yet other banks, and "so on down the chain of banks and beyond."²⁵ Bankers failed to see or appreciate this second correlation, and they almost certainly failed to foresee that the two correlations would combine.

2. Long-Term Capital Management

The meltdown of LTCM, a large hedge fund that engaged in arbitrage-related trading strategies, was also caused, at least in part, by the two correlations we have described working in combination. LTCM's failure to foresee temporary market irrationality in bond pricing during August 1998, touched off by the Russian government's default on its bonds, caused LTCM to lose hundreds of millions of dollars and undermined its financial viability.²⁶ This represented a failure by

(Univ. of Cambridge Faculty of Law, Legal Studies Research Paper Series, Paper No. 09/2011, 2011), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1759983. Bankers therefore convinced themselves that stock prices could not go down on the basis of the 1920s bull market, ignoring earlier stock market performance.

²³ See KLINGAMAN, *supra* note 21, at 217.

²⁴ *Id.*

²⁵ George G. Kaufman, *Bank Failures, Systemic Risk, and Bank Regulation*, 16 *CATO J.* 17, 21 (1996). These effects were exacerbated when, after the stock market crash of October 1929, depositors attempted en masse to convert their bank deposits into cash, creating additional demands on troubled banks to pay debts. See Schwarcz, *supra* note 1, at 199–200.

²⁶ See ROGER LOWENSTEIN, *WHEN GENIUS FAILED: THE RISE AND FALL OF LONG-TERM CAPITAL MANAGEMENT* 144–46, 164, 169–70 (2000).

LTCM to fully appreciate a correlation between low-probability risk and firm integrity.²⁷

LTCM's losses also implicated the second correlation. Most market observers at the time failed to appreciate the tight correlation between hedge funds, which were unregulated, and banks. Hedge funds and banks were closely linked, however, through derivatives-based hedging. At the last minute, the U.S. Federal Reserve Board realized that LTCM's default might trigger a wave of defaults in worldwide financial markets.²⁸ To avoid this, the Fed proactively stepped in to broker a settlement of LTCM's debts.²⁹

3. Enron

To preserve its primary and most profitable business strategy,³⁰ Enron needed to preserve its investment-grade rating.³¹ The main risk to this rating was the possibility that Enron's so-called "merchant assets" might drop in value, requiring Enron to mark (down) to market those asset values.³² Enron sought to avoid marking down those asset values by engaging in a series of structured transactions that effectively used Enron stock, which had an historically rising public-market price, as collateral to hedge the value of those assets. In a typical transaction, Enron would transfer Enron stock to a special-purpose entity (SPE) in exchange for notes or cash, and would also directly or indirectly guarantee the SPE's value.³³ The SPE, in turn, would hedge the value of certain merchant assets on Enron's balance sheet.³⁴ Because of its historically rising stock price, Enron judged the risk that it would have to pay on its guarantee as remote.³⁵

27 Cf. Paul Krugman, *Rashomon in Connecticut: What Really Happened to Long-Term Capital Management?*, SLATE (Oct. 2, 1998, 3:30 AM), <http://www.slate.com/id/1908> (discussing LTCM's failure to account for the low-probability risk of temporary market-pricing irrationality).

28 See Schwarcz, *supra* note 1, at 201.

29 *Hedge Fund Operations: Hearing Before the H. Comm. on Banking and Fin. Servs.*, 105th Cong. 18–19 (1998) (statement of William J. McDonough, President, Federal Reserve Bank of New York) (describing ways that the problems of LTCM could have caused more widespread financial troubles).

30 See Steven L. Schwarcz, *Enron and the Use and Abuse of Special Purpose Entities in Corporate Structures*, 70 U. CIN. L. REV. 1309, 1309–10 (2002) (describing that strategy as acting as a derivatives counterparty).

31 See *id.*

32 See *id.* at 1309 n.2.

33 See *id.* at 1310.

34 See *id.*

35 See *id.* at 1310, 1315.

When Enron's stock price subsequently fell to unanticipated levels, the value of these SPEs also fell, triggering the Enron guarantees; the guarantee payments in turn apparently further reduced Enron stock value, triggering additional guarantee payments.³⁶ Coincidentally, the value of Enron's merchant assets concurrently fell.³⁷ Because the guarantee payments sapped the SPEs' financial strength, they could no longer effectively hedge the value of Enron's merchant assets, causing Enron to lose its investment-grade rating.³⁸ Deprived of its primary business strategy, Enron had little choice but to file for bankruptcy.³⁹

Enron's collapse thus represents a failure to appreciate the correlation between low-probability risk and firm integrity because Enron failed to appreciate the risk that a fall in the value of its merchant assets could be coupled with a significant fall in the price of Enron stock used as collateral, and that the firm would collapse as a result. But Enron's collapse did not trigger a systemic financial crisis, apparently because its collapse did not closely correlate with the viability of other financial institutions.⁴⁰

4. The Recent Global Financial Crisis

The recent global financial crisis almost certainly was caused, or at least exacerbated, by the two correlations working in combination. In recent years, many mortgage lenders made loans to risky borrowers secured by the homes that the borrowers purchased with the loan proceeds. These "subprime mortgage loans" were then bundled together as collateral to partially support the payment of complex asset-backed securities that were sold to banks and other institutional investors worldwide.⁴¹ These securities maintained their value so long as home

36 *See id.* at 1310.

37 *See id.*

38 *See id.* at 1310–11.

39 *See id.*

40 *But cf.* Alan Greenspan, Chairman, Fed. Reserve, Remarks to the Federal Reserve Bank of Chicago's 2003 Conference on Bank Structure and Competition (May 8, 2003), *available at* <http://www.federalreserve.gov/boarddocs/speeches/2003/20030508/default.htm> (arguing that the widespread use of credit-default swaps mitigated the potentially devastating repercussions of the "largest corporate defaults in history (WorldCom and Enron)").

41 *See* Steven L. Schwarcz, *Keynote Address: Understanding the Subprime Financial Crisis*, 60 S.C. L. REV. 549, 550–52 (2009). Although lenders made these subprime loans to risky borrowers, the basic business model was not irrational and had some successful precedent. *See id.* at 550.

prices appreciated, as they had been doing for decades and as most market observers assumed would continue.⁴²

When home prices began falling, some of these asset-backed securities began defaulting,⁴³ requiring financial institutions heavily invested in these securities to write down their value, causing these institutions to appear, if not be, financially risky.⁴⁴ This represented a failure to see, or at least to fully appreciate, the correlation between low-probability risk—the risk that home prices would significantly fall⁴⁵—and firm integrity.

The recent financial crisis also involved a failure to see a correlation among financial institutions—in this case, a failure to see both the tight interconnectedness among not just banks but also non-bank financial institutions (such as Bear Stearns, Lehman Brothers, and AIG),⁴⁶ as well as the tight interconnectedness among financial institutions.

What made the financial crisis so devastating was that these failures combined to facilitate the transmission of economic shocks. As financial firms perceived the riskiness of other financial firms (“counterparty risk”)⁴⁷ increasing, they stopped dealing with each other, thereby reducing the availability of credit.⁴⁸ Similarly, as securities backed by subprime loans began defaulting, investors stopped investing not only in those securities but also in securities backed by other types of collateral and in debt securities more generally.⁴⁹

42 See Jack Guttentag, *Shortsighted About the Subprime Disaster*, WASH. POST, May 26, 2007, at F2 (explaining that because housing prices had been rising for a long period of time, it was assumed that they would continue to rise).

43 See Schwarcz, *supra* note 41, at 550–51 (explaining that home appreciation had been expected to enable risky borrowers to refinance to lower interest rates).

44 See *id.* at 553.

45 See Steven L. Schwarcz, *Protecting Financial Markets: Lessons from the Subprime Mortgage Meltdown*, 93 MINN. L. REV. 373, 379–80 n.35 (2008) (citing, among others, Taleb, *supra* note 11, for the human tendency to fail to anticipate improbable events).

46 Cf. Schwarcz, *supra* note 1, at 203 (observing that size of financial institution rather than “bank” status has become more systemically important).

47 See *infra* note 87.

48 Market participants are bound to become concerned about counterparty risk in the aftermath of an economic shock, such as the collapse of Lehman Brothers, because all parties are only aware of their own contractual obligations. Concern over perceived counterparty risk becomes self-fulfilling because firms become reluctant to deal with each other. This creates additional funding needs; for example, it increases the price of credit default swaps. See Brunnermeier, *supra* note 15, at 97–98.

49 See Schwarcz, *supra* note 45, at 395. The original defaults on securities backed by subprime loans implicated only highly leveraged ABS CDO securities, but those defaults triggered a lack of confidence in the broader asset-backed securities markets and in rating-agency ratings, which in turn triggered a lack of investor confidence in

Because debt markets had been supplanting banks as sources of credit, reduced investment in those markets further reduced the availability of credit.⁵⁰ The resulting lack of credit contributed to the collapse of the real economy.⁵¹

II. CONSTRAINTS ON THE ABILITY AND WILLINGNESS OF MARKET PARTICIPANTS TO ADDRESS SYSTEMIC RISK TRANSMISSION

We do not believe that financial market participants will, on their own, expend sufficient effort in identifying and attempting to prevent the correlations we described in Part I from combining so as to achieve a desirably low level of financial systemic risk. Financial regulatory measures are needed to publicly manage that risk. Consistent with this view, regulators have begun to address perceived sources of excessive risk-taking and instability within the financial system.⁵² Recent regulatory efforts may go some way toward reducing systemic risk. It is our view, however, that additional measures are, and will continue to be, needed to protect the financial system from unforeseen economic shocks. In part, this is because the measures that have been adopted respond to practices specific to the recent global financial crisis, rather than addressing its fundamental causes. It is also because financial innovation can rapidly make existing regulation weak or ineffective.

In Part II we suggest that a series of behavioral and other market failures leads to systemic instability. Our approach focuses on identifying the constraints on the ability and willingness of market participants to address intra-institutional and inter-institutional correlations in the financial system or to prevent them from combining. We begin by describing these constraints. We then consider the likelihood that such impediments will continue to exist in the future.

the broader markets for debt securities. *See* Schwarcz, *supra* note 41, at 552; *see also* Steven L. Schwarcz, *Regulating Complexity in Financial Markets*, 87 WASH. U. L. REV. 211, 223 (2009) (observing that although these (ABS CDO) securities were backed by what appeared to be significantly diverse assets, there was an underlying correlation in the subprime mortgage loans backing many of those securities).

50 This ongoing shift of the source of corporate financing from banks to financial and capital markets is referred to as disintermediation. *See* Schwarcz, *supra* note 1, at 200. Around the time of the recent financial crisis, “conventional commercial bank lending had dropped to [only] 30 percent” of corporate financing. Mortimer B. Zuckerman, *No Time to Lose*, U.S. NEWS & WORLD REP., Mar. 2009, at 80.

51 *See* Schwarcz, *supra* note 41, at 571.

52 *See infra* notes 227–236 and accompanying text.

A. *Impediments to Financial Market Self-Regulation*

In prior scholarship, one of us has argued that the global financial crisis can be attributed in large part to conflicts, complacency, and complexity, as well as to a type of tragedy of the commons, within the financial system.⁵³ In Part II.A, we extend that scholarship to develop a general theoretical framework that can help to explain why market participants tend to make risk-taking choices without adequate regard for the impact of those choices on the financial system.

1. Explaining Risk Transmission Through the Intra-Firm Correlation Between Low-Probability Risk and Firm Integrity

In the world of corporate finance, risk refers to the probability that the return on an investment will deviate from its expected, or long-term average, return.⁵⁴ Financial risk is defined in terms of the distribution of “actual” around “expected” returns.⁵⁵ The actual return on a risk-free investment will always equal its expected return because its return is treated as being certain. When a firm makes a risky investment, however, it is possible that its actual return will be a surprise. That surprise may be positive or negative. Thus, risk presents firms with a tradeoff: In exchange for receiving the possibility of a greater-than-expected return on an investment, a firm must expose itself to the possibility of a return that is lower than expected.⁵⁶

53 See Schwarcz, *supra* note 45, at 404. Running throughout these causes is another cause—*cupidity*; but because greed is so ingrained in human nature and so intertwined with the other causes, it adds little insight to view it separately.

54 More formally, the expected return on an investment is calculated by multiplying the investment’s potential gains or losses by their respective probabilities. See STEPHEN LUMBY & CHRIS JONES, CORPORATE FINANCE 209 (Thomson 7th ed. 2003).

55 See ASWATH DAMODARAN, CORPORATE FINANCE 151 (2d ed. 2001).

56 An investor can, for example, purchase a one-year treasury bill, which is typically assumed to carry no default risk, with a 0.3% annual expected return representing only the time value of money. At the end of five years, the actual return on the investment will have been 0.3%. This is a risk-free investment. In contrast, consider an investor willing to bear risk who buys 100 shares of Google. That investor may anticipate making thirty percent on his money at the end of the year. The actual return over this period, however, may be higher or lower than thirty percent. In statistical terms, the spread of the actual returns around the expected return is measured by the variance of the distribution. The greater the variance, the greater the deviation of actual returns from expected returns. When distributions of returns are normal, that is, symmetric, the variance of a distribution measures risk. It follows that risk-averse investors faced with a choice between two investments with the same expected returns but different variances will always prefer the one with the smaller variance. As a result, investments with higher variances must compensate investors

From a risk-management perspective, risks facing financial institutions fall into three general categories: (i) risks that can be eliminated through diversification; (ii) risks that can be transferred to other financial market participants; and (iii) risks that should not, or cannot, be transferred and must be retained.⁵⁷ The first category of risks relates to idiosyncratic events to which a firm is exposed. This category includes, for example, the risk associated with a specific project undertaken by a single business unit within a firm. Whether the project succeeds or fails will have an impact on the business unit that undertook the project, but the firm can usually limit that impact to the unit by diversifying the array of projects that the firm's other units select. Other risks may be non-diversifiable but transferable to other market participants. Markets exist for many types of risks assumed by financial institutions. For example, firms can transfer credit risk through products such as swaps or other derivatives. Borrowing terms can be altered to effect a change in asset duration. In addition, insurance contracts provide firms with a means of shifting risk. Finally, firms retain and absorb risks that they cannot efficiently eliminate or have a comparative advantage holding.

Because risk is costly to manage or bear, risk-takers must be paid an expected return to compensate them for assuming the burden of uncertainty.⁵⁸ In a perfectly competitive market the expected return on an investment accurately reflects its associated risk. As we describe below, however, we believe that low-probability risks are systematically underpriced, resulting in firms assuming excessive risk relative to the amount of risk they should take in order to maximize firm value. Within our framework, excessive risk-taking by financial firms is correlated with weaker firm integrity because the downside to a firm of taking on excessive risk is a deterioration of its financial condition, or possibly its collapse.

a. Conflicts

Within firms, conflicts of interest exist between day-to-day managers (senior and lower-level executives), on the one hand, and non-manager stakeholders (shareholders, debtholders, employees, as well

with higher expected returns. *See id.* at 151–53; *see also infra* note 58 (discussing the risk versus return relationship).

57 *See* Anthony M. Santomero, *Risk Management in Banking: Practice Reviewed and Questioned*, in *RISK MANAGEMENT AND REGULATION IN BANKING* 15, 17 (Dan Galai et al. eds., 1999).

58 The positive relationship between risk and return is a direct consequence of the risk aversion of most investors. *See* Richard A. Posner, *Law and the Theory of Finance: Some Intersections*, 54 *GEO. WASH. L. REV.* 159, 161 (1986).

as other corporate constituents),⁵⁹ on the other hand. This is most pronounced at large publicly held firms. In such firms, ownership is widely dispersed, with managers typically owning only a small percentage of their companies' equity. Thus, managers' private interests do not naturally coincide with the interests of other stakeholders.

The foregoing conflict of interest is commonly referred to as an "agency problem" between those who own the firm (the principals) and those who operate it (the agents).⁶⁰ Conflicts of interest are important for our purposes because they have implications for the price that firms charge in exchange for agreeing to bear risk. If managers are insulated from the full consequences of their firms' exposure to risk, their decisions may not accurately reflect the cost to their firms of engaging in risky activities.

In fact, both senior and secondary managers at financial firms are typically incentivized in ways that lead them to undervalue risk-taking from the perspective of the firms' other constituencies. This can result in a failure to identify or fully appreciate the first correlation—between low-probability risk and firm integrity. Financial institutions routinely compensate senior executives by making their pay contingent on the value of the firm's common stock or that of a parent holding company.⁶¹ In practice, however, these compensation schemes provide managers with incentives to run their firms differently from the way shareholders would like. This is most obvious in the case of option-based compensation, whereby the option holder enjoys the right to purchase an interest in the company's common stock at a stated price over a specified period of time based on stated eligibility requirements. Such arrangements encourage executives to focus on short-term results—namely, results spanning the duration of their options.⁶² Executives are allowed to cash in their options while the risks embedded in their decisions remain with the firm. They are also allowed to reap rewards on the upside without having to suffer losses other than the expiration of the option on the downside.⁶³ Typical

59 For a general discussion of both the allocation of corporate decisionmaking power within the firm and the social role of the corporation, see STEPHEN M. BAINBRIDGE, *CORPORATE LAW* §§ 5, 9 (2d ed. 2008).

