September 22, 2011

Complexity, Innovation and the Regulation of Modern Financial Markets

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DRAFT: August 25, 2011

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ABSTRACT

The intellectual origins of the global financial crisis (GFC) can be traced back to blind spots emanating from within conventional financial theory. These blind spots are distorted reflections of the perfect market assumptions underpinning the canonical theories of financial economics: modern portfolio theory; the Modigliani and Miller capital structure irrelevancy principle; the capital asset pricing model and, perhaps most importantly, the efficient market hypothesis. In the decades leading up to the GFC, these assumptions were transformed from empirically (con)testable propositions into the central articles of faith of the ideology of modern finance: the foundations of a widely held belief in the self-correcting nature of markets and their consequent optimality as mechanisms for the allocation of society’s resources. This ideology, in turn, exerted a profound influence on how we regulate financial markets and institutions.

The GFC has exposed the folly of this market fundamentalism as a driver of public policy. It has also exposed conventional financial theory as fundamentally incomplete. Perhaps most glaringly, conventional financial theory failed to adequately account for the complexity of modern financial markets and the nature and pace of financial innovation. Utilizing three case studies drawn from the world of over-the-counter (OTC) derivatives – securitization, synthetic exchange-traded funds and collateral swaps – the objective of this paper is thus to start us down the path toward a more robust understanding of complexity, financial innovation and the regulatory challenges flowing from the interaction of these powerful market dynamics. This paper argues that while the embryonic post-crisis regulatory regimes governing OTC derivatives markets in the U.S. and Europe go some distance toward addressing the regulatory challenges stemming from complexity, they effectively disregard those generated by financial innovation.

Key words: complexity; financial innovation; financial regulation; shadow banking system; OTC derivatives; securitization; collateral swaps; synthetic exchange-traded funds; ETFs; Dodd-Frank Act; European Market Infrastructure Regulation.
# TABLE OF CONTENTS

I. Introduction ................................................. 1

II. Toward A More Robust Theory of Complexity and its Drivers .......... 8

III. Toward A Supply-Side Theory of Financial Innovation ................. 29

IV. The Relationship Between Complexity and Financial Innovation: Three Case Studies .......... 37

V. Complexity and Financial Innovation: The Regulatory Challenges .......... 48

VI. The Trillion Dollar Question .................................... 51

VII. Conclusion ................................................ 65
I. Introduction

The intellectual origins of the global financial crisis of 2007-2009 (GFC) can be traced back to shortcomings – blind spots – emanating from within conventional financial theory. These blind spots are distorted reflections of the perfect market assumptions underpinning the canonical theories of financial economics: modern portfolio theory (MPT); the Modigliani and Miller (M&M) capital structure irrelevancy principle; the capital asset pricing model (CAPM) and, perhaps most importantly, the efficient market hypothesis (EMH).1 These theories share a common and highly stylized view of financial markets, one characterized by, inter alia, perfect information, the absence of transaction costs and rational market participants. Yet in reality financial markets – and market participants – rarely (if ever) strictly conform to these assumptions.2,3 Information is costly and unevenly distributed; transaction costs are pervasive and often determinative, and market participants frequently exhibit cognitive biases and bounded rationality.4 Despite these seemingly uncontroversial observations, however, the empirically (con)testable assumptions of conventional

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1 These theories, their centrality to the field of financial economics, and their underlying assumptions are each discussed in greater detail in Parts II and III.  
2 The most notable exception arguably being public secondary markets for equity securities, where a significant body of empirical research exists to support the view that these markets generally conform to the assumptions of semi-strong form EMH. For a survey of this empirical work, see Burton Malkiel, “The Efficient Market Hypothesis and Its Critics” (2003), Centre for Economic Policy Studies Working Paper No. 91, available at www.princeton.edu/~ceps/workingpapers/91malkiel.pdf and Eugene Fama, “Market Efficiency, Long-Term Returns and Behavioral Finance” (1998), 49 J. Fin. Econ. 283. Even in this context, however, it is still unrealistic – and, indeed, actually inconsistent with the operation of the arbitrage mechanism at the heart of conventional financial theory – to expect that markets will always be in equilibrium; see Sanford Grossman and Joseph Stiglitz, “On the Impossibility of Informationally Efficient Markets” (1980), 70:3 Am. Econ. Rev. 393.  
3 As Ron Gilson has observed, it is not altogether clear whether the authors of these theories were initially attempting to describe real world financial markets or, alternatively, provide the basis for a research agenda which – by relaxing the perfect market assumptions – could enhance our understanding of how these markets work in practice; Ron Gilson, “Market Efficiency after the Financial Crisis: It’s Still a Matter of Information Costs” (May 2011) at 17 [working paper on file with author]. Ultimately, at least one of these authors did explicitly adopt the latter view; see Merton Miller, “The Modigliani-Miller Propositions After Thirty Years” (1988), 2 J. Econ. Perspectives 99 at 100.  
financial theory have been transformed into the central articles of faith of the ideology of modern finance: the foundations of a widely held belief in the self-correcting nature of markets and their consequent optimality as mechanisms for the allocation of society’s resources.\(^5\)

The ideology of modern finance has exerted a profound influence on how we regulate financial markets and institutions. Perhaps most significantly, the pervasive belief in the social desirability of unfettered markets represented the driving force behind the sweeping agenda of financial deregulation witnessed in many jurisdictions in the decades leading up to the GFC.\(^6\) This market fundamentalism was grounded in the conviction that rational and fully informed market participants – utilizing sophisticated quantitative methods and the innovative financial instruments these methods made possible – had effectively mastered risk. Public regulation, by implication, was largely relegated to a supporting role: namely, the provision of private property rights and efficient contract enforcement necessary to support private risk-taking. Ultimately, it was this market fundamentalism which justified turning a blind eye to the potential adverse effects of vast global current account imbalances\(^7\);

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\(^6\) See Financial Crisis Inquiry Commission (FCIC), *Final Report of the National Commission on the Causes of the Financial Crisis in the United States* (Public Affairs, New York, 2011) at xviii; Richard Posner, *A Failure of Capitalism: The Crisis of ’08 and the Descent into Depression* (Harvard University Press, Cambridge, 2009); George Cooper, *The Origins of the Financial Crisis: Central Banks, Credit Bubbles and the Efficient Market Fallacy* (Random House, New York, 2008); Gilson (n 3) at 2-3 and Johnson and Kwak (n 5) at 69. The term ‘deregulation’ does not entirely capture the breadth or fundamental character of this trend. Indeed, it is perhaps more accurate to say that deregulation during this period was characterized by (1) significant devolution of regulation from public to private actors, and (2) a non-interventionist stance toward the regulation of many financial markets and institutions which emerged, developed and matured during this period.

\(^7\) The influence of market fundamentalist thinking on the established wisdom underpinning the post-war push to liberalize international trade and capital flows is reflected in the comments of Stanley Fischer, former First Deputy Managing Director of the International Monetary Fund (IMF): “free capital movements facilitate a more efficient allocation of global savings, and help channel resources into their most productive uses, thus increasing economic growth and welfare”; Stanley Fischer, “Capital Account Liberalization and the Role of the IMF”, lecture given at the IMF Annual Meetings (September 19, 1997), available at www.imf.org.
acquiescing to the build-up of huge amounts of risk within the so-called ‘shadow banking’ system, and devolving significant responsibility for the design and implementation of capital adequacy standards to the very financial institutions which were ultimately subject to this micro-prudential regulation. At times, it appeared as if the only question to which ‘more markets’ was not the consensus answer was: where do we turn when markets fail?

The GFC has revealed the folly of market fundamentalism as a driver of public policy. It has also exposed conventional financial theory as fundamentally incomplete. Perhaps most glaringly, conventional financial theory failed to adequately account for both the complexity of modern financial markets and the nature and pace of financial innovation. From sub-prime mortgages, securitization and credit default swaps (CDS) to sophisticated quantitative models for measuring and managing risk, the footprints of complexity and innovation can be observed throughout modern financial markets – and, importantly, at almost every significant step along the road to the GFC. Complexity and innovation have combined to

8 The shadow banking system includes (1) non-bank financial institutions such as finance companies, structured investment vehicles, securities lenders, money market mutual funds, hedge funds and U.S. government sponsored entities, and (2) financial instruments such as repurchase agreements, asset-backed securities, collateralized debt obligations and other derivatives, insofar as these institutions and instruments perform economic functions (i.e. maturity, credit and liquidity transformation) typically associated with more ‘traditional’ banks; see Gary Gorton and Andrew Metrick, “Regulating the Shadow Banking System” (Fall 2010), Brookings Papers on Economic Activity 261 and Zoltan Pozsar, Tobias Adrian, Adam Ashcraft and Halley Boesky, “Shadow Banking”, Federal Reserve Bank of New York Staff Reports No. 458 (July 2010).


10 And, indeed, the road to many previous financial crises. See for example, John Kenneth Galbraith, The Great Crash of 1929 (Houghton Mifflin Company, New York, 1954) at 46-50, 72-76, 80-86 and 89, describing the role of financial innovations such as margin trading and so-called ‘investment trusts’ in helping to fuel the speculative bubble which ultimately precipitated the 1929 U.S. stock market crash. More recent examples include both (1) the role of portfolio insurance in the 1987 stock market crash, and (2) the role of high frequency traders, automated execution algorithms and exchange traded funds in the so-called ‘flash crash’ of May 6, 2010; see Report of the Presidential Task Force on Market Mechanisms, submitted to the President of the United States, the Secretary of the Treasury and the Chairman of the Federal Reserve Board (January 1988) at v and Findings Regarding the Market
generate significant asymmetries of information and expertise within financial markets, thereby opening the door to suboptimal contracting and exacerbating already pervasive agency cost problems. At the same time, the pace of innovation has left financial regulators and regulation chronically behind the curve. Together, complexity and innovation thus give rise to a host of regulatory challenges, the full implications of which we are only just now beginning to understand.

Perhaps nowhere is the myopia of market fundamentalism more evident than in connection with the pre-crisis regulation of over-the-counter (OTC) derivatives markets. Over the course of the past three decades, these markets have grown from an obscure financial backwater into a global behemoth—the 800lb gorilla of modern financial markets. Prevailing dogma prior to the GFC viewed the seemingly insatiable demand for many species of OTC derivatives as a rational response to market imperfections. Supply, in turn, was a rational response to this demand. That supply met demand within the marketplace was then generally interpreted as being dispositive of these instruments’ private and social utility. This viewpoint was firmly rooted in the autonomous rational actor framework underpinning MPT, the M&M capital structure irrelevancy principle, CAPM and the EMH. Not coincidentally, conventional financial theory also provided the rationale—forcefully articulated by, amongst many others, U.S. Federal Reserve Board Chairman Alan Greenspan— for

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11 In the context of a principal-agent (or other co-operative) relationship between two or more parties, the term ‘agency costs’ refers to costs incurred by the parties in connection with the monitoring and bonding of the other parties, along with any residual (hidden) losses stemming from the misalignment of incentives as between the parties; see Michael Jensen and William Meckling, “Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure” (1976), 3:4 J. of Fin. Econ. 305.

12 See for example, Alan Greenspan, “The Regulation of OTC Derivatives”, testimony before the House Committee on Banking and Financial Services, 105th Congress, 2nd session (July 24, 1998), stating: “professional counterparties to privately negotiated contracts also have demonstrated their ability to protect themselves from losses, from fraud, and counterparty insolvencies… Aside from the
why public regulatory intervention was not necessary to ensure the safe and efficient operation of OTC derivatives markets. This stance was ostensibly bolstered by the emergence of private actors such as the International Swaps and Derivatives Association (ISDA), along with various trading platforms and clearinghouses, to provide the legal and operational infrastructure necessary to support the development and growth of these new markets.\textsuperscript{13}

OTC derivatives markets epitomize both the complexity of modern financial markets and the nature and pace of innovation within them. For this reason, they offer us an illuminating window into the regulatory challenges generated by the interaction of these powerful (and yet poorly understood) market dynamics. Perhaps not surprisingly, these challenges ultimately stem from the availability and allocation of a single and immensely precious commodity: information. \textit{How costly is it to acquire? Who has it? And, importantly, who doesn't?}\textsuperscript{14} As we shall see, the answers to these and other related questions are highly instructive in terms of how we should approach the regulation of OTC derivatives markets – and the broader financial system – going forward.