60 *See id.* § 75.

61 *See* Lucian A. Bebchuk et al., *The Wages of Failure: Executive Compensation at Bear Stearns and Lehman 2000–2008*, 27 *YALE J. ON REG.* 257, 263–64 (2010) (discussing the compensation of bank executives).

62 *See id.* at 265.

63 *See* Lucian Arye Bebchuk et al., *Managerial Power and Rent Extraction in the Design of Executive Compensation*, 69 *U. CHI. L. REV.* 751, 777 (2002). *But see* David I. Walker, *The Challenge of Improving the Long-Term Focus of Executive Pay*, 51 *B.C. L. REV.*

bonus plans, which are contingent on a firm's earnings, share this feature.⁶⁴ Even the use of restricted stock, which has been the compensation technique advocated most enthusiastically by those seeking to tighten the link between executive pay and firm performance,⁶⁵ does not fully align managerial and shareholder incentives because the time horizons of restricted stock and unrestricted stock differ.⁶⁶

Conflicts of interest are also created by the compensation structures of secondary managers operating at subordinate levels of the hierarchy of financial institutions.⁶⁷ Secondary managers are typically compensated based on their execution of assigned tasks, without regard to the long-term effects of their actions.⁶⁸ While these employees are not top executives charged with setting firm policies, they nevertheless exercise significant discretion over matters that can affect the financial integrity of their employers. Secondary managers likely to have such influence include analysts and other individuals who structure, sell, or invest in securities on behalf of the firm. The influence of secondary managers is heightened by the nature of their tasks. These tasks are often technically challenging, such as analyzing complex structured securities, and the most senior managers are likely to have less, or at least less recent, technical training and experience in performing them. Thus, the ability of the most senior managers to monitor secondary managers is relatively weak.

If managers—whether senior or secondary—are insulated from the full effect of the downside risk of their decisions they will, on average, benefit more from their firms' large gains than they will lose from their firms' large losses. This asymmetric payoff structure will incentivize managers to under-weight potential adverse consequences to

435, 451 n.79 (2010) (noting that the incentives of executives include elements such as the prospect of advancement or the threat of dismissal).

64 See António Câmara, *Earnings-Based Bonus Compensation*, 44 FIN. REV. 469, 470 (2009) (noting the similarity between an option and a typical bonus).

65 See Brian J. Hall & Kevin J. Murphy, *The Trouble with Stock Options* 20 (Harvard Bus. Sch., Negotiation, Orgs. & Mkts. Unit, Research Paper No. 03-33, 2003), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=415040 (arguing that the granting of restricted stock rather than options better aligns managerial and shareholder incentives because managers holding restricted stock have less incentive to undertake risky investments).

66 The granting of restricted stock aligns managerial and shareholder incentives only to the extent that managers are precluded from unloading these shares for a significant time period. See LUCIAN BEBCHUK & JESSE FRIED, *PAY WITHOUT PERFORMANCE* 171–73 (2004).

67 See Steven L. Schwarcz, *Conflicts and Financial Collapse: The Problem of Secondary-Management Agency Costs*, 26 YALE J. ON REG. 457, 458 (2009).

68 See *id.* at 460.

the firm of the decisions they make. Managers will tend to favor high risk strategies that have high variances and low or negative expected returns. They may assume risks for which their firms are not adequately compensated. Indeed, they may do so even if they see and appreciate the risks inherent in their actions. Simply put, managers will have an incentive to gamble with their firms' assets.⁶⁹

b. Complacency

Behavioral bias is another distorting influence within financial firms that compromises the ability of managers to assess low-probability risks. Having behavioral biases, individuals make systematic errors in judgment. Here, we consider biases that induce decisionmakers to place undue confidence in, or attribute erroneous distributional properties to, unrepresentative samples.⁷⁰ Collectively, these biases suggest that during periods of economic stability managers tend to focus on the opportunity that risk-taking offers for generating out-sized rewards and become dull to the danger it poses to the integrity of their firms.

Complete probability distributions for the occurrences of an economic shock are unobservable. To estimate the likelihood of various outcomes we must rely on available data and then make assumptions about the universe from which those data were drawn. In a limited sample there is a considerable danger that the data we observe will not represent its true underlying distribution.⁷¹ Behavioral biases provide a useful guide for determining how individuals are likely to assess risk when making decisions with limited data. One relevant tendency, "optimism bias," is the observed pattern that people are unrealistically optimistic about the outcomes of uncertain events. This includes

69 The optimal contracting model underlying most scholarship in the area of executive compensation suggests that managers, who typically own only a small percentage of their companies' stock, will fail to maximize shareholder wealth by exposing their firms to too little risk. See Iman Anabtawi, *Explaining Pay Without Performance: The Tournament Alternative*, 54 EMORY L.J. 1557, 1561 (2005). Here, we suggest that compensation schemes designed to encourage risk-taking by managers can create the opposite effect. Managers who face asymmetric payoffs in which they do not have to bear the full costs of their risk-taking decisions may engage in excessive risk-taking. See Lucian A. Bebchuk & Holger Spamann, *Regulating Bankers' Pay*, 98 GEO. L.J. 247, 262-63 (2010) (describing the impact of option-based compensation on risk appetite).

70 See Matthew Rabin, *Inference by Believers in the Law of Small Numbers*, 117 Q.J. ECON. 775, 776, 785-87 (2002).

71 Cf. TALEB, *supra* note 11, at 40 (illustrating the difficulty of predicting the future from past data by using the example of a turkey who believes, until the day before Thanksgiving, that its feeder is solely a benefactor).

over-estimating positive outcomes and under-estimating negative ones. Another demonstrated bias of individuals is to discount the probability of an event's occurrence based on the length of time since it last occurred or how extreme it was. This is known as "availability bias" and reflects the tendency of a recent or especially vivid event to be the most readily accessible example in a person's mind.⁷² Optimism bias and availability bias play a role in explaining why individuals systematically underestimate the likelihood of very rare but potentially devastating risks—a phenomenon known as "disaster myopia." People are unrealistically optimistic when thinking about extreme events with which they have no recent experience, and they may undervalue the importance of those events.

In the presence of the foregoing biases, assessments of the risk of low-probability adverse events are generally understated. The problem will be especially acute during periods in which there have been no major adverse economic shocks; recent stability will allay fears of adverse occurrences. Market participants may begin to view the data as following a normal distribution, in which observations that deviate dramatically from the mean lie in the distribution's thin tails. In reality, however, the data may come from a distribution of outcomes with higher kurtosis, or "fat tails," so that the true risk of extreme events is far greater than it is under a normal distribution.⁷³ Alternatively, decisionmakers may underestimate low-probability events because of their mundaneness. Unusual events, such as a large meteor hitting the earth, are highly salient. In contrast, mundane events, such as changes in collateral value, are commonplace, possibly existing on a continuum. The familiarity with collateral of individuals working in

72 Under the availability heuristic, people overestimate the frequency or likelihood of an event when examples of, or associations with, similar events are easily brought to mind. For example, people typically overestimate the divorce rate if they can quickly find examples of divorced friends. See Paul Slovic et al., *Facts Versus Fears: Understanding Perceived Risk*, in JUDGMENT UNDER UNCERTAINTY 463, 465 (Daniel Kahneman et al. eds., 1982).

73 Similar errors are likely to arise when observed data come from an asymmetric distribution. A negative-skewed, or left-skewed, distribution has relatively few values on its left, its mean being lower than its median. Thus, in a negative-skewed distribution, a typical outcome will be above its expected value. Only occasionally will outcomes from the lower tail be observed. Because of this, it will take a considerably longer period of time to observe the true properties of a skewed distribution than a normal one. As a result, decisionmakers are likely to underestimate the potential losses their choices entail.

the financial sector might have led them to underestimate the potential consequences of a drop in collateral prices.⁷⁴

c. Complexity

Complexity can cause failures to identify or fully appreciate both correlations. Complexity in the financial system refers to the elaborate web of financial and legal relationships that increasingly underlies financial assets, investment securities, and financial markets.⁷⁵ Even a relatively simple financial asset, such as a mortgage loan, involves complexity. Over time, loan originators have developed more varied and sophisticated mortgage products, incorporating terms such as adjustable rates, low or no down payment requirements, interest-only payment options, and negative amortizations.⁷⁶ Valuation of the loans depends on multiple factors, including the likelihood that the obligor will default, movements in interest rates, and whether the borrower will prepay the loan, thereby altering the mortgage's return on investment.⁷⁷

When financial assets, like mortgage loans, are pooled and used to back investment securities, complexity grows. These so-called "structured" or "asset-backed" securities can be constructed from mortgage loans or virtually any other type of financial asset. Asset securitization, for example, involves the creation and issuance by special-purpose entities of investment securities of different classes, or

74 Cf. HANNAH ARENDT, *EICHMANN IN JERUSALEM* (Penguin Books 2006) (1963). Arendt, who studied the trial of Eichmann in Jerusalem and the manner in which the Holocaust was carried out, believed that devastating events like the Holocaust are caused by relatively commonplace human behavior.

75 See Schwarcz, *supra* note 49, at 214.

76 See EDWARD VINCENT MURPHY, CONG. RESEARCH SERV., RL 33775, *ALTERNATIVE MORTGAGES: RISKS TO CONSUMERS AND LENDERS IN THE CURRENT HOUSING CYCLE* (2006).

77 See THOMAS S.Y. HO & SANG BIN LEE, *THE OXFORD GUIDE TO FINANCIAL MODELING* 348 (2004). Some assets, such as credit card loans, are further complicated because, unlike mortgage loans, they have no fixed payment amount or amortization schedule. Borrowers may pay in full, pay a minimum payment (usually two percent of the outstanding balance), or even increase their balance up to a specified credit limit. See Mark Furetti, *An Overview of Credit Card Asset-Backed Securities 2* (Fed. Reserve Bank of Phila., Payment Cards Ctr., Discussion Paper No. 02-14, 2002), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=927489; Suleman Baig, *CDO of ABS: A Primer on Performance Metrics and Test Measures*, YIELDCURVE.COM, 4 (Dec. 2003), http://www.yieldcurve.com/Mktresearch/files/Suleman_CDOABSDec03.pdf. To address these challenges, credit card securities are typically issued separately through a revolving master trust, within which several credit accounts are pooled together to allow for multiple bond issues as well as a revolving flow of receivables. See *id.*

“tranches,” based on a pool of financial assets.⁷⁸ The financial assets underlying these securities serve as collateral for the obligations, and each class of investment securities can have a different seniority of payment priority with respect to the assets.⁷⁹ Securities in the most senior classes are more highly rated as to their creditworthiness by rating agencies because they enjoy a right to be allocated collections on the underlying financial assets that is superior to the rights of the more junior classes.⁸⁰ Securitizations typically involve the creation and interaction of multiple special purpose entities, an understanding of numerous professional disciplines, and reliance on sometimes untested legal theories.⁸¹

The markets in which financial assets and the securities based on them trade present further complexity for financial firms by creating information uncertainty. Under the “indirect holding system,” whereby virtually all debt and equity securities are traded, intermediaries such as banks and brokers hold interests in securities on behalf of investors.⁸² Issuers of securities record ownership as belonging to these intermediaries. As a result, third parties cannot readily determine who ultimately owns, and thus has credit exposure to, specific securities.

On the one hand, complexity—whether relating to financial assets, the securities they underlie, or the markets in which they are traded—can be used beneficially to enhance the functioning of financial markets.⁸³ On the other hand, it can pose serious challenges to market participants seeking to understand and predict how the financial instruments in which they invest will behave under varying conditions. Complexity increases the possibility that financial institutions will fail to see, or at least fail to fully appreciate, low-probability shocks that pose a threat to their financial condition.

Complexity implicates the first correlation insofar as it makes it difficult for financial firms to understand and assess risk. Complexity

78 See Schwarcz, *supra* note 45, at 376–77.

79 See *id.* at 377.

80 See Schwarcz, *supra* note 49, at 220 & n.46.

81 The Dodd-Frank Act attempts to limit complexity in securitization transactions by directing the SEC to require additional disclosure regarding the specific assets backing each class of securitized securities and also to establish more standardized disclosure formats. See Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act), Pub. L. No. 111-203, §§ 942–946, 124 Stat. 1376, 1896–98 (2010) (codified in scattered sections of 15 U.S.C.).

82 See Schwarcz, *supra* note 49, at 231.

83 For example, complex securities enable firms to raise low-cost financing while investors are rewarded with higher returns and the ability to more precisely hedge risk. See *id.* at 213.

obfuscates risk in several ways. First, it creates an inherent information asymmetry between the originator of a financial instrument and the investor who purchases it. Second, the more complex the security and its underlying financial assets, the more likely it will be that the benefit gained from analysis will be, or at least will appear to be, outweighed by the costs.⁸⁴ Finally, individuals face cognitive constraints in processing and using complex information effectively. For example, the usefulness of mathematical models that attempt to value financial instruments depends on being able to correctly specify the variables that influence those instruments, identify their interrelationships, and estimate results using historical data. As complexity increases, financial models become less reliable. Complexity, therefore, increases the likelihood that financial firms will see little benefit in conducting extensive diligence on the securities they purchase. This will lead them to rely more heavily on simplifying heuristics, such as credit ratings, as substitutes for their own analysis.⁸⁵ Under such conditions, firms are likely to underestimate the risk of remote shocks to the financial condition of their portfolios because complexity makes that risk less salient, more opaque, and more difficult to model.

2. Explaining Risk Transmission Through the Inter-Institutional Correlation Among Financial Institutions

The discussion above focused on the tendency for financial firms to underestimate the occurrence of low-probability shocks and the resulting vulnerability that they suffer. Our second correlation—the correlation among financial institutions—considers the ways in which financial firms are interrelated within the financial system. By exploring these interconnections we hope to account for how individual firms affect each other, both through their direct linkages and through their impact on financial markets. This perspective also per-

84 See *id.* at 221–23. Firms are also discouraged from engaging in due diligence with regard to the risk underlying an asset since credit derivatives allow firms to broadly disperse risk creating a collective action problem. See *id.* at 245, 258.

85 See Steven L. Schwarcz, *Disclosure's Failure in the Subprime Mortgage Crisis*, 3 UTAH L. REV. 1109, 1114–15 (2008) (pointing out that rating agencies are also plagued by the complexity of the securities they are assessing and by conflicts between the interests of employees and institutions). The Dodd-Frank Act attempts to strengthen the integrity of rating agencies through measures relating to increased accountability, internal controls, elimination of reliance on ratings by federal agencies, and public disclosure of the information on which ratings are based. Implementation of many of these measures has been left by Congress to regulations to be prescribed by the SEC. See Dodd-Frank Act §§ 931–939H.

mits us to consider the broader framework within which individual firms assess the level, and pricing, of risk-taking.

a. Complexity Revisited

Complexity can also implicate the second correlation. The financial system is a complex “network” comprised of institutions, or “nodes,” that are both interconnected and interactive.⁸⁶ Thinking of the financial system in terms of a network highlights the potential for shocks that originate at one node and travel to others through their links. It also suggests the potential for the network to amplify an initial shock through, for example, positive feedback effects. A network exhibiting positive feedback responds to an initial shock by increasing the shock’s magnitude. Symbolically, “A” leads to “B,” which produces more of “A.”⁸⁷

The most straightforward way that financial firms are networked is through direct contracts, such as derivatives, wherein the parties are commonly referred to as “counterparties.”⁸⁸ Derivatives, most notably credit-default swaps (CDS),⁸⁹ allow firms to trade credit risks on a vari-

86 For a general review of international finance as a complex adaptive system, see, for example, Lawrence G. Baxter, *Internationalisation of Law—The ‘Complex’ Case of Bank Regulation*, in *THE INTERNATIONALISATION OF LAW 3* (Mary Hiscock & William van Caenegem eds., 2010). See Brunnermeier, *supra* note 15, at 97–98; Ross A. Hammond, *Systemic Risk in the Financial System: Insights from Network Science 2* (Pew Fin. Reform Project, Briefing Paper No. 12, 2009), available at http://www.pewfr.org/admin/project_reports/files/EP_HammondNetworks-final-TF-Correction.pdf (explaining the role of nodes in the financial system). See generally Andrew G. Haldane, Exec. Dir., Fin. Stability, Bank of Eng., Speech Delivered at the Financial Student Association: Rethinking the Financial Network 7 (Apr. 2009) (transcript available at <http://www.bankofengland.co.uk/publications/speeches/2009/speech386.pdf>) (analyzing the financial system through a network lens).

87 For example, an increase in property values leads to an increased supply of mortgage capital, which in turn leads to increased property values. See Marcel Arseneault & Liang Peng, Mortgage Fund Flows, Capital Appreciation, and Real Estate Cycles 2–3 (Aug. 2009) (unpublished working paper), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1458188 (arguing that positive feedback loops drive real estate cycles).

88 See Phelim Boyle & Feidhlim Boyle, *Derivatives 7* (2001) (defining parties to a contract, especially a derivatives contract, as counterparties).

89 In a credit-default swap, one party (the credit “seller”) agrees, in exchange for the payment to it of a fee by a second party (the credit “buyer”), to assume the credit risk of certain debt obligations of a specified borrower or other obligor. If a “credit event” (for example, default or bankruptcy) occurs in respect of that obligor, the credit seller will either (a) pay the credit buyer an amount calculated by reference to post-default value of the debt obligations or (b) buy the debt obligations (or other eligible debt obligations of the obligor) for their full face value from the credit buyer. See STEVEN L. SCHWARCZ, *STRUCTURED FINANCE* § 10:3.1 (3d ed. 2002).

ety of exposures. Because of these interconnecting contracts, bankruptcy or other failure of a given market participant can cause that participant to default on its obligations to other market participants, who, in turn, may themselves be so harmed that they default on their own obligations to market participants, leading to a domino-effect collapse.⁹⁰

The domino model of contagion describes a mechanism by which shocks are transmitted directly between firms within a network, but it does not capture the transmission of shocks among firms through the indirect impact of their behavior on markets. Markets serve as another mechanism through which shocks can have network-wide effects. In a simple domino model of contagion, asset prices are treated as fixed, and only counterparty default can affect the financial condition of a firm.⁹¹ In a market-based financial system, however, asset prices respond to the assets' perceived riskiness. Investors are subject to "mark-to-market" or "fair value" accounting rules, requiring them to adjust the value of their securities holdings for accounting purposes to reflect their current market prices.⁹² An investor, for example, may buy securities on credit from a securities broker-dealer, securing repayment of the purchase price by pledging the securities as collateral. To guard against the price of the securities falling to the point where their value as collateral is insufficient to repay the purchase price, the broker-dealer requires the investor to maintain a minimum collateral value. If the market value of the securities falls below this minimum, the broker-dealer will issue a "margin call" requiring the investor to deposit additional collateral, usually in the

90 See Schwarcz, *supra* note 1, at 198–200; Schwarcz, *supra* note 49, at 235–36.

91 See MARKUS BRUNNERMEIER ET AL., *THE FUNDAMENTAL PRINCIPLES OF FINANCIAL REGULATION* 16 (2009).

92 Under fair value accounting (FVA), assets and liabilities are revalued to market value at each balance sheet date. Fair value is generally defined as the most advantageous price that a seller would receive to sell an asset or pay to transfer a liability in an orderly transaction between market participants at the measurement date. FVA is "arguably the most important and controversial issue facing regulators and accounting standard setters today." Doron Nissin & Stephen Penman, *Principles for the Application of Fair Value Accounting* 1 (Columbia Bus. Sch. Ctr. for Excellence in Accounting & Sec. Analysis, White Paper No. 2, 2008); see also David J. Emerson et al., *Fair Value Accounting: A Historical Review of the Most Controversial Accounting Issue in Decades*, 8 J. BUS. & ECON. RES. 77, 80–84 (2010) (examining the evolution of fair value accounting). The financial industry, as well as members of Congress, has blamed FVA for contributing to the current financial crisis by exacerbating the impact of pro-cyclical-ity (i.e., the exaggeration of upturns and downturns in the economy) in the markets. Supporters of FVA argue that, because fair value accurately reflects current market conditions, investors benefit by having a greater understanding of the true value of companies.

form of money or additional securities, to satisfy the minimum. Failure to do so triggers a default, enabling the broker-dealer to foreclose on the collateral.⁹³ As a result, firms subject to margin calls may be forced to engage in asset “fire” sales, thereby depressing prices, requiring more forced sales, and depressing prices even further, thus creating a positive feedback effect, or “loss spiral.”⁹⁴

In highly complex financial markets in which firms are constantly adjusting their risk exposures in the presence of information uncertainty, systemic transmission of localized shocks need not even require that firms be contractually linked or that they conduct “fire” sales. Opaqueness, such as information uncertainty attributable to the indirect holding system,⁹⁵ can lead to the transmission of a firm’s problems by making it impossible to identify the beneficial ownership of specific securities. Unable to determine which institutions are exposed to securities that have become distressed, market participants may attribute those securities to similarly situated firms.⁹⁶ Market participants may, as a result, become reluctant to extend credit to other financial market participants based on “similarity” concerns.⁹⁷

Technological innovation can aggravate network effects within the financial system by making financial markets more “temporally” complex.⁹⁸ Newly developed trading technologies have greatly

93 See ZVI BODIE ET AL., *INVESTMENTS* 78–79 (7th ed. 2008).

94 See Rodrigo Cifuentes et al., *Liquidity Risk and Contagion* 9 (Bank of Eng. Working Paper Series, Paper No. 264, 2005), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=824166; see also Clifford De Souza & Mikhail Smirnov, *Dynamic Leverage: A Contingent Claims Approach to Leverage for Capital Conservation*, 31 J. PORTFOLIO MGMT. 25, 28 (2004) (arguing that, in a bad market, short-term pressure to sell assets to raise cash for margin calls can lead to further mark-to-market losses for remaining assets, which triggers a whole new wave of selling, the process repeating itself until markets improve or the firm is wiped out, and referring to this process as a “Critical Liquidation Cycle”). These spiraling events may well occur rapidly, within days. See, e.g., *Systemic Risk: Examining Regulators’ Ability to Respond to Threats to the Financial System: Hearing Before the H. Comm. on Fin. Servs.*, 110th Cong. 1 (2007) (statement of Richard Bookstaber, Author) (observing the “tendency for the markets to move rapidly into a crisis mode,” and referring to this tendency, by analogy to engineering, as “tight coupling”).

95 See *supra* note 82 and accompanying text.

96 In economic terms, this can be seen as a variant on adverse selection. See George A. Akerlof, *The Market for “Lemons”: Quality Uncertainty and the Market Mechanism*, 84 Q.J. ECON. 488, 488 (1970) (describing the agency costs that arise when sellers have better information regarding the quality of a good than buyers).

97 See Jeffrey N. Gordon & Christopher Muller, *Confronting Financial Crisis: The Case for a Systemic Emergency Insurance Fund*, 28 YALE J. ON REG. (forthcoming 2011).

98 See Schwarcz, *supra* note 49, at 215, 232 (explaining that temporal complexity exists within markets when events move too rapidly for there to be sufficient time or opportunity for parties to intervene).

increased the speed of processing and trading on information. High-frequency algorithmic trading systems are now capable of analyzing vast quantities of market data and transmitting thousands of order messages per second.⁹⁹ They rely on computerized quantitative models that execute trades with little or no human involvement.¹⁰⁰ Reliance on automated trading systems can aggravate loss spirals. For example, because of the speed with which high-frequency algorithmic trading occurs, erroneous trades can lead to substantial losses before they are discovered.¹⁰¹ In addition, if securities prices are subjected to a negative initial shock, automated stop-loss orders could formulaically trigger a chain reaction of selling without the time or opportunity for human judgment to intervene.¹⁰² There is also the danger that the interaction between automated trading systems may result in disorderly markets.¹⁰³

99 See Carol L. Clark, *Controlling Risk in a Lightning-Speed Trade Environment*, CHICAGO FED LETTER (Mar. 2010), http://www.chicagofed.org/digital_assets/publications/chicago_fed_letter/2010/cflmarch2010_272.pdf.

100 See *id.* There are now numerous ways in which a large trade can be executed, allowing customers to choose how much human judgment is involved when executing such a trade. See CFTC & SEC, FINDINGS REGARDING THE MARKET EVENTS OF MAY 6, 2010, at 14 (2010), available at <http://www.sec.gov/news/studies/2010/marketevents-report.pdf>.

101 See Tom Steinert-Threlkeld, *Preventing the Two Minute Meltdown*, SEC. TECH. MONITOR, Aug. 3, 2009 (arguing that the next market meltdown could occur in two minutes because high-frequency traders use new technology to execute trades at blazing speeds); see also Risk Management Controls for Brokers or Dealers with Market Access, 75 Fed. Reg. 4009 (Jan. 26, 2010) (to be codified at 17 C.F.R. pt. 240) (noting that because of the speed of high-frequency trading, a malfunctioning algorithm could enter \$720 million worth of erroneous trades if there were a two minute delay in detection).

102 A stop-loss order is a standing order designed to limit losses by automatically selling a security if it falls to a certain price point. See CFTC & SEC, PRELIMINARY FINDINGS REGARDING THE MARKET EVENTS OF MAY 6, 2010, at 58 (2010), available at <http://www.sec.gov/sec-cftc-prelimreport.pdf>. It is possible for these orders to create a domino effect because the triggering of one stop-loss order puts downward pressure on the price of a security, which can lead to the triggering of another stop-loss order. See *id.* at 5 (“[S]top loss market orders could potentially trigger a chain reaction of automated selling if they are in place in significant quantity for a particular stock.”); Amir E. Khandani & Andrew W. Lo, *What Happened to the Quants in August 2007?*, 5 J. INVESTMENT MGMT 5, 6–7 (2007) (describing how downward pressure on stock prices due to forced selling by quantitative hedge funds was exacerbated by stop-loss orders, which caused further losses).

103 See CFTC & SEC, *supra* note 100, at 6; see also discussion *infra* note 204 (explaining the events of May 6, 2010).

b. The Tragedy of the Commons

When making risk-taking decisions, firms are self-regarding. Because of the interconnectivity among financial institutions, however, individual firm decisions have potential spillover effects. These repercussions are an example of an externality.¹⁰⁴ Externalities can give rise to a type of tragedy of the commons,¹⁰⁵ most familiar in the environmental setting but also relevant in financial markets. In the latter case, the benefits of exploiting finite capital resources accrue to individual market participants, each of whom is motivated to maximize use of the resource, whereas the costs of exploitation are distributed more widely. This can not only result in a failure to identify or fully appreciate the correlations but also, more significantly, a failure to fully appreciate the possibility that the correlations may combine to produce a systemic crisis. The tragedy of the commons suggests that, absent intervention, financial market participants will progressively pursue their self-interest in the form of socially excessive risk-taking.¹⁰⁶

The root of the commons problem in financial markets is the asymmetry in the distribution of gains and losses associated with investment decisions. As we discussed above, in assuming risk, a firm exposes itself to the possibility that the return on its investment will deviate from its long-run expected value, producing either a positive or negative outcome.¹⁰⁷ In the case of a positive outcome, the firm captures the full benefits of the investment's success. In the case of a

104 See James M. Buchanan & Wm. Craig Stubblebine, *Externality*, 29 *ECONOMICA* 371, 372 (1962).

105 We call this a "type" of tragedy of the commons because it is not strictly a tragedy of the commons in which all parties involved commonly suffer the externality they cause. The classic example of a tragedy of the commons is an overgrazed pasture resulting from common ownership so that no individual owner has the right to exclude use by other owners. See generally Garret Hardin, *The Tragedy of the Commons*, 162 *SCI.* 1243, 1244 (1968) (discussing the tragedy of the commons problem in the over-population context). The original concept of a tragedy of the commons can be traced back to Aristotle. See ARISTOTLE, *POLITICS* 57 (Benjamin Jowett trans., Courier Dover 2000) ("[T]hat which is common to the greatest number has the least care bestowed upon it. Every one thinks chiefly of his own, hardly at all of the common interest.").

106 Accordingly, the tragedy of the commons can be viewed as a conflict between individual firms and broader financial-market interests. See Patricia A. McCoy et al., *Systemic Risk Through Securitization: The Result of Deregulation and Regulatory Failure*, 41 *CONN. L. REV.* 493, 532 (2009) (noting that one of the surprising phenomena of the expansion of non-prime mortgage lending from 2002–2006 was that "as systemic risk increased, risk premia did not").

107 See *supra* note 56 and accompanying text.

negative outcome, however, the firm may not suffer the full consequences of the poor investment. Rather, if the firm fails or merely defaults, those consequences will impact financial market participants that rely on the soundness of the firm's financial condition. Furthermore, if the firm is deemed too systemically significant to fail, its losses may be absorbed by the government as a lender of last resort. In either case, the un-internalized costs associated with risk-taking by firms leads them to overexploit scarce capital resources in the form of socially excessive risk-taking.

The commons problem can be even further exacerbated where competition makes socially excessive risk-taking essential to maintaining market share. This collective action problem was captured by Chuck Prince, former chairman and CEO of Citigroup, prior to the recent global financial crisis: "When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to get up and dance. We're still dancing."¹⁰⁸ To avoid being marginalized by losing market share, firms have an incentive to take the same risks as other firms. Doing so increases systemic risk, but much of that harm is externalized, making it rational—viewed from the standpoint of their shareholders—for firms to dance too frenziedly and remain on the dance floor too long.¹⁰⁹

B. *Future Impediments to Financial Market Self-Regulation*

Many of the reasons for which financial market participants have failed to address the correlations (which, we have argued, can combine to propagate economic shocks within and among financial institutions) are likely to continue. Indeed, as explained below, we believe they will become even more pronounced in the future.

Complexity is certainly likely to continue, if not grow. Profit opportunities, for example, are inherent in complexity. This is due in part to investor demand for securities that more precisely match their risk and reward preferences. It is also due to regulatory arbitrage. Regulatory arbitrage refers to the exploitation of differential treatment of financial transactions by alternative regulatory regimes in order to enhance returns.¹¹⁰ Financial, tax, and accounting rules

108 Michio Nakayama & David Wighton, *Citigroup Chief Stays Bullish on Buy-outs*, FIN. TIMES (July 9, 2007), http://us.ft.com/figateway/superpage.ft?news_id=fto070920071725183786.

109 Indeed, viewed from the standpoint of their shareholders, it would be *irrational* for firms not to dance too frenziedly and remain on the dance floor too long.

110 See Frank Partnoy, *Financial Derivatives and the Costs of Regulatory Arbitrage*, 22 J. CORP. L. 211, 227 (1997); Victor Fleischer, *Regulatory Arbitrage* 3 (Univ. of Colo. Law

often apply varying treatment to activities that possess roughly the same economic substance.¹¹¹ By manipulating the form of a transaction, firms can take advantage of these inconsistent regulatory regimes.

Complexity is also a feature of the means by which financial firms develop new products. For example, mortgage securitization transactions originated to bridge the desire of homebuyers for affordable mortgage loans with the desire of investors for enhanced returns.¹¹² Over time, many other types of assets have become the basis for securitizations, and investment banks and other underwriters and arrangers have generated considerable fees for developing these financial products.

Technological advances may also increase complexity. Professor Henry Hu described the potential dark side of the impact on financial markets of increasing sophistication as “science run amok, . . . a financial Jurassic Park,”¹¹³ in which,

[i]n the face of relentless competition and capital market disintermediation, big financial institutions [hire] financial scientists to develop new financial products. Often operating in an international wholesale market open only to major corporate and sovereign entities—a loosely regulated paradise hidden from public view—these scientists push the frontier, relying on powerful computers and esoteric models laden with incomprehensible Greek letters.¹¹⁴

The “new-product generation machines” of investment banks, hedge funds, and other firms have been, and are likely to continue to be, better staffed and stronger than the structures that oversee their

Sch., Legal Studies Research Paper Series, Working Paper No. 10-11, 2010), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1567212.

111 See *Establishing a Framework for Systemic Risk Regulation: Hearing Before the S. Comm. on Banking, Hous. & Urban Affairs*, 111th Cong. 47 (2009) (statement of Vincent Reinhart, Resident Scholar, American Enterprise Institute).

112 See SCHWARCZ, *supra* note 89, § 1.2.

113 *Over-the-Counter Derivatives: Modernizing Oversight to Increase Transparency and Reduce Risks: Hearing Before the Subcomm. on Sec., Ins. & Inv. of the S. Comm. on Banking, Hous. & Urban Affairs*, 111th Cong. 25 (2009) (statement of Henry T.C. Hu, Allan Shivers Chair in the Law of Banking and Finance, University of Texas School of Law). In September 2009, the SEC announced the appointment of Professor Hu as the first Director of the newly created Division of Risk, Strategy, and Financial Innovation.

114 *Id.*

operations.¹¹⁵ This suggests a further motivation for greater product complexity: to elude regulation.

New technologies are likely to continue to add complexity not only to financial products but also to financial markets. We have referred to the financial system as a “network” that connects institutions, or “nodes,” with one another, serving to transmit economic shocks.¹¹⁶ Over time, innovations in financial products have increased the linkages between nodes.¹¹⁷ In addition, new communications technologies have accelerated the speed with which signals travel between them.¹¹⁸ High levels of connectivity, combined with greater speed in the transmission of data, tend to increase the likelihood that local disturbances will rapidly produce network-wide effects.¹¹⁹

While the level of complexity within the financial system is likely to intensify, complacency is likely to persist. Human nature is ingrained and difficult to change. For example, as a result of availability bias,¹²⁰ we are all too susceptible to overestimating the frequency or likelihood of an event when examples of, or associations with, similar events are easily brought to mind.¹²¹ Immediately after a crisis, people may well focus on avoiding that particular type of crisis in the future, but once the crisis loses its immediacy we quickly tend to forget its lessons. Not surprisingly, then, when past financial crises recede in memory, investors almost always “go for the gold,” in the sense of seeking higher rates of return in lieu of protection from risk.¹²² Increasingly, as risk is analyzed using more sophisticated quantitative techniques, behavioral biases become embedded in finan-

115 See Alan Murray, *Getting Started: Sir Howard Davies of the London School of Economics and Political Science Offers Action Items for Fixing the Financial System*, WALL ST. J., Dec. 14, 2009, at R4.