The objective of this paper is to start us down the path toward a more robust understanding of the regulatory challenges flowing from complexity and innovation


\textsuperscript{14} And, indeed, if it can be acquired, manipulated, filtered and/or analyzed within applicable temporal, cognitive, resource and/or technological constraints.
within modern financial markets. In the process, it aspires to establish a more stable and constructive equilibrium between financial *theory* and financial *regulation*.\(^\text{15}\) Just as market fundamentalism has been found wanting in the wake of the GFC, so too will any approach to regulation which favors ideological purity over the rigorous and ongoing evaluation of the market frictions and market failures which attract regulatory scrutiny and the anticipated costs and benefits of various forms of regulatory intervention.\(^\text{16}\) Put somewhat differently, the only antidote to ideological fervor is the systematic study of how markets – and regulation – work in practice.\(^\text{17}\)

The remainder of this paper proceeds as follows. **Part II** begins by articulating a theoretical framework for understanding complexity which conceptualizes it as a function of two variables: information costs and bounded rationality. It then examines six key drivers of high information costs (and information failure) within modern financial markets and their points of intersection with the cognitive and temporal constraints on our ability to process information.\(^\text{18}\) **Part III** shifts the focus to financial innovation and advances a theory which re-conceptualizes it as a process of *change* – but not necessarily one of *improvement* – influenced by, *inter alia*, the supply-side incentives of the principal innovators: financial intermediaries. **Part IV** then examines the multifaceted and mutually reinforcing relationship between complexity and financial innovation through the lens of three case studies drawn from the world of OTC derivatives: securitization, synthetic exchange-traded funds (ETFs)

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\(^{15}\) Although certainly not a more static one.

\(^{16}\) This paper thus adopts as its normative touchstone the evaluative framework provided by welfare economics, pursuant to which ‘optimal’ or ‘efficient’ markets or regulation are understood to be those which maximize net social welfare. For a more fulsome discussion of welfare economics and its utility (and limitations) in the domain of financial regulation, see Awrey (n 13) at 165-167.

\(^{17}\) This approach is reflected in Ronald Coase’s statement that “satisfactory views on policy can only come from a patient study of how, in practice, the market, firms, and government handle the problem of harmful effects.”; Ronald Coase, “The Problem of Social Cost” (1960), 3 J. of Law & Econ. 1 at 10.

\(^{18}\) As explored in greater detail in **Part II**, these drivers include technology, opacity, interconnectedness, fragmentation, regulation and reflexivity.
and collateral swaps. Leveraging these case studies, Part V seeks to identify the regulatory challenges generated by the interaction of these powerful market dynamics. Part VI then concludes by examining whether and to what extent the embryonic post-crisis regulatory regimes governing OTC derivatives markets in the U.S. and Europe effectively respond to these challenges.

As American essayist H.L. Mencken once observed: “for every complex problem there is an answer which is clear, simple and wrong”. Consistent with this axiom, this examination fails to generate an obvious or straightforward set of prescriptions. As in virtually all areas of public policy, tradeoffs abound. This paper concludes, therefore, by extracting and synthesizing the common themes flowing from this exploration of complexity and financial innovation. These themes underscore the importance and pervasiveness of information costs, asymmetries of information and agency cost problems within modern financial markets and, thus, the manifest need for mechanisms which (1) subsidize the production and dissemination of information and (2) align the incentives of both public and private actors with broader social welfare. They also highlight the nature and pace of change within modern financial markets and the resulting desirability of regulation (and regulators) designed and built with the objective of ensuring sufficient flexibility, responsiveness and durability. Finally, they emphasize the imperative of global coordination in a world increasingly defined by truly global risks. Viewed in this light, while this paper does not have in mind a specific destination, it can be understood as strongly advocating certain modes – and a general direction – of travel.

19 Regrettably, the author was unable to unearth the original source for this oft-cited quotation.
II. Toward A More Robust Theory of Complexity and its Drivers

Modern financial markets are very, very complex. This complexity is compounded by the nature and pace of financial innovation. But what do we mean when we say that financial markets are ‘complex’ and ‘innovative’? And what are the key drivers of complexity and innovation within modern financial markets? This section (and the next) sketch out preliminary – and at this stage largely theoretical – answers to these all important questions.

It is almost trite to observe that modern financial markets are ‘complex’.20 Curiously, however, scholars in the fields of both law and finance have expended relatively little time or effort attempting to understand this complexity or systematically identify its potential sources.21, 22 So what makes modern financial


21 At least part of the explanation for this lack of attention likely stems from the fact that the theoretical and empirical literature examining MPT, the M&M capital structure irrelevancy principle, CAPM and the EHM has historically focused on the public markets for equity and, to a lesser extent, debt securities. In a recent review of the literature examining the EMH, for example, 53 of the 54 cited works were primarily or exclusively concerned with its application within the context of public equity markets; see Malkiel (n 2). This of course makes perfect sense: these theories implicitly rely on the existence of the secondary market liquidity typically associated with public capital markets (in effect, to ensure the efficient operation of the arbitrage mechanism which moves markets toward equilibrium). What is more, it is the public nature of these markets which afford scholars access to the information necessary to measure how rapidly new information is impacted into security prices. Simultaneously, however, it must be acknowledged that this research strategy generates an inherently biased (and increasingly myopic) sample if one’s ultimate objective is to measure the informational efficiency of modern financial markets. As we shall see, the vast majority of the complexity – and thus the information costs and bounded rationality – within modern financial markets does not emanate from within the relatively transparent (and static) public markets for capital.

22 This is not to say, however, that scholars have not attempted to construct models designed to reflect the complex dynamics of modern financial markets; see for example, Robert May, Simon Levin and George Sugihara, “Ecology for Bankers” (2008), 451 Nature 893; Robert May and Nimalan Arinaminpathy, “Systemic Risk: The Dynamics of Model Banking Systems” (2010), 46 J. of Royal Society Interface 823; and Prasanna Gai, Andrew Haldane and Sujit Kapadia, “Complexity, Concentration and Contagion” (2011), 58:5 J. of Monetary Econ. [forthcoming]. Many of these models share a common methodology – first employed by Herbert Simon – which is, in effect, based on identifying similarities between financial systems, on the one hand, and physical, biological or other social systems, on the other; see Herbert Simon, “The Architecture of Complexity” (1962), 106:6
markets complex? We can take our first tentative steps toward answering this question by constructing a simple (and hopefully intuitive) framework which conceptualizes complexity as a function of the (1) costs incurred in connection with the acquisition, filtering, manipulation and analysis of information, and (2) cognitive and temporal constraints on our ability to process this information (i.e. bounded rationality). In many ways, this framework brings together, renders explicit, elaborates on and formalizes intuitions previously articulated by scholars such as Ron Gilson and Reinier Kraakman; Steven Schwarcz; Henry Hu; Gary Gorton and Robert Bartlett.

Importantly, this framework views complexity through the eyes of the beholder. Building out this framework, we can envision an actor attempting to understand a particular constellation of facts or state of the world: a ‘snowball’ interest rate swap; the balance sheet of a large, complex financial institution (LCFI), or the systemic interconnections between financial markets and institutions, for example. To fully understand this constellation of facts or state of the world, we

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Proceedings of the American Philosophical Society 467. The obvious shortcoming of this methodology, however, is that while models drawn from other disciplines (and developed to analysis other subject matter) might mimic the complexity of financial markets (at a given moment of time), they fail to explain why financial markets are complex. This is the question at the heart of the present inquiry.

23 Bounded rationality is a semi-strong form of rationality in which economic actors are assumed to be “intendedly rational, but only limitedly so”; Oliver Williamson, *The Economic Institutions of Capitalism* (The Free Press, New York, 1985) at 45, citing Herbert Simon, *Administrative Behavior*, 2ed. (Macmillan, New York, 1961) at xxiv. The concept of bounded rationality is grounded in the notion that, if the mind is a scarce resource, there will exist cognitive and temporal constraints on our ability to process information.


25 Schwarcz (n 20).


28 Robert Bartlett III, “Inefficiencies in the Information Thicket: A Case Study of Derivatives Disclosures During the Financial Crisis” (2010), 36:1 J. Corp. Law 1. This paper is also available at www.ssrn.com. Subsequent pinpoint citations refer to the ssrn version of this article.
would anticipate that our actor would need to incur a given quantum of information costs. We might also expect it to exhibit some form and measure of bounded rationality. For those so inclined, Figure 1.1 depicts these expectations graphically.

![Figure 1.1: The Complexity Line](image)

The \((x, y)\) intercept represents the position of a perfectly rational and fully informed actor. In effect, it reflects a hypothetical world in which the central assumptions of conventional financial theory hold true. In contrast, the point \((IC_A, BR_A)\) represents the level of investment necessary for our ‘real world’ actor to acquire, filter, manipulate and analyse all relevant information, combined with the extent of its bounded rationality at this point.\(^{29}\) The slope of our actor’s complexity line \((L_A)\) is thus determined by its particular mix of information costs and bounded rationality.\(^{30}\) The distance between point \((IC_A, BR_A)\) and the intercept then provides us with a useful measure of our actor’s tolerance for complexity.

\(^{29}\) This framework does not make any assumptions about the existence or extent of any causal or correlative relationships between the quantum of information costs incurred by an actor and the nature or extent of its bounded rationality.

\(^{30}\) Despite the depiction in Figure 1.1, it is not necessarily (or even likely) the case that the slope will remain constant at all points along an actor’s complexity line.
The first important insight we can draw from this framework is that an actor’s tolerance for complexity is inherently relative.\(^{31}\) Thus, we can envision a second actor attempting to understand the *same* constellation of facts or state of the world, but facing a *different* quantum of information costs and/or measure (or kind) of bounded rationality. Figure 1.2 depicts the complexity lines plotting the relative positions of our two actors.

We would expect the differences between each actor’s information costs (\(\text{IC}_A - \text{IC}_B\)) and bounded rationality (\(\text{BR}_A - \text{BR}_B\)) – that is, their relative tolerances for complexity – to be a function of several variables.\(^{32}\) Variables endogenous to each actor might conceivably include, *inter alia*, economies of scale in the production and/or analysis of information; technological and/or resources constraints, and, importantly, the actor’s initial position *within* the constellation of facts or state of the world in question. Exogenous variables, meanwhile, might include market microstructure, 

\(^{31}\) Unless, of course, we assume that *all* actors are perfectly rational and fully informed.

\(^{32}\) Despite the depiction in Figure 1.2, it is not necessarily the case that an actor which must incur a relatively high level of information costs will also be afflicted by higher levels of bounded rationality.
regulation and other institutional features which either subsidize or impede the free flow of information. Ultimately, this simple observation – essentially that complexity is a subjective phenomenon and that, as a result, actors may find themselves asymmetrically exposed to its dangers and opportunities – helps explain the existence and potential value of financial intermediaries and, as explored in greater detail below, is the source of many of the regulatory challenges stemming from the complexity of modern financial markets.

The second important insight we can draw from this framework is that our tolerance for complexity is not infinite. More specifically, we can envision a series of points – a frontier – beyond which the combination of high information costs and bounded rationality render full information and understanding impossible within a given timeframe. Figure 1.3 depicts this complexity frontier. Beyond the complexity frontier, actors will be forced to employ heuristics as a second-best means of understanding a particular set of facts or state of the world. As we shall see, the mere acknowledgement that there may exist financial instruments, markets and institutions – to say nothing of the interconnections between them – which are so

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33 And thus level (or tilt) the informational playing field.
34 So, for example, Actor A may wish to employ Actor B to act as its agent where the costs of doing so are expected to be less than the difference between IC_\text{A} and IC_\text{B}. Theoretically, Actor A might also wish to base its decision on the relative bounded rationality of the two parties although, for obvious reasons, we might expect BR_\text{A} and BR_\text{B} to be significantly more difficult for Actor A to ascertain.
35 Unless, once again, we assume that actors are perfectly rational and fully informed.
36 Figure 1.2 is not intended to express a view as to the shape of the complexity frontier or its distance from the intercept, either generally or in respect of any specific constellation of facts or state of the world.
37 This is not to suggest, of course, that actors might not also elect to employ heuristics in less complex circumstances. We are, ultimately, satisficers.
38 There exists a more fundamental question here, although one which resides beyond the scope of the present inquiry, as to how to understand or conceptualize the behavior of market participants attempting to comprehend constellations of fact or states of the world which reside beyond the complexity frontier. Intuitively, the autonomous rational actor model of behavior upon which conventional financial theory tends to rely would seem to possess limited explanatory power beyond the point at which high information costs and bounded rationality combine to force the use of heuristics.
complex as to make full information and understanding a practical impossibility manifests potentially profound regulatory implications.

![Figure 1.3: The Complexity Frontier](image)

Armed with this provisional framework for understanding complexity, we can embark on an examination of the sources (or drivers) of high information costs – and information failure – within financial markets and the points of intersection between these costs and our own bounded rationality. Predictably, complexity itself hampers our ability to construct anything resembling a complete account of these drivers or the various interactions between them. Indeed, the complexity line and complexity frontier are themselves potentially crude heuristics for understanding the complexity of modern financial markets. Nevertheless, taking a broad look across the financial system, it is possible to identify at least six – in many respects intertwined and overlapping – sources of complexity: technology, opacity, interconnectedness, fragmentation, regulation and reflexivity. I will examine each in turn.

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39 Indeed, the inherent irony of attempting to theorize complexity is not lost on the author.
There is little doubt that advances in information technology, telecommunications and financial theory over the course of the past half century have made a positive (gross) contribution toward the informational efficiency of financial markets.\textsuperscript{40} Faster and more powerful computers have enabled market participants to employ sophisticated and data-intensive quantitative (i.e. statistical) techniques to calculate the value of financial assets with greater precision and to better understand and more effectively manage various risks.\textsuperscript{41} A revolution in telecommunications, meanwhile, has made possible the almost instantaneous transmission of information to every corner of the globe.\textsuperscript{42} Finally, breakthroughs in financial theory – perhaps most notably the development of MPT\textsuperscript{43}, CAPM\textsuperscript{44}, the Black-Scholes option pricing

\textsuperscript{42} Indeed, strong linkages between revolutions in telecommunications and finance are by no means a recent phenomenon. From the telegraph, consolidated ticker tape and electronic fund transfer, to the fax, the internet and the blackberry, the evolution of finance is intricately intertwined with the evolution of how we communicate with one another; see Kenneth Garbade and William Silber, “Technology, Communication, and the Performance of Financial Markets” (1978), 33 J. of Finance 819.
\textsuperscript{43} MPT flows from the premise that there is a tradeoff between risk and return. On the basis of certain assumptions, MPT prescribes, for a given level of risk (variance), how to select a portfolio with the highest possible return (or, conversely, for a given level of return, how to select a portfolio with the least risk). MPT thus makes possible the construction of an efficient frontier from which an investor can choose their desired portfolio on the basis of their individual risk preferences. One of the key insights of MPT is that an asset should not be selected on the basis of its individual risk-return characteristics, but rather with a view to the effect of its addition in terms of the overall risk-return characteristics of the investor’s portfolio; see Harry Markowitz, “Portfolio Selection” (1952), 7:1 J. of Finance 77, and Harry Markowitz, Portfolio Selection: Efficient Diversification of Investments (John Wiley & Sons, New York, 1959).
\textsuperscript{44} CAPM is used to calculate the expected rate of return on an asset to be added to a diversified portfolio on the basis of (1) the risk free rate of return; (2) the sensitivity of the asset to non-diversifiable (systemic) risk, and (3) the expected market return; see William Sharpe, “Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk” (1964), 19:3 J. of Finance 425, and Jack Treynor, “Toward a Theory of Market Value of Risky Assets” (1962) in Robert Korajczyk, (ed.), Asset Pricing and Portfolio Performance: Models, Strategy and Performance Metrics (Risk Books, London, 1999).
model (Black-Scholes)\(^45\) and their respective progeny – have given birth to a universe of new financial instruments which have been credited with, amongst other contributions, enhancing price discovery, market liquidity and systemic resilience. In short, there exists a strong *prima facie* argument that these technological advancements have combined to significantly lower information costs within modern financial markets.

Upon closer scrutiny, however, these technological advancements are also the *source* of potentially significant information costs.\(^46\) The origins of this informational dark side can be traced back to conceptual breakthroughs such as MPT, CAPM and Black-Scholes, the resulting emergence of “financial science”\(^47\) within the field of economics, and its subsequent rise to prominence within the theory and practice of modern finance.\(^48\) The sophisticated mathematical models residing at the core of this discipline render its theoretical underpinnings largely inaccessible to all but a relatively small handful of academic economists, along with the so-called ‘quants’ employed by investment banks, hedge funds and other financial institutions.\(^49\) Even in practice, the utilization of these models contemplates both information-intensive quantitative processes and the formulation of subjective judgments on the basis of accumulated technical expertise and experience in order to generate important input.

\(^{45}\) Black-Scholes is used to calculate the exact theoretical price of a real option; see Fischer Black and Myron Scholes, "The Pricing of Options and Corporate Liabilities" (1973), 81 J. of Pol. Econ. 637. While the original Black-Scholes model technically applied to the valuation of European options (i.e. options exercisable only at maturity), its progeny have been adapted to value far more exotic instruments.

\(^{46}\) This is not to suggest that these costs outweigh the informational benefits of these technological advancements. My point here is simply that the existence of these costs contributes, utilizing my definition, to the complexity of modern financial markets.

\(^{47}\) See Hu (n 26). The discipline is now generally known as financial economics.


Developing a comprehensive understanding of financial theory and how to utilize these models in practice thus requires an enormous upfront investment in human capital. Accordingly, while advances in financial theory are largely responsible for laying the foundations of modern (and at times more informationally efficient) financial markets, they must simultaneously be viewed as a potentially significant driver of information costs and, thus, complexity.

Advances in financial theory and information technology have further contributed to the complexity of modern financial markets by making possible the development and widespread use of new and increasingly sophisticated financial instruments. Specifically, the existence of relatively robust markets for instruments such as OTC swaps, asset-backed securities (ABS) and collateralized debt obligations (CDOs) implicitly rely on two necessary, if not individually sufficient, conditions: (1) the development of rational models for determining their intrinsic

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50 The Black-Scholes option pricing model is a good example. Prior to the development of Black-Scholes, market participants seeking to determine the value of an option faced a problem: namely, they were required to accurately predict, *inter alia*, the probability distribution of the possible prices for the underlying asset at maturity; Hu (n 26) at 1468, citing Stephen Figlewski, “Theoretical Valuation Models” in Stephen Figlewski, William Silber and Marti Subrahmanyan, (eds.), *Financial Options: From Theory to Practice* (McGraw Hill, New York, 1992). Market participants were thus required to formulate subjective judgments about the state of future market conditions. A significant part of the (perceived) genius of Black-Scholes was that it enabled market participants to calculate the precise theoretical value of a European option without having to construct such a probability distribution. In reality, however, Black-Scholes simply substituted the need to predict future asset prices with the need to predict the future *volatility* of those prices.

51 Furthermore, as illustrated below, the nature and pace of financial innovation operates so as to demand significant *ongoing* investment in order to preserve the value of this human capital.

52 Hu (n 26) at 1470.

53 A swap is a series of mutual forward obligations whereby two counterparties agree to periodically exchange (or ‘swap’) cash flows over a specified period of time. The classic example of a swap is an interest rate swap pursuant to which one party – typically a borrower with fixed rate obligations – agrees to make payments at a fixed interest rate to a counterparty who in turn agrees to pay the borrower a variable (or ‘floating’) rate. The fixed rate borrower receiving a floating rate thus stands to benefit from any subsequent increase in interest rates, whereas its counterparty receiving the fixed rate under the swap will benefit from any decline. The periodic payments due under a swap are calculated with reference to what is often referred to as a ‘notional amount’. The resulting obligations are then typically netted out against one another such that only one counterparty is obligated to remit payment in any given period.

54 An ABS is a security the income stream from which is backed by a pool of (typically illiquid) underlying assets such as mortgages, automobile loans, credit card receivables or student loans.

55 A CDO is a type of ABS typically created to hold fixed income assets such as bonds, CDS or, frequently, other ABS.
value, and (2) the ability to meet the computational demands of these models within a timeframe which enables market participants to profit from their use. Financial theory has satisfied the first condition, advances in information technology the second.

The development of the “originate-and-distribute” mortgage lending model provides an illustrative example. Recent years have witnessed the increasing use of computer-generated credit scoring tools to process residential mortgage applications. The sub-prime mortgage market in particular was (originally) predicated on the use of sophisticated quantitative tools to assist lenders in better managing their exposure to high risk borrowers. The utilization of these tools served to enhance the transparency of mortgage underwriting standards, thereby facilitating the development of a deep secondary market for mortgages repackaged and distributed via the process of securitization. In very broad terms, securitization is a financing technique which transforms non-liquid assets such as mortgages and loan receivables into more readily alienable ABS (or MBS in the case of mortgages). This is achieved by pooling assets together and then slicing, dicing and reconstituting the associated cash flow rights into separate tranches. On the supply side, the design of

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56 In the absence of the first condition, one would expect a wide divergence between bid-ask spreads, ultimately leading either to very thinly traded markets or complete market failure. In the absence of the second condition, one would expect the existence of substantial transaction costs to alter the economic incentives of potential market participants, ultimately with much the same effect. A third pre-condition for many instruments – and in particular OTC derivatives – was the development of standardized legal documentation; see Awrey (n 13).

57 Or “originate-to-distribute”, depending on your views respecting why financial intermediaries innovate; see Part IV.

58 Frame and White (2009) (n 41) at 7.


60 Among other implications, securitization has the effect of reducing (and potentially eliminating) lenders’ exposure to borrower default. As a corollary, it also dilutes the incentives of lenders to screen for and monitor creditor and asset quality.
these MBS – and especially the pricing of the tranches – is itself heavily reliant on, once again, sophisticated financial models and modern information technology. On the demand side, purchasers employ the same technologies to measure and manage the risks associated with holding these securities in their portfolios. At every stage of the process, financial theory and information technology combine to facilitate the development of new financial instruments and markets. While the acronyms may change, this same fundamental story can be observed playing out across modern financial markets.

So how have these developments combined to render financial markets more complex? In the wake of the GFC, it has been widely acknowledged that even the most (ostensibly) sophisticated counterparties failed to grasp the technical nuances of many of the new instruments and markets made possible by the confluence of advances in financial theory and information technology. Gary Gorton, for example, has observed that many market participants did not fully appreciate how the unique structure of sub-prime mortgages made the MBS and CDOs into which they were repackaged particularly sensitive to volatility in underlying home prices. Along a similar vein, Joshua Coval, Jakub Jurek and Erik Stafford have demonstrated how ratings agencies and other market participants failed to perceive both (1) how the


62 David Li, for example, developed a formula known as the Gaussian copula which became widely employed prior to the GFC to evaluate the relationships between the default risks associated with various assets held within securitization structures; see Felix Salmon, “Recipe for Disaster: The Formula That Killed Wall Street”, Wired (February 23, 2009).

63 See for example, Containing Systemic Risk: The Road to Reform, Counterparty Risk Management Policy Group III (August 6, 2008) [the “CRMPG III Report”] at 53, observing: “there is almost universal agreement that, even with optimal disclosure in the underlying documentation, the characteristics of these instruments were not fully understood by many market participants.”

64 See Gorton (n 27) at 20-34. As Gorton explains, the unique structure of sub-prime mortgages (specifically their short duration, step-up rates and pre-payment penalties) effectively provided lenders with an implicit embedded option on home prices.
structure of CDOs (and CDO-squared\textsuperscript{65}) amplified initial errors with respect to the calculation of default risk on underlying assets, and (2) the systematic interconnections between these assets.\textsuperscript{66} Advances in financial theory and information technology have, accordingly, proven themselves to be less than perfect tools for understanding the complex dynamics of the very instruments and markets which they have combined to make possible.\textsuperscript{67} Put simply, technology has been unable to keep pace with itself. The (net) contribution of technology toward the complexity of modern financial markets must ultimately be measured by the extent of this imperfection.