116 See *supra* note 85 and accompanying text.

117 See Haldane, *supra* note 86, at 22.

118 See Joy A. Schwartzman, *The Game of ‘Pass the Risk’: Then and Now*, in RISK MANAGEMENT 72, 72 (2008), available at <http://www.soa.org/library/essays/rm-essay-2008-schwartzman.pdf>.

119 See Michael J. Naylor et al., *A Network Theory of Financial Cascades* 21–22 (Jul. 23, 2008) (unpublished working paper), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1184604&rec=1&srcabs=1089357.

120 See *supra* note 72 and accompanying text.

121 See Slovic et al., *supra* note 72, at 463, 465.

122 See Larry Light, *Bondholder Beware: Value Subject to Change Without Notice*, BUSINESSWEEK, Mar. 29, 1993, at 34 (discussing empirical data showing that investors favor higher interest rates over “event risk” covenants, once the examples of events justifying the covenants have receded in memory). “Bondholders can—and will—fuss all they like. But the reality is, their options are limited: Higher returns or better protection. Most investors will continue to go for the gold.” *Id.* This will particularly be the

cial models. Where a low-probability risk cannot be measured statistically, it is sometimes treated as zero in the model's computations.¹²³ This approach is consistent with best practices for modeling low-probability events such as value-at-risk (VaR).¹²⁴ Thus, low-probability events are likely to continue to be ignored in mathematical models, thereby creating at least a perception that they should likewise be ignored in reality.¹²⁵

Conflicts of interest within financial firms are also likely to continue, at least in the absence of government intervention.¹²⁶ Individual firms will be unable to solve the collective-action problem that employing a compensation scheme intended to avoid conflicts, such as paying deferred or contingent compensation, entails. Implementing such measures is likely to disadvantage firms in their ability to compete for the best managers.¹²⁷ Moreover, the increasing competi-

case, as a result of the herd instinct, when other investors are acting in this manner. See Schwarcz, *supra* note 41, at 566.

123 See Joe Nocera, *Risk Mismanagement: Were the Measures Used to Evaluate Wall Street Trades Flawed?*, N.Y. TIMES MAG., Jan. 4, 2009, at 24, 46; *infra* note 167.

124 VaR represents the expected maximum loss (the "value at risk") of a portfolio over a given time horizon within a specified confidence interval. For example, if the daily VaR of a portfolio is twenty-five million dollars at the ninety-nine percent confidence level, there is only a one-in-a-hundred chance that it will suffer a loss greater than twenty-five million dollars over a one-day holding period. See PHILIPPE JORION, VALUE AT RISK 49, 76 (3d ed. 2007) (explaining the meaning of VaR). Properly understood, VaR is a valuable approach to risk measurement. As the VaR model became more accepted, however, analysts began to apply it beyond its intended uses. See Peter Conti-Brown, Note, *A Proposed Fat-Tail Risk Metric: Disclosure, Derivatives, and the Measurement of Financial Risk*, 87 WASH. U. L. REV. 1461, 1469 (2010); see also Sergey Sarykalin et al., *Value-at-Risk vs. Conditional Value-at-Risk in Risk Management and Optimization*, in TUTORIALS IN OPERATIONS RESEARCH 2008, at 270, 271 (Zhi-Long Chen & S. Raghavan eds., 2008), available at http://www.ise.ufl.edu/uryasev/VaR_vs_CVaR_INFORMS.pdf (explaining how VaR's disregarding of extreme tails may be a good property and contributes to its reputation for providing more stable estimates).

125 Cf. Kimberly D. Krawiec, *Operational Risk Management: An Emergent Industry*, in OPERATIONAL RISK TOWARD BASEL III 271, 286 (Greg N. Gregoriou ed., 2009) ("[T]he incentives fostered by [the] Basel II [Capital Accords] to create a numerical measure of . . . risk may cause a focus on those aspects of . . . risk most easily quantified—the high-frequency, low-impact events . . . —rather than on the more challenging and elusive aspects of [risk] that may pose the greatest threat to financial institutions.").

126 See Schwarcz, *supra* note 67, at 468–69 (arguing that government intervention may be required for firms to align compensation incentives with their long term interests, since firms are unlikely to act individually).

127 See *id.*

tion of firms worldwide for top managers¹²⁸ makes it increasingly likely that the collective-action problem will become global.

Finally, there is no reason to believe that individual market participants will cease over-exploiting finite capital resources, imposing externalities on each other and on the general public in the process.¹²⁹ Attempts at cooperative behavior in the form of more prudent risk-taking will be met with cheating in the form of less prudent risk-taking. The knowledge that if one firm behaves prudently its competitors will not creates incentives for all firms to take excessive risks.

It therefore appears that the correlations we have identified as capable of transmitting systemic risk are likely to persist, and that increasing complexity in the financial system will make them even more pervasive and impervious to market-participant correction. Recognizing this, though, does not necessarily address whether the correlations are likely to combine in the future, for it is their combination that is systemically dangerous.¹³⁰ Because the correlations are independent, the likelihood of their combining should be as random in the future as in the past. Therefore, to the extent the correlations become more pervasive, their combination should follow a similar path. The correlations are thus likely to continue to become even more systemically dangerous than they have been historically.

III. IMPLICATIONS FOR REGULATING SYSTEMIC RISK

In the preceding discussion, we described a framework in which two correlations in the financial system can combine to produce systemic economic effects from local shocks. We also identified a series of interrelated factors—conflicts, complacency, and complexity, as well as a type of tragedy of the commons—that helps to explain why market participants are unlikely to address these correlations on their own. Finally, we argued that the correlations are likely to continue to exist in the future and, indeed, become even more pronounced. The correlations are therefore likely to remain systemically significant as a mechanism for transmitting localized adverse economic shocks.

128 See Claudio Fernández-Aráoz, *The Coming Fight for Executive Talent*, BLOOMBERG BUSINESSWEEK (Nov. 25, 2009), http://www.businessweek.com/magazine/content/09_49/b4158080830272.htm?chan=magazine+channelbusiness+views (discussing the shortage of top executive talent and the increasing competition of firms worldwide for the best managers).

129 Cf. *supra* notes 104–06 and accompanying text (discussing risk-taking decisions as a type of tragedy of the commons).

130 See discussion *supra* Part I.A.

The recent global financial crisis highlighted the role of government in responding to systemic failure. In this capacity, the U.S. government, for example, has provided liquidity to help prevent banks and other critical financial firms from defaulting and to help prevent defaulting critical financial firms from failing. To a limited extent, it has also provided liquidity to capital markets to attempt to keep them functioning.¹³¹ Avoiding systemic collapse is an important public risk-management function in a free-market economy, an inevitable feature of which is failure. But to the extent that avoiding systemic collapse entails large-scale risk absorption by government, there are enormous direct and indirect costs, including fostering potential moral hazard by financial firms that may be deemed too big to fail.¹³² Another potential role for a regulator is to help safeguard against systemic crises, as opposed to merely addressing them after they occur, in circumstances in which market participants cannot be counted on to do so.

Our purpose in Part III is twofold. First, we seek to demonstrate that the factors that help explain why the private sector has not acted to constrain the transmission of systemic risk can be associated with specific behavioral and other market failures. Second, we wish to identify available policy tools for correcting such failures, which can be used by regulators to encourage firms to manage risk more prudently from a systemic standpoint. Importantly, our analysis is motivated by our belief that regulatory intervention in financial markets is justified by the inability of the marketplace to achieve allocative efficiency on its own.¹³³ For government regulation to enhance social welfare, it must correct a market failure.¹³⁴ Outside of such circumstances, market participants would rationally trade off risk and return,

131 See *infra* notes 211–13 and accompanying text.

132 See IMF, GLOBAL FINANCIAL STABILITY REPORT (2010), available at <http://www.imf.org/external/pubs/ft/gfsr/2010/01/pdf/text.pdf>.

133 An allocation of resources is economically efficient if resources cannot be reallocated so as to make one person better off without making another person worse off. See IVAN PNG & DALE LEHMAN, *MANAGERIAL ECONOMICS* 145 (3d ed. 2007). Market failure occurs when a market fails to allocate resources efficiently. See PAUL A. SAMUELSON & WILLIAM D. NORDHAUS, *ECONOMICS* 756 (15th ed. 1995) (defining market failure as “an imperfection in a price system that prevents an efficient allocation of resources”).

134 See PNG & LEHMAN, *supra* note 133, at 414. Because regulation can be costly, efficiency also demands that the costs of regulation not exceed its benefits. See Schwarcz, *supra* note 1, at 208–09; see also Charles K. Whitehead, *Destructive Coordination*, 96 CORNELL L. REV. 323, 330 (2011) (pointing out that regulation itself produces systemic costs in the form of coordination’s collective impact on financial markets).

and financial crises would serve as mechanisms for punishing excessive risk-taking.¹³⁵

A. *Managing the Correlation Between Low-Probability Risk and Institutional Integrity*

Our first correlation posits a relationship between the occurrence of a low-probability adverse shock and the integrity of a financial firm. In theory, a firm should address this correlation by managing risk efficiently, eliminating or consensually transferring risks that it is not in the best position to bear.¹³⁶ As for those risks it can bear efficiently, it should charge an appropriate premium.¹³⁷ We argued in Part II.A, however, that a series of interrelated factors (conflicts, complacency, complexity, and a type of tragedy of the commons) explains why managers overexpose their businesses to low-probability adverse shocks. We now advance responses to the behavioral and other market failures associated with these factors.

1. *Regulating Conflicts*

We have argued that conflicts of interest between a firm's managers and other stakeholders of the firm lead managers to take excessive risks with their firm's assets. Specifically, in the presence of these conflicts, managers are incentivized to assume more risk on behalf of the firm than other stakeholders would like. Conflicts of interest between a firm's managers and its non-manager shareholders can arise, for example, when there is an information asymmetry in the managerial labor market.¹³⁸ Markets in which there are differences in information between buyers and sellers are not as efficient as those in which buyers and sellers have symmetric information.¹³⁹ In the presence of symmetric information, buyers and sellers are subject to competition. If, for example, a seller of a product attempts to increase profits by lowering quality, then buyers will switch to other sellers. Sellers are thus constrained from exploiting private information.

135 See Korinek, *supra* note 10, at 2.

136 See Kaen, *supra* note 14, at 470.

137 Firms have different comparative advantages in dealing with different risks. See *id.*; see also René M. Stulz, *Rethinking Risk Management*, 9 J. APPLIED CORP. FIN. 8, 8, 14–16 (1996) (arguing that firms should exploit any comparative advantage in risk-bearing).

138 See, e.g., Michael C. Jensen & Kevin J. Murphy, *Performance Pay and Top-Management Incentives*, 98 J. POL. ECON. 225, 254 (1990) (arguing that disclosure of executive compensation can help deter self-interested behavior).

139 See *supra* note 96.

Information is not symmetric in the market for senior corporate managers. Shareholders, for example, cannot observe directly the behavior of CEOs. Their inability to do so is due primarily to the separation of ownership and control in publicly held corporations with diffuse ownership, which are governed by a centralized board of directors. Directors, in turn, are only weakly beholden to shareholders.¹⁴⁰ The information asymmetry is even greater for secondary managers, who not only are further removed from shareholder control than senior managers but also often have jobs that are so technical that senior managers cannot effectively evaluate their performance.

The agency problem, whereby managers have substantial leeway to pursue their private interests at the expense of shareholder value, is a direct consequence of information asymmetry.¹⁴¹ Because of it, managers can extract economic rents from shareholders. One way they can do this is by pursuing high-risk strategies that inure to the benefit of managers if they succeed but inure to the detriment of shareholders, as well as managers, if they fail. In the absence of market imperfections, shareholders would be able to both observe such self-interested behavior and to act on it by switching their relationships to better-managed firms. Managers would therefore be compelled to behave in the best interests of shareholders. The informational failure that, we contend, allows conflicts of interest to persist in managerial labor markets informs our policy recommendations for better aligning the interests of the managers and shareholders of financial firms. These recommendations fall broadly into three categories: pay-risk disclosure, board-of-director fiduciary duties, and risk-sharing.

Although shareholders cannot directly observe the behavior of managers, they can influence managerial behavior by making managerial pay depend on performance measures that shareholders can observe. Compensation arrangements are a powerful influence on managerial decision-making. Programs that insulate managers from poor performance, link their rewards primarily to short-term metrics, or set performance criteria unreasonably high may provide managers with incentives for excessive risk-taking from the point of view of the firm's shareholders. Enhanced disclosure is a tool that can be used to encourage firms to adopt compensation arrangements that align man-

140 See George W. Dent, Jr., *For Optional Federal Incorporation*, 35 J. CORP. L. 499, 500 (2010) (pointing out that although, in theory, directors are responsive to shareholders, in practice, CEOs dominate boards).

141 See *supra* note 60 and accompanying text.

agerial incentives with the long-term interests of their firms.¹⁴² Recognizing this, the SEC recently amended its compensation disclosure rules under the Securities Exchange Act of 1934¹⁴³ to require discussion of compensation as it relates to risk management.¹⁴⁴ The disclosure is required to the extent that risks arising from a company's compensation policies and practices for its employees, including non-executive officers, are "reasonably likely" to have a material adverse effect on the company.¹⁴⁵

Such a high threshold for disclosing "pay risk" is unlikely, however, to elicit meaningful disclosure.¹⁴⁶ More complete disclosure would better serve shareholders in two respects. First, it would require boards of directors to consider the relationship between compensation and incentives for risk-taking at both the senior and secondary management levels of their firms. This type of disclosure would also better enable shareholders to monitor the incentives that shape decision-making within the firm through advisory votes on executive pay packages.¹⁴⁷

For disclosure to solve the conflicts problem, persons receiving the disclosure must be able to use it to influence the actions of decisionmakers through consent requirements or market actions based on the information provided to them. The complexity of disclosure, cognitive biases, and collective action problems, however, conspire to make it unlikely that investors will make full use of disclosure.¹⁴⁸ We

142 See Betty Simkins & Steven A. Ramirez, *Enterprise-Wide Risk Management and Corporate Governance*, 39 LOY. U. CHI. L.J. 571, 586–87 (2008).

143 Ch. 404, 48 Stat. 881 (codified as amended in scattered sections of 15 U.S.C.).

144 SEC Proxy Disclosure Enhancements Rule, 17 C.F.R. §§ 229.401–.402, .407 (2010).

145 *Id.* § 229.407. The Dodd-Frank Act directs the SEC to issue rules that require companies to disclose in any proxy or consent solicitation material for an annual shareholder meeting a "clear description" of any executive compensation arrangement required to be disclosed by Item 402 of Regulation S-K, including the relationship between executive compensation actually paid and a company's financial performance. See Dodd-Frank Act, Pub. L. No. 111-203, § 953, 124 Stat. 1376, 1903–04 (2010).

146 See Janet L. Fisher et al., *Compensation and Risk: Practical Considerations for the Compensation Committee*, 24 INSIGHTS 2, 2 (2010).

147 Publicly-traded U.S. corporations must give shareholders a "say on pay" by including in any proxy, consent, or authorization for any shareholder meeting for which the SEC mandates compensation disclosure a separate nonbinding resolution subject to shareholder vote to approve the company's executive compensation as disclosed in those materials. See Dodd-Frank Act § 951.

148 See Troy A. Paredes, *Blinded by the Light: Information Overload and Its Consequences for Securities Regulation*, 81 WASH. U. L.Q. 417, 419 (2003) (exploring the effect of cognitive limitations on investor decisionmaking).

therefore believe that disclosure must be supplemented by measures that either reduce information asymmetries between parties who make risk-bearing decisions in the first instance and those who will ultimately bear the risk, or mitigate the consequences of those asymmetries.¹⁴⁹

Acknowledging the limits of disclosure's disciplinary force, corporate law also constrains managerial behavior through the law of fiduciary duty. Directors are generally charged with managing their firms in the best interests of shareholders.¹⁵⁰ Because the board is a centralized decision-making unit, it does not face the collective action problem that shareholders confront as monitors of firm conduct.¹⁵¹ Directors can cause their firms to both establish and implement appropriate risk-management programs. Recent case law has suggested that excessive risk-taking by firms might violate a board's responsibility to monitor the firm under its fiduciary duty of loyalty.¹⁵² Thus, fiduciary duty law can play a valuable role in constraining excessive managerial risk-taking.¹⁵³ Whether it will in fact do so depends in large part on the evolution of the jurisprudence in this area. A more direct approach to constraining the extent to which information asymmetries leave room for managers to take excessive risks is to align the incentives of managers and shareholders by requiring managers to place "skin in the game"—i.e., sharing at least some portion of the risk

149 To this end, the Dodd-Frank Act requires regulators to establish rules prohibiting certain financial institutions with assets of one billion dollars or more from using incentive-based compensation that could encourage inappropriate risks, and requiring those financial institutions to disclose to the applicable regulators incentive-based compensation arrangements that could lead to material financial losses. See Dodd-Frank Act § 956.

150 See, e.g., ROBERT CHARLES CLARK, CORPORATE LAW §§ 3.4–7.9, at 123–262 (1986) (describing at length the duties of officers and directors); cf. Steven L. Schwarcz, *Rethinking a Corporation's Obligations to Creditors*, 17 CARDOZO L. REV. 647, 654 (1996) (analyzing the question of a corporation's fiduciary obligation to creditors).

151 Cf. *infra* notes 173–77 and accompanying text (describing the advantages of centralized risk-assessment by rating agencies).

152 See *In re Citigroup, Inc. S'holder Derivative Litig.*, 964 A.2d 106, 123 (Del. Ch. 2009). Such cases implicate the duty of oversight of the board of directors, as established by *In re Caremark International, Inc. Derivative Litigation*, 698 A.2d 959 (Del. Ch. 1996), and its progeny. See Stephen M. Bainbridge, *Caremark and Enterprise Risk Management*, 34 J. CORP. L. 967, 968 (2009) (suggesting that although cases in which plaintiffs have brought *Caremark* claims typically involve compliance, there is no doctrinal reason that such claims should not also lie in cases involving lax risk management).

153 In recognition of this role, the Dodd-Frank Act increases independence requirements for members of a board's compensation committee. See Dodd-Frank Act § 952.

of loss associated with their actions. By linking pay to long-term performance, management incentives can be aligned more closely with the interests of owners.¹⁵⁴

The specific design of a compensation scheme intended to apportion risk to managers depends on whose interests are being pursued. With respect to banks, Lucian Bebchuk and Holger Spamann have argued that a compelling case exists for thinking of the principals of financial firms more broadly than as only common shareholders.¹⁵⁵ In non-financial firms, shareholder value maximization is generally viewed as appropriate.¹⁵⁶ Bebchuk and Spamann contend that executive compensation at banks should be designed with the interests of not only common shareholders but also other contributors to bank capital, including preferred shareholders and debtholders. This view stems from the recognition that the government has a special interest in banks as guarantor (of the banks and their depositors), senior investor, and liquidity provider of last resort. More generally, it would be appropriate to tie executive compensation to a weighted basket of the firms' securities constructed to represent the constituencies whose interests financial regulators deem those firms' executives to be serving. Alignment is difficult to achieve, however, because individual firms that attempt to align incentives will be disadvantaged in their ability to compete for the best managers.¹⁵⁷ Hence, regulation may well be needed to help resolve this collective-action problem.¹⁵⁸

2. Regulating Complacency

Decisionmakers, even non-conflicted ones, are not always the purely rational actors that classical economic theory assumes them to be. Behavioral research provides an account of human decisionmaking in which individuals are subject to systematic perceptions and

154 Requiring managers to bear risk in their compensation arrangements involves a cost. This cost arises because risk-averse managers must be paid a premium in exchange for accepting an element of risk as part of their compensation. See Brian J. Hall & Kevin J. Murphy, *Stock Options for Undiversified Executives*, 33 J. ACCT. & ECON. 3, 12–13 (2002). Performance-based pay arrangements must therefore balance the gains from improved incentive alignment against the incremental compensation that managers require in order to bear risk.

155 See Bebchuk & Spamann, *supra* note 69, at 278–86.

156 See Lucian Arye Bebchuk, *The Case for Increasing Shareholder Power*, 118 HARV. L. REV. 833, 892 (2005) (describing the objective of corporate governance as the enhancement of shareholder value).

157 See *supra* notes 126–28 and accompanying text.

158 See *supra* notes 126–28 and accompanying text.

processes that do not produce rational choices. These results suggest that policymakers ought to consider behavioral biases in the context of regulatory design.¹⁵⁹ Just as market-failure theory provides a foundation for regulatory intervention in markets, so too does behavioral theory.¹⁶⁰ In other words, regulation should be “behaviorally informed.”¹⁶¹

In Part II.A, we described how an appreciation of cognitive biases can help account for why managers at financial firms tend to underestimate the risk of occurrence of low-probability adverse events. When these biases become embedded in the risk-management techniques of firms they can become even more potent because end-users of the techniques are not always sensitive to the assumptions on which they are based.¹⁶² Appreciating the role that cognitive biases can play in

159 See RICHARD H. THALER & CASS R. SUNSTEIN, *NUDGE* 4–14 (2008); Cass R. Sunstein & Richard H. Thaler, *Libertarian Paternalism Is Not an Oxymoron*, 70 U. CHI. L. REV. 1159, 1162–63 (2003) (describing libertarian paternalism as policies designed to influence people’s behavior in individually welfare-enhancing ways, while at the same time preserving their freedom of choice); see also Russell Korobkin, *Libertarian Welfareism*, 97 CALIF. L. REV. 1651, 1653 (2009) (extending the principle of libertarian paternalism to the goal of social welfare maximization); Daniel Schwarcz, *Regulating Consumer Demand in Insurance Markets*, 3 ERASMUS L. REV. 23, 25 (2010) (considering libertarian-paternalistic approaches to improving insurance markets).

160 See EDWARD J. BALLEISEN & DAVID A. MOSS, *GOVERNMENT AND MARKETS* 21 (2010); see also Christine Jolls & Cass R. Sunstein, *Debiasing Through Law*, 35 J. LEGAL STUD. 199, 200–01 (2006) (drawing attention to the potential for legal rules to promote more rational behavior). But see Anne C. Dailey, *Imagination and Choice*, 35 LAW & SOC. INQUIRY 175, 177 (2010) (pointing out the psychoanalytic limits to attempts to debias individuals).

161 See Michael S. Barr et al., *The Case for Behaviorally Informed Regulation*, in *NEW PERSPECTIVES ON REGULATION* 25, 25–63 (David Moss & John Cisternino eds., 2009) (discussing behavioral perspective of human behavior and its policy implications). On the other hand, we are mindful that reforms intended to redress behavioral imperfections may themselves introduce biases into decisionmaking and must therefore be introduced with caution. See Jennifer Arlen, *Comment: The Future of Behavioral Economic Analysis of Law*, 51 VAND. L. REV. 1765, 1769 (1998).

162 Despite its limitations, for example, the value-at-risk (VaR) model for measuring risk became an acceptable method for calculating bank regulatory capital requirements. See DANIEL K. TARULLO, *BANKING ON BASEL* 63 (2008). Banks responded by focusing investment portfolios to concentrate more on securities, such as MBS and credit-default swaps, that generated frequent gains and rare, but extreme, losses. Because the likelihood of these losses was less than the risk percentages taken into account under VaR modeling—which typically excludes losses that have less than a one percent (or, in some cases, five percent) likelihood of occurring within the model’s limited time frame—such losses were not included in the VaR computations. Analysts knew, but did not always make clear to senior management, that in the rare cases where such losses occurred, their magnitude could be huge. See Schwarcz, *supra* note 49, at 224–25.

risk-related decision making should lead regulators to take measures to encourage financial firms to address weaknesses in identifying, measuring, and controlling risks within their organizations.¹⁶³

Matters such as the level of a firm's in-house risk expertise, the authority of its risk managers, and the way in which its board monitors risk all bear on the sophistication and effectiveness with which an organization addresses risks. Anecdotal evidence from the global financial crisis suggests that during the economic expansion in the United States that occurred between 2002 and 2007, risk managers were ineffective in their efforts to curb risk-taking within their organizations.¹⁶⁴ If, as we have suggested, cognitive biases undermine individuals' appreciation of low-probability risks, particularly during periods of sustained economic growth, then it should not be surprising that risk managers are often marginalized. Because risk managers are likely to be the individuals within an organization most sensitized to cognitive biases, the situational environment within which risk managers operate should be reformed with a view toward giving them sufficient independence and authority to effectively challenge risk-takers within their firms.

More broadly, in carrying out its supervisory and regulatory responsibilities, regulators can incorporate a behavioral perspective into their oversight of risk-taking. For example, firms could be asked to specify risks that are not fully captured by internal models. Risks that are not possible to address using quantitative approaches should be analyzed qualitatively. The supervisory process already allows regulators to evaluate a firm's risk-management systems using scenario

163 The Basel Committee on Banking Supervision, established by the central-bank governors of the Group of Ten countries in 1974 to promulgate standards for banking guidelines, takes a risk-focused approach to supervision and regulation, with the goal of improving, and encouraging banks to focus on, risk management. (The Committee's conclusions and recommendations do not have the force of law but are intended to formulate broad supervisory standards and guidelines of best practice in the expectation that individual authorities will implement them on the basis of their own needs.) In doing so, however, it allows qualifying banks to generate their own estimates of the probability of default of credit portfolios for purposes of determining their associated capital requirements. See TARULLO, *supra* note 162, at 6. In theory, a capital-requirement approach based on the internal ratings of a firm should be more accurate than an approach based on standardized risk groupings, whereby all bank assets are assigned to categories and capital requirements assigned to them. On the other hand, cognitive failures can undermine the accuracy of internal assessments of credit risks.

164 See Viral V. Acharya et al., *Corporate Governance in the Modern Financial Sector*, in RESTORING FINANCIAL STABILITY 185, 185–87 (Viral V. Acharya & Matthew Richardson eds., 2009).

analysis and stress testing techniques.¹⁶⁵ These simulation exercises help to expose weaknesses in risk-management, but they depend on the choice of scenarios simulated and on assumptions about how returns on different assets behave under the scenarios. “Reminding” managers of historically relevant negative economic shocks is likely to encourage firms to engage in more critical reflection and provide more accurate assessments of risk.

3. Regulating Complexity

The complexities that have come to characterize financial products and markets can, even in the absence of conflicts of interest or complacency, prevent financial markets from operating efficiently by producing information uncertainty through two avenues. The first relates to the ability of financial market participants to fully appreciate the low-probability risks inherent in complex financial products. This aspect of complexity can be thought of as cognizant complexity—things are just too complex to understand.¹⁶⁶ Cognizant complexity gives rise to an information asymmetry between originators and purchasers of financial instruments, which can potentially be addressed through transparency and disclosure. Better access to information cannot respond completely to cognizant complexity, however, because individuals face cognitive constraints in processing and using complex information effectively.¹⁶⁷

The second avenue through which complexity produces information uncertainty relates to people’s willingness to undertake the costs necessary to become informed about and assess the low-probability

165 In fact, the Supervisory Capital Assessment Program, better known as the stress tests, was conducted by the Federal Reserve to assess capital adequacy under alternative macroeconomic scenarios in 2009.

166 See Schwarcz, *supra* note 41, at 563–64. Social psychology uses a related term, “cognitive complexity,” to refer to different people perceiving the same phenomena on different levels of complexity. Some people tend to notice more and thus have a more nuanced view of a given phenomena, whereas others notice less and therefore have a simplified view. See JON E. ROECKELEIN, *DICTIONARY OF THEORIES, LAWS, AND CONCEPTS IN PSYCHOLOGY* 98–99 (1998).

167 See Paredes, *supra* note 148, at 419; Schwarcz, *supra* note 85, at 1121–22; Steven L. Schwarcz, *Rethinking the Disclosure Paradigm in a World of Complexity*, 2004 U. ILL. L. REV. 1, 4–6. The limitations of cognitive complexity may help to explain the inability of even financial analysts and other “experts” to see at least some of the correlations in the recent financial crisis. As the complexity of financial products increased, fewer analysts possessed sufficiently nuanced cognition to properly understand and price the products. Trying to do their jobs, many analysts made oversimplifications, usually on the optimistic side because the economy was expanding. See Schwarcz, *supra* note 49, at 224.

risks embedded in complex securities. Financial products are continually evolving, and even sophisticated investors can find it challenging to anticipate product behavior under different assumptions.¹⁶⁸ Gaining product information is also resource-intensive: At some point, the cost of conducting incremental analysis on a complex structure will outweigh the benefit expected to be obtained from it. When risk is highly dispersed, this point can occur very early on in the due diligence process.¹⁶⁹

Regardless of why complexity prevents financial participants from obtaining full information about financial products, the information lacuna contributes to the correlation between low-probability risk and firm integrity. One possible response is standardization, whereby regulators require securities to be traded through exchanges or similar institutions that list securities with specified characteristics.¹⁷⁰ Standardization would render financial products more cognizable, so that prospective purchasers would better understand their features.¹⁷¹ It would also reduce the cost to investors of familiarizing themselves with the operation of new securities. The overall economic impact of standardization is unclear, however, because standardization would interfere with the ability of parties to achieve the efficiencies that arise when issuing firms tailor securities to the particular needs of investors by providing a variety of options relating to risk, return, and timing of cash flows. It is therefore preferable to address complexity through supplemental protections that do not interfere with the ability of mar-

168 Indeed, sophisticated investors suffered the greatest losses in the global financial crisis. See Schwarcz, *supra* note 49, at 243.

169 See *supra* note 85 and accompanying text.

170 The Dodd-Frank Act requires only derivatives subject to mandatory clearing to be traded on an exchange or swap execution facility. See Dodd-Frank Act, Pub. L. No. 111-203, § 723(a)(8), 124 Stat. 1376, 1681–82 (2010). The legislation further requires that derivatives clear through a clearinghouse, but only provided that a clearinghouse will accept a trade for clearing. See *id.* § 956; *infra* note 190. However, because clearinghouses generally require a high degree of standardization in the derivatives they clear, market participants can continue trading customized derivatives in opaque markets without the benefits of price transparency to which standardized contracts are subject. See Matthew Goldstein, *Derivatives and the Blizzard of Paperwork*, BLOOMBERG BUSINESSWEEK (May 15, 2009), http://www.businessweek.com/investing/wall_street_news_blog/archives/2009/05/derivatives_and.html (“[A] large percentage of derivatives are non-standard instruments . . .”).

171 See SCOTT J. MOSS, AN ECONOMIC THEORY OF BUSINESS STRATEGY 121 (1981) (“A commodity is cognizable if its physical specifications will be known and understood with precision by prospective purchasers, who will not have seen the units they purchase prior to assuming ownership and taking delivery of them. If a particular type of commodity is cognizable, then every unit produced will conform to known specifications.”).

ket participants to design financial products that respond to or anticipate investor needs.¹⁷²

An alternative to standardization as a response to complexity is centralization of risk assessment. Like standardization, centralization allows individuals or firms to achieve a better cognitive grasp of financial products. However, centralization does not rely on constraining the available range of securities in the financial marketplace. Rather, it concentrates expertise. At the same time, centralization produces cost efficiencies in the production of research and analysis through specialization and economies of scale. Centralization can therefore result in approaches to, and levels of, due diligence that would be uneconomic for dispersed investors to undertake.

Rating agencies offer one possibility for centralized risk assessment. They are in a unique position to observe, analyze, and assess financial products, and they also have better access to information than most investors because information is made available to them on a confidential basis during the ratings process. In addition, because various regulatory determinations have depended on credit ratings, rating agencies have regularly been called upon to rate securities.¹⁷³

172 Cf. Schwarcz, *supra* note 49, at 240–41 (arguing that regulatory attempts to limit uncertainty by standardizing transactions and financial products would likely have unintended negative consequences).

173 Credit rating agencies have historically benefitted from their ability to confer what Professor Frank Partnoy refers to as “regulatory licenses” upon entities that depend on credit ratings. See Frank Partnoy, *Historical Perspectives on the Financial Crisis: Ivar Kreuger, the Credit-Rating Agencies, and Two Theories About the Function, and Dysfunction, of Markets*, 26 YALE J. ON REG. 431, 432, 438 (2009) [hereinafter Partnoy, *Historical Perspectives*] (discussing the role of credit agencies as providing “regulatory licenses,” i.e., the right to be in compliance with regulation); Frank Partnoy, *The Paradox of Credit Ratings*, in RATINGS, RATING AGENCIES, AND THE GLOBAL FINANCIAL SYSTEM 65, 65–84 (Richard M. Levich et al. eds., 2002) (same); Frank Partnoy, *The Siskel and Ebert of Financial Markets?: Two Thumbs Down for the Credit Rating Agencies*, 77 WASH. U. L.Q. 619, 623 (1999) [hereinafter Partnoy, *Siskel and Ebert*] (same). Because numerous legal rules and regulations have historically depended substantively on credit ratings, and particularly on those of a small number of Nationally Recognized Statistical Ratings Organizations (NRSROs), financial market participants have become increasingly dependent on credit ratings. See *id.* at 690–703 (documenting the growth of the value of credit ratings beginning in the mid-1970s). The SEC recently removed references to credit ratings in certain rules because of concerns that ratings requirements constitute an “official seal of approval” that creates undue reliance on NRSRO ratings. See References to Ratings of NRSROs, 74 Fed Reg. 52,358, 52,358 (Oct. 9, 2009) (to be codified at 17 C.F.R. pts. 240, 242, 249, 270); see also Jefferey Manns, *Rating Risk After the Subprime Mortgage Crisis: A User Fee Approach for Rating Agency Accountability*, 87 N.C. L. REV. 1011, 1016 n.13 (2009) (analyzing the proposed rulemaking). The recent financial reform legislation takes a similar approach by removing references to NRSROs in several statutes. See Dodd-Frank Act § 939.