\textit{Opacity.} A second significant driver of complexity is the opacity of many financial instruments, markets and institutions. There are in essence two species of opacity. The first stems from the simple non-availability of information within a particular segment of the marketplace.\textsuperscript{68} Markets exhibiting this form of opacity – in particular with respect to pricing information and the identity of counterparties – have historically included those for OTC swaps, ABS, CDOs and repurchase agreements (or ‘repos’)\textsuperscript{69}, along with so-called ‘dark pools’.\textsuperscript{70} Many financial institutions also exhibit this form of opacity: the most frequently cited example perhaps being the

\textsuperscript{65} In broad terms, a CDO-squared is simply a CDO which has invested in securities issued by other CDOs.
\textsuperscript{67} Indeed, many of these imperfections are attributable to the unrealistic assumptions (e.g. the existence of autonomous rational actors, perfect information, liquidity) underpinning many financial models – assumptions which, not coincidentally, largely mirror those of conventional financial theory.
\textsuperscript{68} That is, the non-availability of information to a particular subset of market participants (and, potentially, regulators).
\textsuperscript{69} A repurchase agreement is essentially a sale of securities under an agreement by which equivalent securities are to be repurchased at a future date. The duration of these agreements vary from overnight to months or even years, with compensation paid to the seller either in the form of interest or as a mark-up incorporated into the repurchase price. The purchaser may also be required by the seller to post collateral; see Louise Gullifer, (ed.), \textit{Goode on Legal Problems of Credit and Security} (Sweet & Maxwell, London, 2008) at 250.
\textsuperscript{70} Dark pools are effectively private OTC trading platforms used to match orders internally (i.e. between clients of the same firm) and between institutional trading desks; see “Big Traders Dive Into Dark Pools”, Bloomberg Businessweek (October 3, 2007), available at www.businessweek.com.
historical lack of transparency surrounding the investors, holdings and trading strategies of hedge funds.\textsuperscript{71} Even traditional commercial banks, however, manifest opacity of this variety insofar as the marketplace does not generally possess the borrower or asset specific information needed to accurately determine the value of these banks’ loan books and, accordingly, the enterprise value of the lenders themselves.\textsuperscript{72} Furthermore, while banks and other financial institutions can be expected to possess a reasonable amount of information regarding their own counterparties, one would at the same time expect a marked decline in the extent and quality of the information they possess in respect of their counterparties’ counterparties (and so on down the counterparty daisy chain). Investors in ABS, CDOs and especially CDO-squared face an analogous challenge insofar as it is often not possible to penetrate the layers of securitization in order to evaluate the quality of the underlying assets.\textsuperscript{73} This first species of opacity can thus be understood as giving rise to classic asymmetries of information.

The second species of opacity stems from the dense “information thicket”\textsuperscript{74} generated by the overwhelming volume of data swirling around within modern financial markets. This opacity is the product of information which, while publicly available in a strictly technical sense, is extremely (if not prohibitively) costly to


\textsuperscript{74} See Bartlett (n 28).
acquire, filter, manipulate and/or analyze. The balance sheets of LCFIs exemplify this form of opacity. The number of positions held by LCFIs, the technical sophistication of the financial instruments used to take these positions, and the intricate (and potentially contradictory) nature of the resulting market and counterparty exposures render it virtually impossible to construct – in a timely fashion – a comprehensive picture of the overall risk profile of these institutions.

Much of the explanation for the growth of this information thicket in recent years can once again be traced back to the development new financial instruments. As described above, the computational demands associated with many of these instruments are exceedingly high. As explained by Robert Bartlett:

> “Valuing even a single CDO investment – let alone a portfolio of such investments – requires a multi-faceted analysis of a considerable amount of both legal and financial data, ranging from an estimation of the default and prepayment risks of hundreds (potentially thousands) of underlying assets, analysis of the particular overcollateralization and subordination provisions attached to particular tranches of CDO securities, and an assessment of potential counterparty risk of the CDO’s various hedge counterparties.”

Furthermore, insofar as these instruments facilitate the reconstitution and redistribution of risk within the financial system (often via transactions within relatively opaque markets), they obscure the location, nature and extent of the ultimate exposures. Like the first species of opacity, the information thicket manifests the potential to generate acute asymmetries of information. Unlike the first,

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75 Schwarcz (n 20) at 222.
76 As arguably evidenced by the fact that, in retrospect, the pre-GFC CDS spreads on LCFIs reflected significant under-pricing of the default risks associated with these institutions (the primary counter-argument being that the low spreads reflected the so-called ‘too-big-too-fail’ subsidy). In fact, CDS spreads within the financial services sector suggested that risks were at historically low levels; see Financial Services Authority (FSA), The Turner Review: A Regulatory Response to the Global Banking Crisis (2009) [the “Turner Review”] at 46, available at www.fsa.gov.uk.
77 The information thicket surrounding LCFIs is exacerbated by the existence of the first species of opacity insofar as, for example, GAAP only mandates that positions be reported in the aggregate.
78 Schwarcz (n 20) at 10 and 13 and Gorton (n 27) at 48–49. See also Warren Buffett, Letter to Shareholders (May 2, 2009), available at www.berkshirehathaway.com and CRMPG III Report (n 63).
79 Bartlett (n 28) at 4.
80 Schwarcz (n 20) at 10 and 13.
however, this second species of opacity thus raises the additional and rather sobering prospect that information may become altogether “lost”. 81

Robert Bartlett’s event study involving Ambac Financial provides a compelling illustration of how the information thicket may result in the loss of information. 82 Ambac was and is a large, publicly-listed monoline insurance company which, prior to the GFC, was active in the business of insuring multi-sector CDOs. As a result of the confluence of (1) statutory accounting rules mandating disclosure by monoline insurers of their largest exposures, and (2) European regulatory requirements mandating disclosure of large volumes of legal and financial documentation in respect of insured CDOs, it is possible to construct a relatively complete picture of Ambac's exposures and, accordingly, its financial health. 83 In 2008, a number of CDOs insured by Ambac experienced multi-notch credit rating downgrades. Bartlett’s analysis of the abnormal returns surrounding the announcement of each of these downgrades revealed no significant reaction in Ambac’s stock price, short-selling data or the CDS spreads on its senior debt securities. 84 The subsequent disclosure of these downgrades within Ambac’s quarterly earnings announcement, however, was associated with significant one-day abnormal returns. 85 Bartlett attributes this inefficiency to the low salience of individual CDOs within Ambac’s portfolio and the logistical challenges of processing CDO disclosures. 86 In effect, however, the density of the information thicket overwhelmed the powerful incentives possessed by market participants to seek out and exploit such informational inefficiencies.

81 In the sense of being unknown to anyone; Gorton (n 27) at 45.
82 See Bartlett (n 28).
83 Ibid. at 5 and 8-12.
84 Ibid. at 23-35.
85 Ibid. at 28. Using a single factor market model, Bartlett reports a one-day abnormal return of -43%.
86 Ibid. at 1, 7 and 48-49.
Interconnectedness. The ongoing process of market liberalization – aided by advances in telecommunications\textsuperscript{87} – has sparked a pronounced trend toward greater globalization and integration of financial markets and institutions. This process has generated complex linkages within and between these markets and institutions and, importantly, the real economies they support. Financial institutions are connected to one another via their (increasingly complex) counterparty arrangements.\textsuperscript{88} The balance sheets of these institutions, meanwhile, are connected to markets – and via markets to the balance sheets of other financial institutions – through mark-to-market accounting methods.\textsuperscript{89} These balance sheet linkages in turn generate systemic feedback effects between asset values, leverage and liquidity.\textsuperscript{90} At an even higher macro level, household savings patterns in China\textsuperscript{91} are linked to global asset values via the resulting demand for (primarily U.S.) government securities, the consequent

\textsuperscript{87} Mishkin (n 61) at 10.


\textsuperscript{89} Mark-to-market or ‘fair value’ accounting refers to the practice, reflected in Generally Accepted Accounting Principles (GAAP) and International Financial Reporting Standards (IFRS), of accounting for the value of an asset on the basis of its current market price, the market price of similar assets or, if neither is available, another metric of ‘fair’ value.

\textsuperscript{90} The basic (spiral) pattern of these effects can be summarized as follows: (1) rising asset values inflate bank balance sheets, allowing them to extend greater leverage; (2) the resulting expansion of credit stimulates demand for assets and liquidity; and (3) increased demand for assets and liquidity has the effect of inflating prices while simultaneously reducing the liquidity premium on the assets. These effects operate in reverse in an environment of falling asset prices; Tobias Adrian and Hyun Song Shin, “Liquidity and Financial Cycles”, presentation to the 6\textsuperscript{th} BIS Annual Conference (June 2007) and IMF, “Assessing the Systemic Implications of Financial Linkages” in Global Financial Stability Report, Volume 2 (April 2009), available at www.imf.org.

\textsuperscript{91} Or, more precisely, China’s resulting current account surplus (combined with its managed exchange rate regime).
reduction in yields on these securities, and the incorporation of these lower yields as a proxy for the real risk-free rate into the discount rates used in asset pricing models.  

These are but a small sampling of the myriad of intricate, constantly evolving and often undetected interconnections which shape modern financial markets. While we have arguably come some distance in identifying and understanding the dynamics of some of these interconnections, the acquisition, analysis and ongoing monitoring of markets and institutions which this entails comes at a high (informational) cost. Put differently, these interconnections make it more costly to identify and monitor potential sources of risk within the financial system. What is more, the sheer number of these linkages, their intricacy and their rapid evolution suggest that our ability to identify and understand them will ultimately be constrained by bounded rationality. It is perhaps not surprising, therefore, that many of these interconnections are only revealed (or their importance fully understood) at the point at which they become channels for the transmission of financial shocks. Ultimately, interconnectedness represents a significant source of opacity – and thus complexity – within modern financial markets.

**Fragmentation.** One of the most striking features of many of the transactions which exemplify modern financial markets is the extent to which they result in the fragmentation of economic interests. The archetypal example of this is securitization. As Kate Judge explains, by repackaging underlying assets such as mortgages into

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92 See Turner Review (n 76) at 11-13. This has a double-barreled effect in terms of stimulating demand: (1) lower yields on U.S. government securities reduce real interest rates (thereby making it cheaper to employ leverage to purchase assets), and (2) the incorporation of lower yields into discount rates reduces risk premiums (thereby making the assets themselves cheaper).

93 For an overview of some of the tools used to evaluate systemic linkages within the financial system (including the network approach, co-risk models, distress dependence matrices and default intensity models), see IMF (n 90). For a critique of these tools, see Steven Schwarcz, “Systemic Risk” (2008), 97 Geo. L. J. 193 at 206.

94 Avgouleas (n 20) at 22.
ABS, repackaging ABS into CDOs, and CDOs into CDO-squared, securitization transforms what was initially, in many instances, a bilateral relationship into a complex web involving potentially hundreds of dispersed counterparties. Judge has coined the term “fragmentation nodes” to describe this category of transactions. Each successive fragmentation node attenuates the informational and economic relationship between counterparties and the underlying assets in which they have, ultimately, invested. This attenuation has the double-barreled effect of (1) increasing information and coordination costs for counterparties and (2) diluting their incentives to coordinate their activities and/or invest in the acquisition of information. Like interconnectedness, fragmentation thus represents a potentially significant driver of opacity within modern financial markets.

Regulation. The complexity of modern financial markets is further compounded by the complexity of the regulatory regimes which govern them. This regulatory complexity manifests both substantive and structural elements. Substantive regulatory complexity stems from what U.S. Senator Charles Schumer and New York Major Michael Bloomberg, speaking in reference to the U.S. regulatory landscape, have characterized as the “thicket of complicated rules” which have built up over time within many regulatory regimes. The recently enacted Dodd-Frank Wall Street Reform and Consumer Protection Act, to take one example, runs to 848 pages, is estimated to require up to 243 new federal

96 Ibid. at 3.
97 Ibid.
98 Ibid. at 4 and 61-64.
99 Ibid. at 4.
regulations\textsuperscript{102} and is believed by many – no doubt speaking with a touch of hyperbole – to manifest a “trillion unintended consequences”.\textsuperscript{103} This comes on top of the substantial pre-existing edifice of federal securities laws, regulations and jurisprudence governing U.S. financial markets. Synthesizing this regulation – to say nothing of staying abreast of new regulatory developments – represents no small challenge for either market participants or financial regulators.

Structural regulatory complexity, meanwhile, stems from the disconnect between the increasingly globalized and integrated structure of many financial markets and institutions, on the one hand, and the fragmentation exhibited within and between many regulatory regimes, on the other.\textsuperscript{104} In the U.S., for example, federal responsibility for financial regulation is currently divided between a cacophony of regulators including the Federal Reserve Board, Financial Stability Oversight Council (FSOC), Securities and Exchange Commission (SEC), Commodity Futures Trading Commission (CFTC), Federal Deposit Insurance Corporation (FDIC), Financial Industry Regulatory Authority (FINRA), Office of the Comptroller of the Currency (OCC), Federal Housing Financing Agency (FHFA) and Consumer Financial Protection Bureau (CFPB).\textsuperscript{105} A similar degree of regulatory fragmentation can be observed within the E.U., where the new European Systemic Risk Board, European Banking Authority, European Securities and Market Authority and European Institutional and Occupational Pensions Authority must coordinate their activities both with each other and with national supervisors in each of the bloc’s 27 member

\textsuperscript{102} This estimate was made by New York law firm Davis Polk & Wardwell; \textit{see} “The Uncertainty Principle”, \textit{The Wall Street Journal} (July 15, 2010).
\textsuperscript{103} \textit{See} “A Trillion Unintended Consequences”, \textit{The Wall Street Journal} (July 7, 2010).
\textsuperscript{104} Merton (n 40) at 31.
\textsuperscript{105} Compounding this fragmentation, many segments of the U.S. financial services industry are also highly regulated at the state level.
states. This regulatory fragmentation results in higher information costs for both market participants (seeking to understand and comply with regulation) and regulators (seeking to coordinate their activities). What is more, the inevitable gaps generated by this fragmentation open the door to regulatory arbitrage. As we shall see, these gaps can also provide the stimulus for financial innovation and, as a result, contribute still further to the complexity of modern financial markets.

Reflexivity. Complexity does not exist independently of the observer. It is observers, after all, who incur information costs and who are inevitably constrained by bounded rationality. Yet we are not simply passive observers within financial markets: we are participants. Economists develop theories of market behavior which in turn influence the very behavior of market participants which economists seek to understand. Asset values effect our perception of risk, which effects the availability of credit, which effects asset values. Regulators introduce rules designed to constrain the behavior of market participants, incentivizing market participants to find ways of circumventing these constraints, thereby necessitating further regulatory intervention. The interactions between the cognitive perceptions of market participants and regulators, the actions predicated on these perceptions and

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108 As examined in greater detail in Part IV, the term ‘regulatory arbitrage’ refers to transactions or strategies designed to exploit gaps or differences within or between regulatory regimes, ultimately with the intention of either reducing costs or capturing profits; see Frank Partnoy, “Financial Derivatives and the Costs of Regulatory Arbitrage” (1996-1997), 22 J. Corp. L. 211 at 211.

109 A fact which is reflected in the framework for understanding complexity set out above.


111 To clarify, asset values effect our perception of risk (and thus the availability of credit) primarily by impacting the value of the collateral pledged and received in connection with the extension of credit.

the impact of these actions within markets generate complex and often self-reinforcing feedback loops. George Soros has characterized the interference created by these feedback loops as “reflexivity”.\textsuperscript{113} As Soros explains:

“\textit{In situations that have thinking participants, there is a two-way interaction between the participants’ thinking and the situation in which they participate. On the one hand, participants seek to understand reality; on the other, they seek to bring about a desired outcome. The two functions work in opposite directions: in the cognitive function reality is the given; in the participating function, the participants’ understanding is the constant. The two can interfere with each other by rendering what is supposed to be given, contingent… Reflexivity renders the participants’ understanding imperfect…”}\textsuperscript{114}

Further explaining:

“\textit{The imperfection I am concerned with arises because we are participants. When we act as outside observers we can make statements that do or do not correspond to the facts without altering the facts; \textit{when we act as participants, our actions alter the situation we seek to understand.”}\textsuperscript{115}

The incursion of information costs with a view to better understanding the complex dynamics of financial markets (whether in search of knowledge or profit or as a means of achieving regulatory ends) will thus invariably alter these dynamics, thereby demanding the incursion of further information costs.\textsuperscript{116} It is a game without end. Furthermore, our location \textit{within} the object of study – indeed, ultimately, \textit{as the object of study} – would, intuitively, seem likely to magnify the extent of our bounded rationality. Accordingly, while many economists have tended to shy away from the utilization of concepts such as reflexivity, any systematic attempt to understand the drivers of complexity within modern financial markets must somehow account for this uniquely human element.

\textsuperscript{113} George Soros, \textit{The Alchemy of Finance} (John Wiley & Sons, New Jersey, 2003) at 2.
\textsuperscript{114} Ibid. at 2.
\textsuperscript{115} Ibid. [emphasis added].
\textsuperscript{116} Schwarcz (n 20) at 238.
Technology, opacity, interconnectedness, fragmentation, regulation and reflexivity together generate significant information costs and set us on a collision course with our own bounded rationality. In the process, they drive financial markets toward – and potentially beyond – the complexity frontier. Indeed, this process is in many ways the defining feature of what I have characterized as modern financial markets. Yet this is only one half of the story. To more fully appreciate the regulatory challenges posed within modern financial markets we must also examine the unique nature of financial innovation and, ultimately, the important relationship between complexity and innovation. In many respects, this examination boils down to a single question: *who benefits from the complexity of modern financial markets?*

**III. Toward a Supply-Side Theory of Financial Innovation**

The word ‘innovation’ brings to mind products and processes – the printing press, indoor plumbing, penicillin, the designated hitter, etc. – which have unequivocally made the world a better place. Economists, however, employ the term in a somewhat more expansive (and, on the surface at least, less normative) fashion to describe unanticipated shocks to the economy.117 Yet beneath this veneer of academic objectivity there survives a marked tendency within the literature to view these unanticipated shocks as being more in the nature of “unforecastable improvements”118. This view seems likely to have been influenced by Joseph

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117 Along with the responses of economic actors to these shocks; Tufano (n 61) at 310.
118 Merton Miller, “Financial Innovation: The Last 20 Years and the Next” (1986), 21:4 J. of Fin. & Quant. Anal. 459 at 460 [emphasis added]. See also Frame and White (2004) (n 41) at 5 (“Profit-seeking enterprises and individuals are constantly seeking new and improved products, processes, and organizational structures that will reduce their costs of production, better satisfy customer demands, and yield greater profits… *When successful, the result is an innovation.*” [emphasis added]); Frame and White (2009) (n 41) at 4 (“we define financial innovation as something new that reduces costs, reduces risks, or provides an improved product/service/instrument that better satisfies financial system participants’ demands.”), and Merton (n 40) at 6 (“Looking at financial innovations… one sees them as the force driving the global financial system towards its goal of greater economic efficiency.”).
Schumpeter’s conception of innovation as the catalyst of the ‘Creative Destruction’ which fuels growth within capitalist economies.119 As Schumpeter explains:

“The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers, goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates.”120

Continuing:

“The opening up of new markets, foreign and domestic, and the organizational development from the craft shop and factory to such concerns as U.S. Steel illustrate the same process of industrial mutation – if I may use the biological term – that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism.”121

While Schumpeter himself may not necessarily have espoused this view, it is not difficult to see how one might interpret his analysis as equating innovation – in the form of new goods, methods of production or forms of industrial organization – with progress. As we shall soon see, however, the welfare implications of financial innovation are not nearly so straightforward.122 This indeterminacy points to the desirability of a more cautious, less value-laden understanding of financial innovation as an ongoing process of experimentation whereby new institutions, instruments, techniques and markets are (or are perceived to be) created.123 Ultimately, framing our understanding of financial innovation as simply a process of (perceived) change – and not necessarily one of improvement – has profound implications in terms of the way we look at modern financial markets.

119 See Joseph Schumpeter, Capitalism, Socialism and Democracy (Harper & Row, New York, 1975) [orig. pub. 1942].
120 Ibid. at 83.
121 Ibid. at 84.
123 See Tufano (n 61) at 309 and Gubler (n 88).
We know relatively little about what stimulates financial innovation. The dominant economic view, grounded in the M&M capital structure irrelevancy principle\(^{124}\), envisions financial innovation as a rational demand-side response to market imperfections.\(^{125}\) These imperfections – many of which are themselves the products of exogenous changes to the economic environment\(^{126}\) – include, \textit{inter alia}, regulation and taxes\(^{127}\); incomplete markets\(^{128}\); transaction costs\(^{129}\); asymmetries of information and the ensuing agency costs\(^{130}\), and other inefficiencies which constrain the ability of market participants to maximize their utility functions. Following this view, these imperfections generate demand for financial innovations which promise, \textit{inter alia}, greater choice, lower costs, enhanced liquidity and/or more effective risk management.\(^{131}\) Thus, for example, the extreme interest rate volatility of the 1970s and early 1980s lead to innovations such as adjustable rate mortgages, variable-rate certificates of deposit, financial futures and interest rate swaps\(^{132}\); U.S. regulatory

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\(^{124}\) The M&M capital structure irrelevancy principle advances, on the basis of certain assumptions, that the value of a firm is independent of its capital structure (i.e. its mix of equity, debt and other capital); see Franco Modigliani and Merton Miller, “The Cost of Capital, Corporation Finance and the Theory of Investment” (1958), 48:3 Am. Econ. Rev. 261. The assumptions underlying the M&M principle include, \textit{inter alia}, the absence of (1) information costs (and thus asymmetries of information and agency cost problems); (2) bankruptcy costs and (3) taxes. In a world where these assumptions held true, the M&M principle would suggest that there should be no demand for financial innovation (at least in terms of security design).


\(^{126}\) Mishkin (n 61) at 1.

\(^{127}\) Frame and White (2004) (n 41) at 9; Mishkin (n 61) at 11; Kane (n 112); Miller (n 118), and Van Horne (n 122) at 623-624.


\(^{132}\) Hu (n 26) at 1466; Mishkin (n 61) at 2-5, and Van Horne (n 122) at 622-623.
constraints on the remuneration arrangements, eligible investors and trading strategies of registered investment companies and advisers spurred the development of hedge funds, and the thirst for yield on fixed income investments in the low interest rate environment of the 2000s stimulated demand for, *inter alia*, new forms of CDOs and synthetic CDOs domiciled in tax efficient jurisdictions such as Ireland and the Cayman Islands.\(^\text{133}\)

While this demand-side story is important, it paints a fundamentally incomplete picture. First, it is deeply rooted in the Schumpeterian paradigm in which the intersection of supply and demand are too frequently viewed as being dispositive of an innovation’s private and social utility. Second, and more importantly, it fails to adequately account for the incentives of the institutions at the center of the market for financial innovation: it ignores the role of financial intermediaries.

Henry Ford was apparently fond of saying that if he had asked people what they wanted, they would have said faster horses.\(^\text{134}\) Put another way: supply-side incentives can be extremely influential in determining the course and speed of innovation. Curiously, however, the supply-side dynamics influencing financial innovation have been largely overlooked by both academics and policymakers. *So who are the primary suppliers of financial innovation and what are their incentives to innovate?* The suppliers are, by and large, financial intermediaries such as commercial and investment banks, securities dealers, investment funds and insurance companies. At first glance, the incentives of these intermediaries might appear

\(^{133}\) See Adair Turner, “The Financial Crisis and the Future of Financial Regulation”, speech at *The Economist*’s Inaugural City Lecture (January 21, 2009), available at http://www.fsa.gov.uk, explaining that a reduction in medium and long-term real risk free rates “had driven among investors a ferocious search for yield – a desire among any investor who wishes to invest in bond-like instruments to gain as much as possible spread above the risk-free rate, to offset at least partially the declining risk-free rate”.

\(^{134}\) I was reminded of this quotation by an article which appeared, somewhat ironically, in the Schumpeter column of *The Economist*; see “The Wiki Way”, *The Economist* (September 23, 2010).
relatively straightforward: profit. In a competitive environment, however, one would expect these profits to rapidly erode as imitators enter the marketplace, attract market share and drive down margins. One would further expect the rate of this profit erosion – and thus the inclination of financial institutions to innovate – to be a function of the diffusion speed of the innovation.

We would thus expect the incentives of potential innovators to be relatively muted in the absence of some means of preventing imitators from freely appropriating the innovation. This is the traditional economic justification – articulated by Schumpeter and others – for the extension of intellectual property rights to innovators. By granting innovators a temporary monopoly on the fruits of their invention, these rights provide the economic incentives (i.e. rents) necessary to spur innovation. The problem, of course, is that intellectual property rights do not extend to the vast majority of financial innovations. JPMorgan cannot patent a CDO

135 Mishkin (n 61) at 1.
136 Van Horne (n 122) at 622. What little empirical evidence exists on this front (at least with respect to financial innovation) is inconclusive and not altogether relevant to the present inquiry. In a widely cited empirical study of financial innovations from 1976 to 1984, Peter Tufano found that financial intermediaries did not charge higher prices in the brief ‘monopoly’ period before imitations appeared and, in the long-run, charged lower prices than rivals offering imitative products. Tufano did find, however, that innovating banks captured a larger share of underwriting business for the relevant products than did imitators; Peter Tufano, “Financial Innovation and First Mover Advantages” (1989), 25 J. of Fin. Econ. 213. In a more recent study, Kenneth Carrow found an inverse relationship between the number of imitators and the size of underwriting spreads; Kenneth Carrow, “Evidence of Early Mover Advantages in Underwriting Spreads” (1999), 15:1 J. of Fin. Services Research 37. Neither study, however, is particularly illuminating or immediately relevant insofar as (1) their research was focused exclusively on innovations within markets for publicly-traded securities, and (2) neither researcher looked beyond underwriting spreads to examine other potential benefits – the informational advantages associated with market-making or reputational effects, for example – derived from being an innovator.