As a result, they enjoy information advantages over investors arising from their exclusive access to information and the specialization and economies of scale associated with being frequent, repeat reviewers of financial products.¹⁷⁴

Much has been made of the shortcomings of rating agencies, especially following the recent global financial crisis.¹⁷⁵ Regulatory reforms are focused, in part, on addressing these shortcomings.¹⁷⁶ Although it is too soon to predict the effect of these measures, we believe that it is important to strive to harness the potential of rating agencies to assess risk.¹⁷⁷

A final approach to addressing the problem of information asymmetries caused by complexity is to require those who “produce” risk to place “skin in the game” by retaining a portion of the risk of loss associated with the financial products being sold.¹⁷⁸ Risk-sharing of this

174 See Susan M. Phillips & Alan N. Rechtschaffen, *International Banking Activities: The Role of the Federal Reserve Bank in Domestic Capital Markets*, 21 *FORDHAM INT'L L.J.* 1754, 1762–63 (1998) (arguing that credit rating agencies are capable of distilling vast amounts of information, making them a critical tool for investors). *But see* Partnoy, *Historical Perspectives*, *supra* note 173, at 432 (arguing that credit rating agencies do not provide information to investors, but rather “regulatory licenses”).

175 See, e.g., Claire A. Hill, *Why Did Rating Agencies Do Such a Bad Job Rating Subprime Securities?*, 71 *U. PITT. L. REV.* 585, 590–600 (2010) (exploring the shortcomings of rating agencies); Manns, *supra* note 173, at 1013–14, 1043–48 (discussing the failures of rating agencies and pointing out that private actors also shoulder blame).

176 See *supra* note 173 (discussing reforms concerning NRSROs). The financial reform legislation also contains various mechanisms designed to strengthen credit rating agencies, including a new Office of Credit Ratings within the SEC whose mandate is, among other things, to prevent conflicts of interest. See Dodd-Frank Act §§ 931–939. The legislation also attempts to eliminate conflicts of interest by ensuring that the ratings functions of these agencies are separated from the sales and marketing department. See *id.* § 932. There are other provisions in the bill intended to ensure the legitimacy of rating agencies, including requiring independent boards, continuing education, disclosure requirements, and exposing them to greater liability. See *id.* §§ 931–939.

177 Professor Manns advocates the creation of an SEC-administered user fee system whereby ratings agencies would have to bid for the right to rate debt. See Manns, *supra* note 173, at 1059–65. Such a system would allow for coordination among creditors to ensure that credit ratings are accurate and updated regularly. See *id.* at 1061–62. An alternative proposal by John Patrick Hunt would force rating agencies to disgorge profits when rating new products if the ratings are ultimately judged to be below a specified level of quality. See John Patrick Hunt, *Credit Rating Agencies and the “Worldwide Credit Crisis”: The Limits of Reputation, the Insufficiency of Reform, and a Proposal for Improvement*, 2009 *COLUM. BUS. L. REV.* 109, 182.

178 Cf. Hall & Murphy, *supra* note 154, at 12–23 (discussing aligning incentives in this manner).

sort can be achieved in numerous ways.¹⁷⁹ What is important for our purposes is that such measures mitigate the incentives of sellers of complex financial products to transfer risks that are not easily discerned by others.¹⁸⁰

B. *Managing the Correlation Among Financial Institutions*

Our discussion in Part III.A above sought to identify and address the various behavioral and other market failures that cause market participants to underestimate the likelihood of low-probability adverse economic events at the individual firm level. It is insufficient, however, for systemic risk regulation to be limited to addressing risk-taking within firms because the financial system incorporates properties of a complex network in which institutions are connected through direct and indirect relationships. Our second correlation recognizes that interconnections within the financial system have dynamic effects. In this subpart, we examine the implications of these dynamics for the functioning of financial markets and suggest that they provide an independent justification for their regulation.

1. Regulating Complexity Revisited

Complexity in the ways in which institutions interact generates information uncertainty, which can impair the functioning of the financial system. In a financial system, every market participant is theoretically vulnerable to every other market participant.¹⁸¹ Market participants are aware of this, but they may be unaware of the specific channels through which an initial shock to the financial system will travel and how large the ultimate impact of the shock will become. As we described in Part II.A.2, networks transmit and amplify shocks in ways that can be convoluted and unpredictable. In a market-based financial system, the repercussions of an economic shock depend on the precise ways in which institutions are linked. Systemic complexity

179 See, e.g., Schwarcz, *supra* note 85, at 1118–19 (discussing the possible use of seller guaranties, such as warranties on the sale of goods, to shift risk from the buyer to the seller). The Dodd-Frank Act attempts to limit conflicts of interest between originators and investors in securitization transactions by requiring originators, in many cases, to retain an unhedged economic interest (generally five percent) in the credit risk of securitized assets. See Dodd-Frank Act §§ 941–945. The Act also limits certain conflicts of interest in derivatives transactions, including conflicts between swaps dealers and major swaps participants. See *id.* §§ 725, 731, 764–765.

180 Of course, risk sharing does not address failures by *both parties* to identify risks—the problem of “mutual misinformation.” See Schwarcz, *supra* note 49, at 241–42.

181 See *supra* note 15 and accompanying text.

thus adds a layer of information uncertainty to that which exists at the firm level.

Firms operating within the financial system confront varying degrees of opacity regarding the identities of the parties holding credit risk, the characteristics of the instruments they hold, and the network topology that describes their interconnectivity. Such uncertainty makes it difficult to ascertain the vulnerabilities of individual institutions. An example is the counterparty risk that firms face on derivatives contracts.¹⁸² Market participants are exposed not only to the risk that a counterparty will default on its obligation but also to the risk that firms linked to that counterparty, either directly through contracts or indirectly through markets, will fail to fulfill their obligations. Market participants recognize these risks, but they lack sufficient information from which to determine the location of contingent exposures within the financial system. As a result, if the financial condition of a large market participant is compromised, firms may lose confidence in their counterparties, irrespective of their actual soundness.

Difficulties in assessing the vulnerability of market participants to economic shocks is especially likely to arise when information about the creditworthiness of individual financial firms is non-public and thus asymmetric. Central clearing and settlement of derivatives addresses concerns regarding asymmetric information by limiting counterparty risk. “Clearing” is the process by which net payment obligations between firms are computed, and “settlement” is the process by which they are discharged.¹⁸³ Contracts that are cleared and settled are protected from counterparty default to the extent central clearinghouses interpose themselves between the original counterparties, effectively guaranteeing the settlement of transactions.¹⁸⁴ This means, for example, that in a swap transaction between parties X and Y, a clearinghouse will be the counterparty in the middle. To protect themselves, in turn, clearinghouses rely on a variety of risk-management strategies, including margin requirements and the maintenance of a loss-sharing pool funded by members to cover losses arising from

182 See *supra* notes 48, 88–89 and accompanying text.

183 See Christopher L. Culp, *The Treasury Department's Proposed Regulation of OTC Derivatives Clearing and Settlement*, 8–9 (Univ. of Chi., Booth Sch. of Bus., Working Paper No. 09-30, 2009), available at http://papers.ssrn.com/so13/papers.cfm?abstract_id=1430576.

184 See Darrell Duffie, *How Should We Regulate Derivatives Markets?*, 7–8 (Pew Fin. Reform Project, Briefing Paper No. 5, 2009), available at http://www.pewfr.org/project_reports_detail?id=0017.

any clearing member defaults.¹⁸⁵ Although central clearing does not limit the aggregate amount of derivatives counterparty risk, it simplifies the computation of that risk, which now can be measured by aggregating clearinghouse risk. This enables counterparty risk to be better monitored and, as appropriate, regulated by government agencies, such as the SEC and CFTC.¹⁸⁶ Clearinghouses also serve to disperse losses, reducing the systemic impact of the failure of an individual firm.¹⁸⁷

While central clearing reduces counterparty risk posed by individual firms, it is an incomplete approach to systemic risk management in several respects. First, it may have the perverse effect of increasing systemic risk by concentrating derivatives exposure at the clearinghouse level. Central clearing merely shifts counterparty risk to a clearinghouse, reducing that risk only to the extent that clearinghouses can manage risk better or are more creditworthy than individual firms. Although clearinghouses have the ability to monitor the positions that they clear and can pool losses among their members, these advantages diminish in the face of correlated losses. Indeed, central clearing can itself serve as a transmission mechanism for systemic risk by concentrating credit risk within a few major clearinghouses. If a major clearinghouse were to default, the credit risk associated with all of the products cleared by it would simultaneously rise.

Second, central clearing and settlement require some degree of standardization in the financial products being cleared to facilitate their valuation for purposes of calculating margin requirements.¹⁸⁸ Yet, as we pointed out earlier, standardization would be disruptive to customized transactions that yield efficiencies in risk-bearing.¹⁸⁹ Excluding non-standard derivatives from mandatory clearing, on the

185 See Culp, *supra* note 183, at 15–16

186 See Dodd-Frank Act, Pub. L. No. 111-203, §§ 721–774, 124 Stat. 1376, 1658–1802 (2010).

187 In dispersing risk among clearinghouse members, however, clearinghouses may create the collective action problem that investors have reduced incentives to monitor the actual risk posed by any given counterparty. In other words, risk transfer can make individual risks relatively *de minimis* from the standpoint of any given market participant. Cf. Schwarcz, *supra* note 45, at 390–91 (asking whether structured finance dispersed subprime mortgage risk so widely that no investor had a clear incentive to monitor it).

188 See Duffie, *supra* note 184, at 8; John Hull, OTC Derivatives and Central Clearing: Can All Transactions Be Cleared? 7, 10 (Apr. 2010) (unpublished working paper), available at <http://www.rotman.utoronto.ca/~hull/downloadablepublications/HullOTC.pdf>.

189 See *supra* note 172 and accompanying text.

other hand, would leave unregulated financial products that could be systemically significant.¹⁹⁰

The foregoing discussion shows why central clearing and settlement are insufficient to prevent domino-type contagions that occur directly through firms. Central clearing and settlement are also insufficient to prevent loss spirals that propagate through markets. To prevent these loss spirals, we propose that systemic risk transmission be further disrupted by enhancing the resilience of asset markets in times of crisis. Asset markets can pose systemic risk when firms are forced to sell illiquid assets in response to changes in short-term valuations. When a firm is forced to sell an asset in an illiquid market, the asset's market price is likely to deviate from its long-term value. Firms also encounter liquidity needs because of maturity mismatches between their assets and their liabilities. As long as a solvent firm's assets mature when its debt is due, it will not encounter liquidity issues. However, financial firms often use short-term borrowings to fund long-term projects.¹⁹¹ If demands to repay the short-term borrowings exceed available liquidity, firms must rely on external funding sources to bridge the gap. When external funding is unavailable or prohibitively expensive, it may be necessary to sell illiquid assets at a discount.

190 Cf. Duffie, *supra* note 184, at 6 (explaining that the clearing of standard derivatives would not have prevented the federal bailout of AIG because the CDS positions held by AIG were not sufficiently standard). In the debate over the scope of derivatives that should be cleared leading up to the passage of the Dodd-Frank Act, prominent figures, including Gary Gensler, Chairman of the CFTC, and Treasury Secretary Timothy Geithner, advocated clearing standard derivatives. See Gary Gensler, *The Derivatives Debate: Clearinghouses Are the Answer*, WALL ST. J., Apr. 21, 2010, at A21; Letter from Timothy Geithner, Secretary of the Treasury, to Harry Reid, Senate Majority Leader (May 13, 2009), <http://www.treasury.gov/initiatives/Documents/OTCletter.pdf>. Others argued that customized derivatives should also be cleared, while some opposed any mandatory clearing requirement. See Carol E. Curtis, *Derivatives Regulation Could Be Bonanza for Clearing Houses*, SEC. TECH. MONITOR (Jan. 25, 2010), http://www.securitiestechologymonitor.com/issues/22_2/-24562-1.html (quoting John Chrin, former Managing Director of JPMorgan Chase, who argues in favor of clearing customized derivatives); see also *The Effective Regulation of the Over-the-Counter Derivatives Market: Hearing Before the Subcomm. on Capital Mkts., Ins. & Gov't Sponsored Enters. of the H. Comm. on Fin. Servs.*, 111th Cong. 54–56 (2009) (statement of Terrence A. Duffy, Executive Chairman, CME Group Inc.) (arguing that all derivatives clearing should be voluntary). The Dodd-Frank Act includes provisions requiring that standard derivatives be cleared through central clearinghouses. See Dodd-Frank Act § 956. Certain customized derivative transactions, as well as derivatives transactions by non-financial companies, however, are not subject to centralized clearing. See *id.* §§ 723, 727, 731, 763–764, 766.

191 See RICHARD A. POSNER, *A FAILURE OF CAPITALISM* 128–30 (2009) (discussing why banks borrow short-term to fund long-term lending and explaining the risks associated with such a practice).

As we have pointed out, disposing of assets at fire-sale prices can initiate a loss spiral in which forced selling leads to falling prices which, in turn, leads to more forced selling.¹⁹² These loss spirals can be ameliorated by decoupling the valuation of a financial asset for regulatory purposes from its current market price at times when the two diverge substantially.¹⁹³

Finally, greater transparency with respect to the credit risk posed by existing or potential counterparties to derivatives transactions can help to forestall the occurrence of contagion that is transmitted through similarity effects. Recall that, in the presence of uncertainty about a firm's counterparty exposure, market participants may incorrectly infer from the failure of that firm that other similarly-situated firms are at risk.¹⁹⁴ If market participants avoid dealing with firms that they believe to be similarly situated to that distressed firm, the localized economic shock to the distressed firm is transmitted to the similarly situated firms.¹⁹⁵ Disclosure of detailed information on positions beyond the information that is generally included in financial statements can provide firms with the information they need to assess counterparty risk, which should allow them to better protect themselves against default. It can also serve to protect markets from loss spirals to the extent that firms are less likely to avoid doing business

192 See *supra* text accompanying note 19.

193 One approach to doing this is to value financial assets according to the liquidity needs of the holder of the asset. This approach, known as "mark-to-funding," assumes that financial assets should be valued neither on the assumption that they will be sold under then-current market conditions ("mark-to-market" valuation) nor on the assumption that they will be owned through their life ("held-to-maturity" or "present value" valuation). Rather, it reflects the principle that financial assets should be valued based on the ability of their holder to finance, or "fund," their retention. Under a mark-to-funding approach to valuation, the capacity to hold assets is evaluated based on the term of the financial instruments that are used to fund them. If a firm funds its holdings of long-term assets using short-term borrowings, for example, then it would be required to value the assets based on current market prices; that is, on a mark-to-market basis. See *supra* note 92. If, however, the assets are funded through the issuance of long-term bonds, then the assets would be valued based on the present value of their estimated future cash flows through maturity. See BRUNNERMEIER ET AL., *supra* note 91, at 43. Market liquidity could be additionally enhanced by requiring financial products to be traded on regulated exchanges. Exchanges provide a trading venue for the products they list, facilitating the incorporation of new information into securities prices, which are reported. In contrast, securities that trade in over-the-counter transactions are privately negotiated and their pricing is confidential. Exchange-traded securities must be standardized and trade with sufficient frequency in order to ensure their liquidity.

194 See Gordon & Muller, *supra* note 97, at 7.

195 See *supra* note 97 and accompanying text.

with a counterparty based on a mistaken assumption about that counterparty's holdings.

Currently, third parties cannot readily determine the exposure of financial market participants to specific securities because there is no single location from which that information can be obtained. Counterparties can mitigate this risk voluntarily by disclosing their contingent liabilities, but it is unlikely that such disclosure will be credible. The Dodd-Frank Act¹⁹⁶ has addressed this problem in part by requiring counterparties to report transactions to a swap data repository from which regulators can ascertain risk allocation.¹⁹⁷ Because contract information would be aggregated in one place, the database would allow regulators to view market exposure on contracts and assess risk from a systemic vantage point, which is critical in times of uncertainty.¹⁹⁸ Requiring detailed contract information to be made public is likely to be viewed as revealing proprietary information regarding contract terms, trading positions, and investment strategies.¹⁹⁹ *Vis-à-vis* other market participants, concerns about confidentiality can be addressed, however, by controlling the type and level of aggregation of the information being disseminated, as well as its timeliness.²⁰⁰

If greater transparency is to result in more accurate securities pricing, market participants must be capable of incorporating information into securities markets. Increased speed in data transmission is generally associated with market efficiency.²⁰¹ Because of the

196 Dodd-Frank Act, Pub. L. No. 111-203, 124 Stat. 1376 (2010) (codified in scattered sections of 15 U.S.C.).

197 *See id.* § 727. Individual counterparty trade and position data must be reported to regulators upon request. *See id.* § 728(c)(7). The Act requires that the SEC and the CFTC make publicly available swap trading volume and position data but only in aggregate form. *See id.* § 729.