138 Outside the limited scope of business method patents; see the Federal Circuit Court of Appeals decision in State Street Bank v. Signature Financial, 47 U.S.P.Q. 2nd 1596 (Fed. Cir. 1998) [“State Street”]. However, one would expect such patents to be of limited practical application in the context of financial innovation insofar as the application process contemplates public disclosure as a precondition to protection. More specifically, it is likely that financial intermediaries will in many instances find such disclosure unpalatable for strategic reasons. This intuition finds empirical support
Goldman Sachs cannot copyright the acronym ‘CDS’. It is perhaps unsurprising, therefore, that the diffusion rates of many financial innovations are exceptionally high. As a corollary, we would expect to observe relatively little innovation. Yet this is precisely the opposite of what we often see occurring within modern financial markets. This observation suggests that we need to develop a better understanding of why financial intermediaries innovate.

The key insight is derived from understanding that financial intermediaries possess at least three very different incentives to innovate. First, as previously acknowledged, they innovate in response to the emergence of genuine demand within the marketplace. Second, they often possess their own demand-side incentives stemming from, for example, the desire to mitigate the impact of various regulatory requirements. A prime example of this, examined in greater detail in Part IV, has been the use (and adaptation) of securitization techniques by banks to circumvent capital adequacy requirements. Third, financial intermediaries possess supply-side incentives to design and implement strategies with the intention of recreating the monopolistic conditions – usually afforded by the protection of intellectual property rights – which allow for the ongoing extraction of rents. There are at least two such strategies and, together, they help reveal the multifaceted relationship between complexity and financial innovation.

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140 See Hu (n 26) at 1484. Although, as we shall see, this diffusion is in many cases limited to a relatively small group of financial intermediaries.
The first strategy involves artificially accelerating the pace of innovation. Financial intermediaries engage in this strategy for the purpose of achieving product differentiation – not only vis-à-vis the innovations of their competitors but, crucially, between previous generations of their own innovations. In this respect, this strategy is broadly analogous to the short-term ‘planned obsolescence’ through innovation observed within, inter alia, the fashion, consumer electronics, software and academic textbook industries. This strategy does not necessarily rely on the existence of any natural demand in the marketplace, nor on the innovation itself being ‘new’ in any material respect. Rather, it can theoretically be premised on little more than tapping the instinctive human desire for the ‘next new thing’. The practical effect of this strategy is to reset the diffusion clock – in essence creating more (albeit shorter) monopoly-like periods – thereby enabling intermediaries to extract greater rents from their innovations. Importantly, this strategy also manifests the potential to generate what U.K. FSA Chairman Adair Turner has characterized as “socially useless” over-innovation.

The second strategy employed by financial intermediaries in response to the appropriability problem is to embrace complexity as an integral component of their business models. More specifically, many financial intermediaries have harnessed

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142 Tufano (n 61) at 309.
144 Van Horne (n 122) at 626. Or, in the case of academic textbooks, having a captive audience.
145 Who, after all, would want to imitate previous innovations now viewed as being outmoded?
146 Primarily in the form of higher underwriting spreads.
technology (and especially financial theory) to develop – and move an increasingly large proportion of their business activities into – new and relatively opaque institutions, instruments and markets. They have also lobbied fiercely against regulatory reforms which would seek to achieve, amongst other objectives, a leveling of the informational playing field. Interestingly, this confluence of technology and opacity has not necessarily been utilized, as one might predict, to thwart imitators and thereby slow the diffusion rate of innovation. Indeed, small groups of financial intermediaries have often collaborated in the development of new financial instruments, markets and institutions. The resulting complexity has instead often been used by intermediaries as a group to prevent the commoditization of many financial innovations, ultimately forestalling the redistribution of rents from innovators to consumers which one might otherwise expect to take place over time. Within more arcane and opaque markets, these rents flow not only from higher underwriting spreads but also the informational advantages derived from the role financial intermediaries play as market-makers. It is in their quest to maximize and exploit their comparative informational advantage that financial intermediaries have thus driven us toward – and beyond – the complexity frontier.

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148 This of course makes perfect sense given the expectation of higher profit margins within such markets.
150 The most notable exception to this likely being a financial institution’s investment strategies, where opacity is employed specifically with a view to preventing imitation.
151 See Awrey (n 13) for an exploration of how financial intermediaries and other private actors – and ISDA in particular – have collaborated in the development of OTC derivatives markets.
152 And, simultaneously, preventing a potentially costly innovation ‘arms race’ between competing financial intermediaries.
153 Including, inter alia, (1) pricing and counterparty information, and (2) lower search costs for underwriting opportunities. See Part IV for a discussion of the market-making role played by financial intermediaries within OTC derivatives markets.
All of this is not to suggest that this nascent supply-side theory of financial innovation fully encapsulates the incentives – or explains the behavior – of all financial intermediaries, in all markets, at all times. Demand-side factors are clearly important. Nor am I suggesting that financial intermediaries have engaged in some sort a grand conspiracy to make financial markets more complex. What I am suggesting, however, is that re-conceptualizing financial innovation as a process of change influenced by the incentives of innovators – who have the most to gain and possess a comparative informational advantage – can enhance our understanding of the complex and rapidly evolving dynamics within modern financial markets. What is more, re-conceptualizing financial innovation in this light serves to illuminate the regulatory challenges stemming from the interaction of complexity and innovation. We will turn our attention to these challenges in a moment. First, however, it is important to unpack the multifaceted relationship between complexity and financial innovation.

IV. The Relationship between Complexity and Financial Innovation: Three Case Studies

As may already be apparent, complexity and financial innovation are mutually reinforcing dynamics. This symbiosis can be observed across at least four dimensions. First, as described above, complexity can be utilized by financial intermediaries for the purpose of preventing the commoditization of an innovation. Second, financial intermediaries which enjoy a higher tolerance for complexity relative to other market participants (and regulators) can exploit this advantage – i.e. extract rents – by offering ‘innovative’ products and services which their clients may
not fully understand. Third, newer and more innovative financial instruments invariably demand the incursion of high (initial) information costs on the part of both market participants and regulators. What is more, these instruments often (1) trade within less developed and more opaque markets and (2) generate unanticipated and undetected interconnections within and between financial markets and institutions, thereby exacerbating complexity. Finally, insofar as financial innovation is employed as a reflexive response to changes in the prevailing regulatory environment, both this innovation and the regulation which spawned it can be viewed as contributing to the complexity of modern financial markets.

There exists no shortage of potential case studies illustrating various dimensions of the relationship between complexity and financial innovation. Three particularly compelling examples, however, are securitization, synthetic ETFs and collateral swaps. It should come as no surprise that all three of these case studies are drawn from the world of OTC derivatives. OTC derivatives markets have long been recognized at hotbeds of financial innovation. Perhaps more importantly, however, the dealer-intermediated microstructure which characterizes these markets has bestowed upon OTC derivatives dealers a distinct informational advantage –

154 This, of course, begs the question: why would clients knowingly contract for products and services they do not fully understand? Put differently: would we not expect adverse selection to 'resolve' this problem through (1) average cost pricing, (2) market failure or (3) the utilization of (costly) contractual and/or extra-contractual mechanisms by financial intermediaries to generate a separating equilibrium? For a theoretical discussion of this so-called 'lemons’ problem, see George Akerlof, “The Market for Lemons” (1970), 84:3 Q. J. Econ. 488. As we shall see, the answer to this question (at least in part) is that complexity serves to obscure these risks from the view of many market participants.

155 Nor that they are drawn from the vast, opaque and intricately interconnected plumbing of the shadow banking system.

especially in terms of pricing and deal flow – vis-à-vis their clients, other market participants and regulators.

The defining feature of this microstructure is the fact that dealers perform an explicit market-making role: structuring derivatives instruments and marketing them to clients on the basis that they are willing to take either side of the transaction.¹⁵⁷ These dealers then typically look to eliminate the resulting exposures by seeking out and entering into offsetting transactions with other clients or, in many cases, other OTC derivatives dealers.¹⁵⁸ Dealers are thus central – indeed, essential – to the operation of OTC derivatives markets: representing not only the primary source of innovation, but also of market access, information and liquidity.¹⁵⁹ This reality is reflected in the concentration of trading activity within these markets. As of June 2010, for example, the fourteen largest OTC derivatives dealers (the so-called ‘G14’) were responsible for approximately 82% of the global swaps market.¹⁶⁰ This microstructure has historically deprived the marketplace of objective and transparent market-access and pricing mechanisms. To put it bluntly, OTC derivatives markets bear almost no resemblance to the perfect markets of conventional financial theory.

The information costs (and information failure) generated by this microstructure are compounded by, inter alia, the opacity of the LCFIs, hedge funds

¹⁵⁷ This description is most apt in respect of swaps markets. The circumstance is somewhat more complicated in respect of many securitization markets, where dealers can also perform a role more closely resembling that of an underwriter in a traditional securities offering. Ultimately, the dealer’s role will generally hinge on how bespoke the instrument is to the needs of a particular client or clients.
¹⁵⁹ Duffie et. al. (n 156) at 10.
¹⁶⁰ ISDA, “Concentration of OTC Derivatives Among Major Dealers”, ISDA Research Note, Issue 4 (2010), available at www.isda.org. Broken down by instrument, the G14 held 82% of the total outstanding notional amount of interest rate derivatives, 90% of CDS, and 86% of equity derivatives; ibid.
and many other counterparties which utilize OTC derivatives\textsuperscript{161}; the fragmentation which many OTC derivatives engender\textsuperscript{162} and, in many cases, the sophisticated technical aspects of the instruments themselves.\textsuperscript{163} Furthermore, as amply illustrated by the GFC, the widespread use of OTC derivatives strengthens and expands the intricate web of interconnections within and between financial markets and institutions. Collectively, these attributes epitomize the complexity of modern financial markets. They also render securitization, synthetic ETFs and collateral swaps uniquely illuminating case studies in terms of both the relationship between complexity and financial innovation and, ultimately, the regulatory challenges posed by the interaction of these powerful market dynamics.

\textit{Securitization.} The case study which has to this point garnered the most scholarly attention is undoubtedly securitization.\textsuperscript{164} As described in Part II, securitization is a process whereby the cash flows associated with non-liquid assets are pooled together, restructured and sold as securities. Most structured finance vehicles are, in effect, a form of credit derivative.\textsuperscript{165} The first ABS was issued by the U.S. Government National Mortgage Association (Ginnie Mae) in 1970.\textsuperscript{166} This nascent ABS market initially revolved around the issuance of residential MBS by

\textsuperscript{161} See discussion at 19-20. Indeed, the fact that the identity of counterparties to OTC derivatives matters cuts against the grain of conventional financial theory.

\textsuperscript{162} See discussion at 24-25.

\textsuperscript{163} It is certainly the case that many OTC derivatives are (at least from an economic perspective) relatively straightforward to understand and use. It would take a small upfront investment to familiarize oneself with, for example, the basic structure and potential uses of a single currency interest rate of foreign exchange swap. At the same time however, the derivatives universe is populated by a diverse array of far from complex instruments. For a comprehensive description of the technical aspects of many of these instruments, see Satyajit Das, \textit{The Swaps and Financial Derivatives Library: Products, Pricing, Applications and Risk Management}, 3\textsuperscript{rd} ed. (John Wiley & Sons, New York, 2005) and Richard Flavell, \textit{Swaps and Other Derivatives}, 2\textsuperscript{nd} ed. (John Wiley & Sons, New York, 2009).

\textsuperscript{164} See for example Schwarz (n 20); Gorton (n 27); Bartlett (n 28); Jackson (n 73); Gubler (n 88) and Judge (n 95).

\textsuperscript{165} Essentially because the obligations of the issuers of these securities to make periodic payments to the holders are contingent upon the (non-)performance of the underlying assets (as measured by their ability to generate the expected cash flows).

\textsuperscript{166} Shelagh Heffernan, \textit{Modern Banking} (John Wiley & Sons, Chichester, 2005) at 46.
U.S. government sponsored enterprises (GSEs) such as Ginnie Mae, the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac).\(^{167}\) Between 1970 and 2010, annual issuances within this so-called ‘agency’ MBS market grew from approximately $USD452 million to over $USD1.9 trillion.\(^{168}\) As of June 30, 2011, the outstanding amount of U.S. mortgage-related securities stood at approximately $USD7 trillion.\(^{169}\)

Observing this success, private sector financial institutions – primarily large commercial and investment banks – began structuring and distributing ‘private label’ ABS in the mid-1980s.\(^{170}\) Notably, the timing of this move roughly corresponded with the completion of the 1988 Basel Capital Accord (Basel I). These financial institutions employed the structures developed by the GSEs in connection with residential mortgages and quickly adapted them to securitize cash flows derived from a far broader range of underlying assets including, *inter alia*: commercial mortgages; home equity and student loans; automobile, aircraft and equipment leases; credit card receivables; corporate debt; swaps, and even other securitizations.\(^{171}\) Between 1985 and 2011, the outstanding amount of non-mortgage-related ABS issued in the U.S. and Europe grew over 1800% – from an estimated $USD1.2 billion to over $USD2.2 trillion.\(^{172}\)

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\(^{167}\) Prohibited by law from originating mortgages, the GSEs would acquire mortgages from private lenders, securitize them and then guarantee the income streams generated by the resulting MBS; ibid. at 47.


\(^{170}\) SIFMA (n 168) and Heffernan (n 166) at 47.


The emergence and precipitous growth of both agency and private label securitization markets – to say nothing of the markets for CDOs and CDO-squared – is attributable to a complex bundle of supply-side, demand-side and other incentives. The agency ABS market, for example, grew at least in part out of a desire on the part of the U.S. federal government to expand home ownership, essentially as a means of ameliorating rising economic inequality. Investors, meanwhile, flocked to ABS, CDOs and other securitizations in search of both (1) higher yields and (2) diversified exposure to, *inter alia*, the U.S. residential and commercial property sectors. Ultimately, however, much of this growth is attributable to the supply-side incentives of the commercial and investment banks which structured and sold these securities. As a preliminary matter, financial institutions sponsoring securitized offerings earned sizable fees in connection with these transactions. What is more, securitization enabled originators to shift the market, liquidity, interest rate and other risks associated with the underlying assets off their balance sheets. Most importantly, however, securitization enabled banks to secure relief from capital adequacy requirements, thus freeing up capital for reinvestment. Viewed in this light, the supply-side incentives come from and centre: the more assets a bank could repackage and sell via securitization, the more capital it could deploy toward new investments,

174 Turner (n 133).
175 FCIC (n 6) at 43.
176 While a detailed examination of capital adequacy requirements is well beyond the scope of this paper, these requirements – and specifically those articulated under Basel I, II and III – prescribe, *inter alia*, that banks and certain other classes of financial institution maintain a specified ratio of capital to risk-weighted assets. Insofar as many securitization vehicles attract a lower risk weighting than the underlying assets under these requirements, financial institutions will *ceteris paribus* be required to hold a lower amount of capital and, accordingly, will be incentivized to repackage and sell these assets via securitization.
and the more assets it would have to fuel the securitization machine. Introduce CDOs and CDO-squared into this mix – and thus the ability to make new assets out of thin air – and it is little wonder that securitization markets witnessed such exponential growth in the decades leading up to the GFC.

The complexity generated by the constant stream of new innovation within ABS, CDO and other securitization markets is well documented. As both Gorton and Coval et. al. observe, many of the most (ostensibly) sophisticated institutional investors failed to fully grasp the complex technical aspects of both mortgage-backed ABS and the more complex CDOs into which they were repackaged.\(^{178}\) Along the same vein, the structure of many of these instruments undermined the ability of both underwriters and investors to effectively screen for and monitor asset and creditor quality.\(^{179}\) These informational problems became more acute with each successive fragmentation node.\(^{180}\) Ultimately, these factors combined to obscure from view the enormous risks building within this market.

**Synthetic ETFs.** A second (and considerably less notorious) case study illustrating the relationship between complexity and financial innovation is the burgeoning market for synthetic ETFs. ETFs are exchange-traded investment funds designed to replicate the value of a portfolio of assets (e.g. the FTSE, S&P 500 or MSCI Emerging Markets Index).\(^ {181}\) ETFs are generally regarded as low cost and liquid vehicles for investors seeking portfolio diversification.\(^ {182}\) Their economic

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\(^{178}\) Gorton (n 27) at 20-34 and Coval et. al. (n 66).

\(^{179}\) Gorton (n 27) at 45 and 59 and Jackson (n 73).

\(^{180}\) Judge (n 95) at 3.

\(^{181}\) The investment firm BlackRock estimates that there are now in excess of 2,700 ETFs worldwide, replicating various portfolios of public equity and debt securities, across virtually every conceivable investment style, country and region; see “Too Much of a Good Thing”, *The Economist* (June 25, 2011).

rationale is thus very much grounded in MPT. Introduced in the early 1990s, plain vanilla ETFs physically replicate the reference portfolio by purchasing the underlying assets.\textsuperscript{183} Synthetic ETFs, in contrast, are a more recent innovation designed to replicate the reference portfolio through the use of OTC derivatives.\textsuperscript{184}

While there exist a number of ways to structure a synthetic ETF, perhaps the most common technique involves the sponsor of the fund entering into a total return swap\textsuperscript{185} with a financial intermediary.\textsuperscript{186} There are two components – or ‘legs’ – of this swap. In the first leg, the ETF sponsor contracts with the financial intermediary to receive the total return on the reference portfolio in exchange for cash equal to the notional amount of the swap.\textsuperscript{187} In return, the financial intermediary transfers a portfolio of collateral to the ETF sponsor. Importantly, the collateral assets are often unrelated to those which the synthetic ETF has been designed to replicate.\textsuperscript{188} The second leg of the swap then involves the transfer of the total return on the collateral package back to the financial intermediary.\textsuperscript{189}


\textsuperscript{184} Ibid. and FSB (n 182) at 2.

\textsuperscript{185} A prototypical total return swap (or TRS) involves swapping cash flows calculated with reference to a floating rate of interest for those derived from the total return (i.e. all capital gains and interest/dividend income) on a given asset or portfolio of assets; BIS (n 183) at 5.

\textsuperscript{186} This structure is commonly referred to as the ‘unfunded swap structure’; ibid. This is in contrast to the ‘funded swap structure’ which, in a nutshell, involves the ETF sponsor buying a structured note secured by a collateral pledge from a financial intermediary. Notably, in the funded swap structure, the financial intermediary posts eligible collateral into a ring-fenced custodial account. Accordingly, unlike the unfunded swap structure, the ETF sponsor is not the beneficial owner of the collateral assets; see ibid. at 6 for further details.

\textsuperscript{187} Ibid. This has the benefit of transferring the tracking risk in the reference portfolio to the swap counterparty.

\textsuperscript{188} Ibid. and The Economist (n 181). For ETFs domiciled in the E.U., for example, the Undertakings for Collective Investments in Transferable Securities (UCITS) Directive 88/220/EEC (as amended) only prescribes that the collateral assets be selected from among certain prescribed classes of equity or debt securities; see UCITS Directive, Arts. 22 and 23 and FSB (n 182) at 4 for further details.

\textsuperscript{189} BIS (n 183) at 5.
Synthetic ETFs have thus far proven especially popular in Europe and Asia. The growing demand for these derivatives has been stoked by institutional investors in search of higher returns in less liquid fixed income and emerging markets where physical replication of a reference portfolio would almost certainly prove prohibitively expensive. At least some of the impetus for the development of synthetic ETFs, however, stems from the desire on the part of the financial intermediaries acting as swap counterparties to remove less liquid collateral from their balance sheets – ultimately with a view to enhancing their liquidity profile, lowering securities warehousing costs and, once again, obtaining relief from regulatory capital requirements. In the extreme – and in particular where the financial intermediary is affiliated with the fund sponsor – synthetic ETFs can thus be utilized as a “dumping ground” for lower quality assets. This in turn serves to highlight the fact that these instruments expose investors to both (1) counterparty credit risk in connection with the swap itself and (2) market and liquidity risk in connection with the swap collateral. Accordingly, while synthetic ETFs are themselves exchange-traded (and thus highly regulated) instruments, their complexity and risk profile more closely resemble the OTC derivatives which reside at the core of this increasingly popular investment fund structure.

190 FSB (n 183) at 3. Synthetic ETFs are less popular in the U.S. owing to regulatory constraints imposed under the Investment Company Act of 1940, codified at 15 U.S.C. §80a (1940) [the “ICA”]; see IMF (n 182) at 68. Notably, in March 2010 the SEC announced that it was conducting a review of the use of derivatives by ETFs; see SEC, “SEC Staff Evaluating the Use of Derivatives by Funds”, Press Release 2010-45 (March 2010), available at www.sec.gov.

191 The Economist (n 181) and BIS (n 183) at 1. These increased costs are attributable to, inter alia, the wider bid-ask spreads typically encountered within these markets; BIS (n 183) at 4.

192 Ibid. at 1 and 8-10; FSB (n 182) at 2, and Bank of England (n 182) at 8. In effect, synthetic swaps can thus be utilized to perform the same economic function (i.e. liquidity transformation) as collateral swaps (see below).

193 The Economist (n 181).

194 IMF (n 182) at 71-72.

195 Ibid. and BIS (n 183) at 8-9. What is more, these risks are likely to be exacerbated during periods of market turmoil.

196 As previously mentioned, these instruments are subject to the ICA in the U.S. and the UCITS Directive in the E.U., along with the rules of the exchange on which they trade.
The complexity associated with synthetic ETFs stems primarily from the opacity of the underlying swaps and, more specifically, their collateral packages. This opacity is illustrated by a recent exercise conducted by the BIS involving a widely traded synthetic ETF replicating the MSCI Emerging Markets Index.\textsuperscript{197} With the assistance of the fund sponsor, the BIS was able to determine that the collateral package for this fund contained over 1000 securities, consisting largely of Japanese equities and unrated U.S. corporate bonds.\textsuperscript{198} In the end, however, the BIS found that a more detailed breakdown of the assets in the collateral package was “not readily available”\textsuperscript{199} and that obtaining this information “would be a cumbersome process”.\textsuperscript{200} It is also worth noting that the geographic dispersion of the assets within the collateral package bears little relation to the emerging market portfolio the fund is designed to replicate. The BIS exercise thus reinforces the concern that investors in synthetic ETFs may be operating with less than perfect information respecting the risks to which they are ultimately exposed.

\textit{Collateral swaps.} Our final case study is the emerging market for so-called ‘collateral swaps’. A collateral swap is essentially a form of secured lending whereby one counterparty transfers relatively liquid assets to another in exchange for a pledge of less liquid collateral.\textsuperscript{201} In a typical collateral swap, a bank holding a portfolio of ABS or other securitizations will transfer these assets to a pension fund or insurance company which, in exchange for a periodic fee, will deliver a portfolio of more liquid

\textsuperscript{197} BIS (n 183) at 9-10. This fund utilizes the ‘funded’ swap structure.
\textsuperscript{198} Ibid.
\textsuperscript{199} Ibid.
\textsuperscript{200} Ibid.
\textsuperscript{201} For this reason, these transactions are often referred to within collateral management circles as ‘liquidity transfers’. In effect, collateral swaps are economically quite similar to a long-dated repo arrangement.
collateral such as high-grade government or corporate bonds. The pension fund or insurer thereby receives a higher yield on its (ostensibly) safe investments, while the bank obtains access to a portfolio of liquid assets which it can then re-pledge to obtain funding from central banks and other sources which, in the wake of the GFC, have been less willing to accept ABS and other securitizations as eligible collateral.

The development of collateral swaps is thus, in effect, an innovative response to both the post-crisis funding constraints on banks and the need to satisfy new liquidity requirements soon to be imposed under Basel III.