198 *See* Viral V. Acharya et al., *Centralized Clearing for Credit Derivatives*, in *RESTORING FINANCIAL STABILITY*, *supra* note 164, at 251, 266.

199 *See* Olufunmilayo B. Arewa, *Trading Places: Securities Regulation, Market Crisis, and Network Risk* 61–62 (Northwestern Univ. Sch. of Law, Pub. Law & Legal Theory Series, No. 09-01, 2009), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1324951. Swap transaction data, including price and volume, are to be reported to the public in real-time under the new law. *See* Dodd-Frank Act § 727.

200 *See* Dodd-Frank Act § 727(13)(E) (providing that publicly reported data for certain swaps not identify participants and instituting a time delay for reporting large block trades).

201 *See* Matt Samelson, *Answering the Question of High-Frequency Trading*, *SEC. INDUS. NEWS*, May 3, 2010, at 23 (arguing that high-frequency trading has improved execution quality and reduced short-term volatility in large cap U.S. equities); James Angel et al., *Equity Trading in the 21st Century* 5–6 (USC Marshall Sch. of Bus., Marshall Research Paper Series, Working Paper FBE 09-10, 2010), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1324951.

extreme speeds at which algorithmic trading takes place, however, there is a danger that trading in highly automated markets will sometimes occur at aberrant prices.²⁰² On May 6th, 2010, the Dow Jones Industrial Average plunged nearly 1000 points in twenty minutes.²⁰³ The “flash crash” was precipitated by a trader executing an algorithm to sell approximately \$4.1 billion worth of stock market index futures contracts without regard to time or price.²⁰⁴ In response, the SEC adopted a universal circuit breaker rule to halt trading of an individual security across all exchanges for five minutes if its price moves up or down ten percent or more over a five-minute period.²⁰⁵ Assuming a security’s price has been pushed below its intrinsic value, a pause should give traders enough time to recognize the disparity and to respond if they believe the security is mispriced.²⁰⁶

ssrn.com/sol3/papers.cfm?abstract_id=1584026 (arguing that high-frequency trading results in improved market quality).

202 Cf. Clark, *supra* note 99 (discussing the risk implications of high-frequency trading).

203 See CFTC & SEC, *supra* note 102, at 2. During this period, otherwise valuable stocks traded momentarily at distorted prices, including as low as one cent. See *id.* at 34.

204 See CFTC & SEC, *supra* note 100, at 14. The market was able to handle a trade of a similar size by the same trader in the past because there was sufficient liquidity to absorb the order over a five-hour period. However, the prior algorithm executed much more slowly as it factored in time and price, as well as volume. See *id.* On May 6, the downward selling pressure was exacerbated by high-frequency traders issuing sell orders to reduce their temporary long positions after they had absorbed a large part of the initial sell order. See *id.* at 15. As the price of the contracts was pushed further downward, the traders’ volume-based sell algorithm began to execute even faster due to the increased volume generated by high-frequency traders. See *id.* The interaction between two different types of algorithmic trading strategies resulted in an erosion of liquidity and downward price pressure that reverberated across the entire market. See *id.* at 6.

205 See Order Granting Accelerated Approval to Proposed Rule Change to Amend FINRA Rule 6121, 75 Fed. Reg. 34,183, 34,183–86 (June 16, 2010) [hereinafter FINRA Order]. The disparate mechanisms exchanges used to determine when to pause trading in volatile stocks were identified by the SEC as a possible aggravating factor in the flash crash. See CFTC & SEC, *supra* note 102, at 32. Under the new universal approach to circuit breakers, the primary listing exchange of a security must notify the other exchanges and market participants when the price of the security moves ten percent or more in the preceding five-minute period. See FINRA Order, 75 Fed. Reg. 34 at 184.

206 However, there is a possibility that traders might mistakenly believe that a trading pause caused by order imbalance was based on fundamental valuation issues. See Letter from Larry Harris, USC Marshall Sch. of Bus., to Elizabeth M. Murphy, Sec’y, SEC 3 (May 26, 2010), available at <http://ftp.sec.gov/comments/sr-nyse-2010-39/nyse-201039-4.pdf>. Therefore, a universal circuit breaker could aggravate the problem,

The adoption of the universal circuit breaker rule reflects that traditional market-wide circuit breakers can create instability in increasingly temporally complex markets.²⁰⁷ The universal circuit breaker rule is an important first step in counteracting the effects of an erroneous trade, an ill-designed sell algorithm, or a cascade of stop-loss market orders.²⁰⁸ If the universal circuit breaker proves successful, regulators may consider expanding the program to informal markets.²⁰⁹ We are hopeful that regulators will continue to develop ways to limit the extent to which technology can contribute to the transmission of localized economic shocks to other parts of the financial system.²¹⁰ Even the best risk-management strategies will be inef-

because traders might increase the order imbalance during the trading halt rather than stabilize it. *See id.*

207 A circuit breaker is a procedure for temporarily halting trading when a severe market downturn threatens to exhaust available liquidity. *See Circuit Breakers and Other Market Volatility Procedures*, SEC, <http://www.sec.gov/answers/circuit.htm> (last modified Oct. 13, 2010). Existing circuit breakers in place on the New York Stock Exchange, which are based on the Dow Jones Industrial Average, were not triggered during the flash crash despite the incredible volatility of individual stocks listed on the exchange. *See* John Wu, *SEC Stock Market Circuit Breaker for Exchanges, NYSE and NASDAQ*, SUITE101 (May 18, 2010), <http://www.suite101.com/content/sec-stock-market-circuit-breaker-for-exchanges-nyse-and-nasdaq-a238700>. In a temporally complex market, liquidity may be exhausted before the traditional market-wide circuit breakers are even implemented. Instead, universal circuit breakers, tied to the price movement of an individual security rather than an index price, could increase market stability by controlling the volatility of individual stocks, preventing a liquidity crisis from spreading to the entire market.

208 The SEC received comments from parties concerned that circuit breakers could exacerbate price volatility by inducing panic. *See* FINRA Order, 75 Fed. Reg. at 34,185. However, most concluded that a universal circuit breaker would reduce excess market volatility. *See id.* at 34,185–86. Circuit breakers are also criticized as giving an unfair advantage to market makers and sophisticated traders over individual investors. *See* Frank Partnoy, *Why Markets Crash and What Law Can Do About It*, 61 U. PITT. L. REV. 741, 783 (2000); *cf.* Emiliios Avgouleas, *A New Framework for the Global Regulation of Short Sales: Why Prohibition Is Insufficient and Disclosure Insufficient*, 16 STAN. J.L. BUS. & FIN. 376 (2010) (arguing that the circuit breaker rule takes into account both longer term price trends and levels of liquidity).

209 Circuit breakers are designed to prevent the exhaustion of liquidity or to restore liquidity to an ill-functioning market. *See Circuit Breakers and Other Market Volatility Procedures*, *supra* note 207. Thus, as a precondition to implementation on any informal market, the market must contain mechanisms that would allow for liquidity to be replenished during a trading halt. Otherwise, circuit breakers are bound to be ineffective or even counterproductive. If a security's price has been pushed below its intrinsic value in an illiquid market, the triggering of a circuit breaker may only serve to fuel panic. *See* Partnoy, *supra* note 208, at 783.

210 For example, the SEC has also proposed a rule that would ban unfiltered sponsored access to exchanges, a practice common to high-frequency traders, by requiring

fective to the extent that they can be eluded by mistake or design. Controlling the transmission of localized shocks within the financial system thus necessitates not only providing market participants with sufficient information to evaluate risks accurately, but also ensuring that human judgment is not displaced by new technologies.

2. Regulating the Financial Commons

Even if firms had complete information regarding their counterparties' exposures and the prices of financial assets accurately reflected their long-term values, the level of risk in the financial system would still be suboptimally high. As we discussed in Part II.A, the existing financial regulatory framework largely ignores the "commons" aspect of the financial system—the problem that, in the presence of externalities, over-exploitation of shared resources occurs. If financial market participants perceive their price of risk as being artificially low, they will "over consume" it, producing excessive levels of systemic risk. It is in each individual firm's interest to pursue this tragic course of action, despite the fact that its private gains are exceeded by social losses. And firms are especially likely to over-consume this risk if abstaining from such over-consumption would cause them to suffer an inferior payoff relative to other parties, such as a reduction of market share. Systemic risk regulation can therefore be justified on the basis of another market failure: the unregulated cost to market participants of financial-market risk understates its true cost to society.

To be sure, existing financial regulation aims to secure the stability of the financial system. In doing so, however, it does not take sufficient account of the systemic importance of the behavior of individual financial institutions. In that sense, it is incomplete. The primary regulatory instruments now used to address systemic risk are deposit insurance, capital adequacy requirements, and the supervisory process.²¹¹ In the United States, the Federal Deposit Insurance Corporation (FDIC) insures bank deposits with the aim of alleviating fear that

that all trades be subject to pre-trade risk filters. See Risk Management Controls for Brokers or Dealers with Market Access, 75 Fed. Reg. 4007, 4011–15 (Jan. 26, 2010) (to be codified at 17 C.F.R pt. 240). Such risk filters could potentially limit the transmission of a localized shock by reducing the likelihood that high-frequency traders will default on their obligations, which would have to be covered by the firms' clearing members. See Clark, *supra* note 99 (discussing the risk implication of unfiltered sponsored access and noting that "[c]learing members are financially responsible for the trades of their customers").

211 See BRUNNERMEIER ET AL., *supra* note 91, at 1–11; Martin Summer, *Banking Regulation and Systemic Risk*, 14 OPEN ECONOMIES REV. 43, 47–51 (2003).

banks will default on deposit accounts.²¹² Banks are also required to hold minimum capital based on the riskiness of their assets.²¹³ The main objective of the supervisory process is to evaluate the safety and soundness of banking organizations, including assessment of their individual financial condition, risk-management programs, and compliance with applicable laws. The foregoing tools are directed at reducing the likelihood of the failure of individual banks as a means of protecting the financial system. The lesson of the tragedy of the commons, however, is that overexploitation of shared resources occurs in advance of its impact on individual group members. Thus, the financial system can be endangered even while its individual members appear to be in sound financial condition.

Analogizing excessive risk-taking to the tragedy of the commons suggests that regulatory policy should correct for risk-spillovers in financial markets by requiring firms to take into account the impact of their behavior on systemic stability.²¹⁴ To induce firms to manage risk with the interests of the financial system in mind entails causing them to take into account the systemic importance of their activities. In general, when the social cost of an action exceeds its private cost, a tax equal to the difference between the two can correct the market outcome.²¹⁵ The tax induces decisionmakers to internalize the costs to others of their behavior, resulting in a reduction in the activity. Increased minimum risk-based financial ratios have recently been advanced by the Basel Committee on Banking Supervision²¹⁶ to enhance systemic stability.²¹⁷ These ratios are commonly used to measure a firm's strengths and weaknesses along various dimensions. They can also be used to manage a firm's cost of doing business because they produce tax-like effects. Capital adequacy ratios, for example, compel firms to set aside minimum capital levels relative to

212 See Schwarcz, *supra* note 1, at 210.

213 See *id.*

214 An earlier version of the Dodd-Frank Act included a provision that would have helped to address the tragedy of the commons—a resolution fund sourced by large banks and other systemically important financial institutions to be used as a possible bailout mechanism in lieu of taxpayer funds. See Restoring American Financial Stability Act of 2010, S. 3217, 111th Cong. § 210(n) (2009). This provision was dropped, however, after certain politicians alleged it would institutionalize bailouts. See Greg Hitt & Damian Paletta, *Senate Ends Financial-Bill Standoff*, WALL ST. J., Apr. 29, 2010, at A2.

215 See Korinek, *supra* note 10, at 4.

216 See *supra* note 163.

217 See *Group of Governors and Heads of Supervision Announces Higher Global Minimum Capital Standards*, BANK FOR INT'L SETTLEMENTS (Sept. 12, 2010), <http://www.bis.org/press/p100912.htm>.

their risk-weighted assets. It is not our purpose here to evaluate the relative merits of each type of financial ratio. Rather, our aim is to describe how an appreciation of the commons aspect of the financial system can inform their use.

Conceptually, risk-based financial ratio requirements can be used to preserve the financial commons by making those requirements sensitive to a firm's systemic importance.²¹⁸ A firm's systemic importance is a function of two variables. The first is the extent of the firm's direct importance to other market participants through, for example, its counterparty relationships. The second is the extent of the firm's indirect importance to other market participants resulting from the degree of correlation of its assets with market assets. An asset with a higher degree of market correlation would, for example, be considered more systemically significant because its forced liquidation would negatively impact a market to which other firms were exposed.

Precise specification of the systemic risk function would require an understanding of the entire topology of the financial system. Determining the systemic importance of even a single asset held by a firm, for example, involves knowing the quantities of the asset held by each firm, the pattern of those holdings, and the elasticity of the asset's demand curve. In practice, the task of gathering the information that is necessary to evaluate the interconnections among financial institutions, although daunting, is achievable through a requirement that counterparties, or intermediaries for those parties, report transactions that bear on risk allocation to a central data repository.²¹⁹ Only with such detailed knowledge can the true systemic importance of a firm be measured and its potential to impair the financial system be charged to it to safeguard the financial commons.

C. *Addressing Systemic Crises Ex Post*

Our primary objective until now has been to identify behavioral and other market failures within the financial system that prevent financial market participants from addressing risk to a socially optimal degree and to suggest avenues for safeguarding financial systemic stability through regulatory approaches directed at these failures. We recognize, however, that policies designed to implement such regula-

218 The Basel Committee on Banking Supervision has espoused the view that systemically important financial firms should have loss absorbing capacity beyond the capacity of financial firms generally, but has not yet developed standards for such firms. See *BASEL III ACCORD*, <http://www.basel-iii-accord.com> (last visited Feb. 7, 2011).

219 See *supra* note 197 and accompanying text.

tory approaches may not be politically feasible. Even if they were feasible, prescriptive regulation cannot always prevent systemic breakdowns. Market participants cannot anticipate “black swan” events, which are unforeseen, however incentivized they are to do so. In addition, there are epistemological limits to our ability to discern hidden correlations within the financial system, and new correlations may emerge. When prescriptive regulation fails, it may be desirable for government to intervene to preserve the stability of the financial system on an *ex post* basis.

A market liquidity provider of last resort (a “market liquidity provider”) can serve to address market breakdowns while minimizing moral hazard.²²⁰ The objective of a market liquidity provider would be to stabilize financial markets in times of panic, when securities prices have fallen below their intrinsic values.²²¹ A market liquidity provider must have the necessary means to take sufficiently large positions in the markets it targets. Such an entity would likely have to be governmental,²²² though it may be able to obtain partial funding from

220 Such a market liquidity provider would clearly operate *ex post*, insofar as it would limit systemic consequences. Semantically, however, this article’s focus on disrupting the transmission of systemic risk could be viewed as either *ex ante* (insofar as a disruption mechanism makes the financial system more resilient) or *ex post* (insofar as a disruption mechanism mitigates an actual failure from spreading). For a more detailed analysis of *ex ante* and *ex post* financial regulation, see Iman Anabtawi & Steven L. Schwarcz, *A Theory of Ex Post Financial Regulation* (working draft) (on file with authors).

221 The Troubled Asset Relief Program, commonly known as TARP, was initially intended promote financial stability by allowing the U.S. Department of the Treasury to purchase troubled assets from financial firms, but was replaced by programs under which the Treasury would invest directly in the equity of financial firms and guarantee new debt issuances. See Dinara Bayazitova & Anil Shivdasani, *Assessing TARP 8–10* (July 2010) (unpublished working paper), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1461884.

222 As a governmental entity, a market liquidity provider would bear at least superficial similarity to the U.S. Resolution Trust Corporation (RTC), created in 1989 to clean up the savings and loan (S&L) mess by buying troubled loans. The RTC, however, “is not a perfect parallel for today’s needs” for several reasons, including that it was created to clean up the mess years after it occurred, not necessarily (as this chapter also contemplates for a market liquidity provider) to minimize occurrence of the mess. *Beyond Crisis Management: Bold Ideas for Solving America’s Financial Mess*, *ECONOMIST*, Sept. 20, 2008, at 94. Nonetheless, the RTC is a helpful model insofar as it represents a credible and reasonably efficient model of a governmental entity purchasing troubled financial assets. See Sudhir Nanda et al., *An Analysis of Resolution Trust Corporation Transactions: Auction Market Process and Pricing*, 25 *J. REAL EST. ECON.* 271, 290 (1997) (concluding that mispricing of its purchases were not typical but occurred only in limited cases).

the private sector.²²³ A market liquidity provider could support panicked markets by purchasing market securities at prices that are below their intrinsic values but above their then-current prices.²²⁴ Alternatively, a market liquidity provider could try to stabilize markets by assuming through derivatives contracts only risks that the markets have the greatest difficulty hedging.²²⁵

The U.S. government acted as a market liquidity provider in a limited context in the recent financial crisis. Shortly after Lehman Brothers failed, the commercial paper market collapsed.²²⁶ In response, the Federal Reserve created the Commercial Paper Funding Facility (CPFF), to act as a lender of last resort for that market, with the goal of addressing “temporary liquidity distortions” by purchasing commercial paper from highly rated issuers that could not otherwise sell their paper.²²⁷ The CPFF apparently helped to stabilize the commercial paper market.²²⁸

The foregoing types of strategies aimed at supporting financial markets in times of crisis by providing liquidity should be more cost-effective than strategies in which governments act as a lender of last resort to financial firms.²²⁹ A lender of last resort is more likely to

223 For example, as part of an ongoing effort to improve the balance sheets of financial firms, the Treasury Department is pursuing the Public-Private Investment Program (PPIP). Under the PPIP, capital earmarked for the Troubled Asset Relief Program is co-invested alongside private capital in eligible securities, a portion of which consists of non-recourse government loans. See *Public Private Investment Program*, U.S. DEP’T TREASURY, <http://www.treasury.gov/initiatives/financial-stability/investment-programs/ppip/Pages/publicprivatefund.aspx> (last visited Mar. 6, 2011); see also Schwarcz, *supra* note 1, at 226–27 (examining how to privatize the role of a market liquidity provider).

224 To induce holders of securities to sell them at such prices, the market liquidity provider could employ flexible pricing approaches such as those used in structured financing transactions to buy financial assets of uncertain value. See Steven L. Schwarcz, *Too Big to Fail?: Recasting the Financial Safety Net*, in *THE PANIC OF 2008*, at 94, 99 (Lawrence E. Mitchell & Arthur E. Wilmarth, Jr., eds., 2010).

225 For example, in an effort to encourage private entities to purchase toxic assets from banks, the Treasury Department proposed guaranteeing a floor value of these troubled assets. See Floyd Norris, *U.S. Bank Bailout to Rely in Part on Private Money*, N.Y. TIMES, Feb. 9, 2009, at A1.

226 Commercial paper consists of short-term corporate promissory notes.

227 See Tobias Adrian et al., *The Federal Reserve’s Commercial Paper Funding Facility*, FRB NY ECON. POL’Y REV. (forthcoming) (manuscript at 1), available at <http://www.ny.frb.org/research/epr/forthcoming/1006adri.pdf>.

228 See *id.* (manuscript) (concluding that “[t]he CPFF indeed had a stabilizing effect on the commercial paper market”).

229 The U.S. Federal Reserve Bank has traditionally acted as a lender of last resort in “unusual and exigent circumstances” to banks and other financial institutions. See Gordon & Muller, *supra* note 97, at 29–34 (describing the history of emergency lend-

foster moral hazard by providing a safety net to fiscally reckless entities, particularly those that believe they are “too big to fail.” Moreover, loans may never be repaid if the lender eventually fails. In contrast, a market liquidity provider can instill confidence in markets by establishing a floor on prices and at the same time giving taxpayers a chance to profit by purchasing securities at a discount to their intrinsic values.

D. Applying the Framework to Financial Crises

In this subpart we test the conceptual framework of this Article by examining how it would have applied to the four financial crises discussed in Part I.B.

1. The Great Depression

In the Great Depression, the first correlation was triggered by complacency in the form of optimism bias and availability bias that led banks to underestimate a low-probability risk of margin lending to risky borrowers, namely the risk that stock value (which in the recent past had only risen) would decline in value. These biases could have been managed through regulation requiring banks to stress their assumptions to reasonable worst-case scenarios. Stock prices historically rise and fall, so banks making margin loans would have had to take into account the potential impact of a falling stock market on repayment of their loans. Regulation also could have addressed complacency by requiring that the collateral for margin loans made to risky borrowers exceed loan value by a minimum threshold based on reasonable worst-case scenarios.²³⁰

ing by the Federal Reserve under § 13(3) of the Federal Reserve Act). The Dodd-Frank Act drastically limits the authority of the Federal Reserve to make emergency loans under § 13(3). The Act amends § 13(3) to require the Federal Reserve to consult with and receive approval from the Secretary of the Treasury to ensure that any emergency lending is designed to provide liquidity to the markets and not to aid a financially failing firm. *See* Dodd-Frank Act, Pub. L. No. 111-203, § 1101(a)(6), 124 Stat. 1376, 2113–15 (2010). The FDIC is authorized to make short-term loans to solvent depository institutions subject to Congressional approval. *See id.* § 1105.

230 After the Great Depression, the Federal Reserve promulgated one-size-fits-all rules to this effect. *See* Disclosure and Reporting of CRA-Related Agreements (Regulation G), 12 C.R.F § 207 (2010); Credit by Brokers and Dealers (Regulation T), 12 C.F.R. § 220 (2010); Credit by Banks and Persons Other than Brokers or Dealers for the Purpose of Purchasing or Carrying Margin Stock (Regulation O), 12 C.F.R. § 221 (2010); Borrowers of Securities Credit (Regulation X), 12 C.F.R. § 224 (2010) (requiring two-to-one collateral coverage for all margin loans).

The combining of the first correlation with the second—in the case of the Great Depression, an interconnectedness among banks—caused the individual bank failures (resulting from margin-lending losses) to trigger a broader systemic shock. The conductivity of the network formed by that interconnectedness could have been managed through regulation designed to mitigate loss spirals, such as requiring banks to maintain financial robustness (e.g., through risk-based financial ratios) and to also maintain sufficient liquidity to avoid having to sell assets at fire-sale prices in order to pay current debts.

2. Long-Term Capital Management

The first correlation was triggered by complacency in the form of overreliance on recent patterns in bond pricing and overreliance on mathematical models incorporating these patterns. That led LTCM to ignore a low-probability risk that these patterns could change—a change subsequently caused by a default on Russian government bonds. This complacency could have been managed through regulation designed to require financial firms to stress their assumptions to reasonable worst-case scenarios.

When LTCM was about to fail, the Federal Reserve stepped in to broker a deal to prevent default, thereby avoiding triggering a broader systemic shock. The Fed clearly recognized, consistent with the second correlation, an interconnectedness among large non-bank financial firms (like LTCM) and banks resulting from interlinked contractual obligations. The conductivity of the network formed by that interconnectedness could have been managed through regulation designed to mitigate loss spirals, such as making counterparty risk more transparent and requiring even large non-bank financial firms to maintain financial robustness and to also maintain sufficient liquidity to pay current debts without having to sell assets at fire-sale prices. Because these latter requirements can be costly, they could be applied only to non-bank financial firms of systemic importance—systemic importance being measured by such factors as the firm's size, the extent of its counterparty relationships, and (to mitigate the harm of selling assets at fire-sale prices) the degree of correlation of the firm's assets with financial-market assets and assets owned by other firms.

3. Enron

The first correlation was triggered by complacency in the form of optimism bias and availability bias, exacerbated by a conflict of interest between Enron's chief financial officer (Andrew Fastow) and the

firm,²³¹ and further exacerbated by the complexity of Enron's structured transactions. As a result, Enron underestimated the risk that its stock, which had been rising in price, would fall—a fall that ultimately required Enron to pay on guarantees of the structured transactions, causing Enron to lose its investment-grade rating and thus its business viability.

This correlation could have been managed through regulation designed to address complacency, conflicts, and complexity. Regulation could have addressed complacency by requiring financial firms to stress their assumptions to reasonable worst-case scenarios. Even though Enron's stock price had consistently risen, stock market prices generally rise and fall; thus, a fall in the overall stock market could (as in fact happened) cause a fall in Enron's stock price. Regulation could have addressed conflicts by requiring financial firms to better align compensation incentives with long-term interests of the firm, such as by pay-risk disclosure and risk-sharing. Thus, Enron would have had to disclose that Fastow's compensation in his capacity as an agent in Enron's structured transactions dwarfed his Enron compensation. Fastow also would have had to share a measure of losses if Enron ever had to pay on the guarantees of those transactions. That sharing of economic risk also would have mitigated the problem of complexity—in Enron's case, that the structured transactions were so complex that even Enron's board of directors did not fully understand them.²³² By having "skin in the game," Fastow would have had less incentive to make these transactions complex in order to mislead his firm.

Enron's collapse did not trigger a systemic financial crisis because it was not closely correlated with the viability of other financial institutions. Thus, even large financial firms are not always interconnected in systemically significant ways. The significance of interconnections among firms would depend to a large extent on the contractual obligations between them.

4. The Recent Global Financial Crisis

The first correlation was triggered by complacency in the form of optimism bias and availability bias, exacerbated by conflicts of interest

231 For a discussion of this conflict of interest, see Schwarcz, *supra* note 30, at 1312.

232 See WILLIAM C. POWERS, JR., ET AL., REPORT OF INVESTIGATION BY THE SPECIAL INVESTIGATIVE COMMITTEE OF THE BOARD OF DIRECTORS OF ENRON CORP. 182, 202 (2002), available at <http://i.cnn.net/cnn/2002/LAW/02/02/enron.report/powers.report.pdf>.

between financial firms and their secondary managers and the complexity of modern financial products, and further exacerbated by the “commons” problem. As a result, many financial firms underestimated the low-probability risk that housing prices would decline, causing subprime mortgage loans to default.

This correlation could have been managed through regulation designed to address complacency, conflicts, complexity, and the commons problem. Complacency could have been regulated by requiring financial firms to stress their assumptions to reasonable worst-case scenarios. Thus, subprime mortgage lenders would have had to highlight how falling housing prices could affect repayment of their loans. Regulation also could have addressed complacency by requiring that the value of the houses collateralizing subprime mortgage loans exceed loan value by a minimum threshold based on reasonable worst-case scenarios of housing prices.

Conflicts could have been regulated by requiring financial firms to better align compensation incentives, including those of secondary managers, with long-term interests of the firm. For example, regulation could have required financial firms to pay a portion of management compensation contingently over time or in the form of equity, or to pay compensation subject to retroactive clawback. Investment analysts then would have been much less likely, for example, to recommend that their firms invest in complex and highly-leveraged asset-backed securities that they did not fully understand.

Although complexity could have been regulated by requiring a degree of standardization of financial products, that could backfire, limiting the flexibility needed to design financial products to respond to or anticipate investor needs. Complexity also could have been addressed through centralized risk assessment. Although rating agencies attempted to perform this function, they failed to accurately predict risk on the most leveraged tranches of securities backed by subprime mortgages. Regulation can be used, however, to attempt to address potential flaws in the rating process; and, indeed, has already begun to do so.²³³ Additionally, complexity could have been regulated by requiring those who produce risk to place skin in the game, for example by requiring underwriters of complex financial products to retain a degree of risk on the products they sell.

The commons problem could have been regulated by requiring financial firms to take into account the impact of their behavior on systemic stability. Regulation could have required these firms, for example, to manage risk levels not only to maximize their own share-

233 See *supra* note 176.

holder value but also to protect the interests of third parties from systemic consequences. Thus, financial firms could have been required to maintain sufficient liquidity to avoid needing to sell assets at fire-sale prices and possibly also to comply with robust financial adequacy requirements. Because these requirements can be costly, they could (as previously discussed) be applied only to firms of systemic importance.

The financial crisis occurred when the first correlation combined with the second—an interconnectedness among institutions. This caused localized defaults on asset-backed securities to trigger a widespread loss of confidence in debt markets, in turn cutting off credit, creating counterparty risk, and triggering a global systemic shock. The conductivity of the network formed by the interconnectedness among institutions could have been managed through regulation designed to mitigate loss spirals, such as decoupling financial asset valuation from current market prices at times when the two substantially diverge and requiring greater transparency of credit exposures of counterparties to potential liabilities.

This Part has examined, in the context of the financial crises discussed in Part I.B, how regulation could have helped to disrupt the transmission of systemic risk by weakening correlations within the financial system that serve to transmit systemic risk. We do not claim that regulation can always be successful in preventing systemic crises, merely that regulation based on an understanding of the transmission mechanism for systemic risk is more likely to be successful. To the extent such regulation is unsuccessful, we have discussed in Part III.C how systemic crises could be addressed *ex post*.

CONCLUSION

As a result of the recent global financial crisis, there is widespread support for using regulatory policy to reduce systemic risk. To be effective, however, systemic risk regulation must address the underlying causes of systemic instability. Our objective in this Article has been to provide a theoretical framework that can help inform the efforts of policymakers as they pursue this task.

Despite the enormous resources being devoted by policymakers to systemic risk regulation, current measures aimed at reducing the likelihood of another systemic breakdown are largely untethered from a coherent theoretical account of the underlying causes of systemic crises, raising the possibility that the resulting financial regulatory reforms will be sub-optimally designed or even misdirected. Under our theoretical framework, one focus of optimal regulation should be

on attempting to weaken correlations within the financial system that serve to transmit systemic risk. Localized economic shocks, by themselves, are unlikely to produce systemic effects, but when these shocks are transmitted through firms and markets, even relatively small shocks can have systemic consequences. This analysis implies that regulation should be designed to disrupt that transmission.

The framework that we have set forth can help to guide the course of global financial regulatory reform. It is especially pertinent to domestic U.S. regulation. The Dodd-Frank Act represents a wide-ranging effort to safeguard the stability of the financial system, but much of the substance of that Act will be realized in the future through administrative rulemaking. To that end, the Dodd-Frank Act creates a Financial Stability Oversight Council to examine and monitor possible sources of systemic risk.²³⁴ The Council is further authorized to identify regulatory gaps and other potential threats to the nation's financial stability.²³⁵

Regulators are thus in a position to analyze how systemic risk is transmitted and to monitor that transmission, including transmission through the correlations we have identified. They will also be able to advance additional regulatory recommendations.²³⁶ Other scholars

234 See Dodd-Frank Act, Pub. L. No. 111-203, § 111, 124 Stat. 1376, 1392–94 (2010). The Secretary of the Treasury chairs the Council, which has nine additional voting members (all but one of whom is a federal agency head, including the Chairman of the Federal Reserve Board). The Council has authority to designate certain firms as “systemically important.” See *id.* §§ 112–115. For firms so designated, the Council may instruct the Federal Reserve to impose various regulatory constraints, including capital, leverage, and liquidity requirements, periodic “stress testing.” See *id.* A systemically important firm also can be required to submit a resolution plan that sets forth how, if it fails, the firm would wind down in a way that minimizes systemic impact. See *id.* (although the Federal Bankruptcy Code arguably already provides sufficient resolution procedures for this purpose). Because the Council only meets periodically, its day-to-day operations are run through a new Office of Financial Research within the Department of the Treasury. This office is responsible for collecting data from regulators and market participants, issuing reports on potential regulatory gaps, and making supervisory recommendations. See *id.* §§ 116, 152–154.

235 See *id.* §§ 116, 152–154. Under the Act, the Council may subject not only banks but also other large financial companies, including investment banks, broker-dealers, asset management firms, and insurance companies, to registration and reporting requirements and direct supervision by the Federal Reserve. See *id.* § 102.

236 We cannot know with certainty how successful the Act will ultimately be at disrupting the systemic risk transmission mechanism that we have elaborated. Nothing in the Act's statutory language statutory addresses it directly. The Act potentially addresses systemic risk transmission through its impact on certain aspects of the market failures—namely, conflicts and complexity—that underlie the transmission of systemic risk. These provisions are discussed throughout this Article in the sections to which they relate.

have argued the near-impossibility of substantially reducing systemic risk.²³⁷ They may be correct, and it is not our purpose here to assess the accuracy of their claims. What is clear, we think, is that policymakers seeking to preserve the stability of the financial system will be unsuccessful in doing so unless they take into account the two correlations about which we write and their potential to combine. Failure to do so, we fear, will lead to misdirected regulation that will not only leave the financial system exposed to future crises, but also impose unnecessary costs on the financial sector and the real economy.²³⁸

237 See, e.g., CARMEN M. REINHART & KENNETH S. ROGOFF, *THIS TIME IS DIFFERENT* (2009).

238 Two provisions of the Dodd-Frank Act are already troubling in this regard. If the Secretary of the Treasury designates a systemically important financial firm that defaults or is at risk of default as a “covered financial company,” that firm cannot reorganize through the Federal Bankruptcy Code but, instead, must be liquidated under Federal Deposit Insurance Corporation (FDIC) receivership. See Dodd-Frank Act §§ 204–205. Another provision sharply limits the power of the Federal Reserve to make emergency loans to individual or insolvent firms, thereby restricting the Federal Reserve’s long-standing ability to act as a liquidity provider of last resort to financial institutions. See *id.* § 1101(a)(6). Perversely, these provisions actually increase the risk that a systemically important financial firm will fail, transmitting failure to other financial institutions through their inter-institutional correlation.