Collateral swaps contribute to the complexity of modern financial markets in at least three ways. First, the collateral swap market is extremely opaque. Nobody knows with any certainty, for example, how big this market is, who the major players are, or the size of the aggregate exposures. As a result, it is exceedingly difficult to ascertain the nature and extent of the attendant risks. Second, given the identity of the counterparties, collateral swaps seem destined to strengthen the interconnections between (1) banking markets and (2) insurance and pension markets. Finally, as described above, collateral swaps are a reflexive response to changes in the post-crisis market and regulatory environment.

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203 Ibid.

204 Ibid. In effect, the counterparties to collateral swaps are arbitraging differences in the capital adequacy regimes applicable to banks, on the one hand, and pension funds and insurance companies, on the other.

205 Bank of England (n 182) at 8.
V. Complexity and Financial Innovation: The Regulatory Challenges

As amply illustrated by our three case studies, complexity and financial innovation together generate a host of regulatory challenges. Sophisticated new instruments, derived from esoteric financial theory, structured in ways which obscure the attendant risks, and traded in opaque dealer-intermediated markets by opaque financial institutions raise clear investor protection issues. Paramount amongst these are the potential for both (1) uninformed (suboptimal) contracting\(^{206}\), and (2) fraud, misconduct and other opportunistic behavior on the party of financial intermediaries. The potential for suboptimal contracting in turn raises the prospect of both overinvestment and excess leverage leading, ultimately, to the build-up of systemic risk.

Simultaneously, opacity and the pace of innovation also render it more difficult for regulators to effectively police financial markets and – in conjunction with interconnectedness and fragmentation – to locate and monitor potential risks. Meanwhile, the vast array of intricate, evolving and often undetected interconnections within and between markets and institutions – themselves often the byproducts of financial innovation – foment systemic fragility and manifest the potential to become channels for the transmission of contagion during periods of market distress.\(^{207}\)

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\(^{206}\) As Milton Friedman observed, optimal contracting necessitates that the actions of counterparties are both voluntary and informed; Milton Friedman, *Capitalism and Freedom* (University of Chicago Press, Chicago, 1962) at 13. Accordingly, where counterparties face high information costs, asymmetries of information and the resulting agency costs problems, there is reason to question the private (and social) optimality of the contracts into which they enter.

\(^{207}\) Essentially, these interconnections exacerbate informational problems during periods of market distress as financial institutions seek to determine the sources and scope of their potential exposures. Where the informational costs are too great, the resulting uncertainty can lead to panic and the mass withdrawal of liquidity from the financial system; Schwarcz (n 20); Gorton (n 27), and Caballero and Simsek (n 88). What is more, these interconnections may result in the transmission of financial shocks faster than regulators are able to address them; Schwarcz (n 20) at 215, citing W. Brian Arthur, “Complexity and the Economy”, *Science* (April 2, 1999).
Reflexivity contributes still further to this fragility insofar as its self-reinforcing feedback effects drive the formation of asset bubbles.\textsuperscript{208}

Financial innovation itself represents yet another source of systemic vulnerability. Newer, less liquid and highly concentrated markets frequently lack the legal, operational and/or risk management infrastructure necessary to withstand financial shocks.\textsuperscript{209} Compounding matters, the appropriability of financial innovation dilutes the incentives of market participants to invest in the development of such infrastructure.\textsuperscript{210} In the end, financial regulators face the decidedly daunting prospect of mounting effective responses to these (and other) challenges as, all the while, the forces of regulatory arbitrage – often in the guise of financial innovation – shift the ground beneath their feet.

Lurking in the background is one final regulatory challenge: welfare indeterminacy. Regulators cannot directly observe the preferences of their constituents, nor do they have any practical means of aggregating these preferences into a social welfare function.\textsuperscript{211} Simultaneously, they possess imperfect knowledge of (exogenous) future events and the (endogenous) welfare consequences of their

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\item[208] Soros (n 113) at 23.
\item[209] Gubler (n 88) at 15.
\item[210] Hu (n 26) at 1482. Indeed, such under-investment is part of a broader issue stemming from the fact that financial stability is, in effect, a public good.
\item[211] Indeed, many critics of welfare economics have gone so far as to suggest that the concept of social welfare is both logically incoherent and inherently contested; see Timothy Besley, Principled Agents? The Political Economy of Good Government (Oxford University Press, Oxford, 2006) at 21. Perhaps most notably, the assumption that the aggregation of individual utilities or preferences into a social welfare function is in fact possible has been challenged by Kenneth Arrow; see Kenneth Arrow, “A Difficulty in the Concept of Social Welfare” (1950), 58:4 J. of Pol. Econ. 328. Arrow argued that the task of aggregating individual preferences is “plagued by the difficulties of interpersonal comparison.”; Ibid. at 329. Under certain specified conditions, Arrow illustrated that a rational paradox could result from the aggregation of the preferences of as few as two individuals faced with as few as three potential states, thus precluding the construction of a social welfare function. For a discussion of the unrealistic nature of many of the assumptions underpinning Arrow’s analysis, see Awrey (n 13) at 165-167.
\end{enumerate}
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policy choices. These blind spots limit the ability of regulators to evaluate the net welfare effects of, *inter alia*, (1) existing financial institutions, instruments and markets; (2) financial innovation; (3) existing regulation, or (4) contemplated regulatory intervention. It is impossible to know with any real certainty, for example, whether the net social costs of taxpayer funded bailouts for the financial institutions at the epicenter of the GFC exceed those which would have resulted from the economic turmoil which these bailouts likely averted; whether the systemic benefits flowing from the implementation of the Basel III capital adequacy framework will outweigh any attendant costs in terms of lost economic growth, or whether the benefits of OTC derivatives stemming from more complete markets, enhanced price discovery and improved market liquidity exceed the costs arising from inefficient contracting, opportunistic behavior and potential systemic risks. What is certain, however, is that this welfare indeterminacy represents a significant regulatory challenge.

The common theme running through this inventory of regulatory challenges is the existence of pervasive, acute and often deeply entrenched asymmetries of information and expertise within modern financial markets. These twin asymmetries – exacerbated, if not always caused, by complexity and financial innovation – can be

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212 Indeed, we do not even know with certainty which future events are exogenous and which are endogenous. Furthermore, even if we could determine the net welfare effects of a given policy choice at a particular moment in time, there is no guarantee that it would be representative of the net effects at any other moment.

213 Although this has not stopped scholars from attempting to quantify these costs; see Pietro Veronesi and Luigi Zingales, “Paulson’s Gift” (2009), available at www.ssrn.com.

observed both within the marketplace itself and, importantly, between market participants and regulators. These asymmetries have combined to make the entire financial system increasingly reliant on a relatively small oligopoly of intermediaries which serve as the repositories and purveyors of this information and expertise. As made all too clear by the economic turmoil unleashed by the GFC, the nature and extent of this reliance has generated what can fairly be described as the mother of all agency cost problems.

VI. The Trillion Dollar Question

Prior to the GFC, the approach adopted toward the regulation of OTC derivatives markets in jurisdictions such the U.S. and U.K. – which between them account for the vast majority of global trading activity\(^\text{215}\) – can best be described as ‘non-interventionist’.\(^\text{216}\) Swaps markets effectively (if not at all times legally) fell outside the perimeter of securities and futures regulation in both jurisdictions.\(^\text{217}\) ABS, CDOs and other securitizations, meanwhile, were frequently offered under exemptions from the prospectus, registration and other requirements imposed under

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\(^\text{215}\) As of April 2010, for example, these two jurisdictions accounted for roughly 70% of global turnover in OTC interest rate derivatives and 55% of the global turnover in OTC foreign exchange derivatives; BIS, Triennial Central Bank Survey of Foreign Exchange and Derivatives Markets Activity (April 2010) at 5-6, available at www.bis.org. Other jurisdictions with a meaningful share of global turnover in these instruments include Japan (6% of OTC foreign exchange derivatives and 3% of OTC interest rate derivatives), Singapore (5% and 3%) and Switzerland (5% and 3%); ibid. While reliable comparable data for equity, credit and commodity-linked derivatives is more difficult to come by, the available data suggests a similar (if not greater) degree of geographic concentration within these market segments; Duffie and Hu (n 156) at 12-16.

\(^\text{216}\) It is worth briefly noting that a handful of observers have suggested that, despite appearances, the U.S. Federal Reserve Board and other federal banking regulators actually played a robust oversight role in respect of OTC derivatives; see for example, Schuyler Henderson, Henderson on Derivatives, 2nd ed. (LexisNexis, London, 2010). Ultimately, however, these observers downplay (or altogether ignore) the myriad of ways in which these regulators systematically relaxed the regulatory rules surrounding these instruments in the decades leading up to the GFC. For a survey of these actions, see Awrey (n 107); Saule Omarova, “The Quiet Metamorphosis: How Derivatives Changed the ‘Business of Banking’” (2009), 63 U. Miami L. Rev. 1041, and Saule Omarova, “From Gramm-Leach-Bliley to Dodd-Frank: The Unfulfilled Promise of Section 23A of the Federal Reserve Act” (2011), 89 North Carolina L. Rev. 1683. More fundamentally, these observers seemingly fail to appreciate the rather obvious point that U.S. banking regulators do not enjoy jurisdiction over global markets.

\(^\text{217}\) See Awrey (n 107) for a detailed description of the pre-crisis regulatory treatment of swaps in both the U.S. and U.K.
applicable securities laws.\textsuperscript{218} This non-interventionist approach was dictated – especially in the U.S. – by the prevailing free market ideology which viewed market participants as invariably best positioned to address the risks arising in connection with OTC derivatives.\textsuperscript{219} It was also influenced by mounting competitive pressures within the increasingly global market for investment banking services.\textsuperscript{220} Ultimately, this approach effectively disregarded the risks and regulatory challenges generated by complexity and financial innovation. The trillion dollar question thus becomes: \textit{what lessons, if any, have policymakers taken away from the GFC?}

The frenzied and destructive events of March-September 2008 spurred policymakers on both sides of the Atlantic to fundamentally rethink their approach toward the regulation of OTC derivatives markets.\textsuperscript{221} On March 4, 2009, the European Commission announced its commitment to implement reforms designed to

\textsuperscript{218} In the U.S., for example, exemptions could be obtained under sections 3(a)(2) and 4(2) of the \textit{Securities Act of 1933}, codified at 15 U.S.C. § 77a (1933) [the “\textit{Securities Act}”] and sections 3(c)(1) and 3(c)(7) of the ICA. Very briefly, Section 3(a)(2) provides an exemption for securities issued by federally regulated banks and savings and loan associations. Section 4(2) provides an exemption for transactions not involving a public offering of securities. Section 3(c)(1) provides an exemption where the beneficial holders of outstanding securities number less than 100 at any time. Section 3(c)(7), meanwhile, provides an exemption where the issuer does not make a public offering and the securities are owned by certain qualified purchasers (i.e. those meeting a prescribed income or asset test). The SEC would subsequently expand the available exemptions through the promulgation of Rule 144A under the \textit{Securities Act} (adopted in 1990) and Rule 3a-7 under the ICA (adopted in 1992).


\textsuperscript{220} \textit{See} Duffie and Hu \textit{(n 156)} and the Bloomberg Report \textit{(n 100)}.

\textsuperscript{221} This shift began (modestly enough) in March 2008 – in the immediate aftermath of the Bear Stearns bailout – when the CFTC and SEC entered into a mutual cooperation agreement with a view to enhancing coordination and facilitating the review of new derivatives instruments; \textit{see} CFTC Press Release 5468-08, “CFTC, SEC Sign Agreement to Enhance Coordination, Facilitate Review of New Derivatives Products” (March 11, 2008), available at www.cftc.gov. Then, in November, the CFTC, SEC and Federal Reserve Board entered into a memorandum of understanding to establish a framework for consultation and information sharing on regulatory issues related to centralized counterparties for CDS contracts; \textit{see} http://www.cftc.gov/About/HistoryoftheCFTC/history _2000s.html. Shortly thereafter, the CFTC announced that the CME had certified a proposal to clear CDS through the CME’s clearing facilities; \textit{see} CFTC Press Release 5592-08, “CFTC Announces that CME Has Certified a Proposal to Clear Credit Default Swaps” (December 23, 2008), available at www.cftc.gov.
increase transparency and reduce systemic risk within OTC derivatives markets.\footnote{222} This commitment would eventually be met in the form of the E.U. Regulation on OTC Derivatives, Central Counterparties and Trade Repositories (or EMIR\footnote{223}), adopted on September 15, 2010.\footnote{224} The U.S. Treasury Department, meanwhile, was also eager to signal its enthusiasm for a new approach: unveiling the draft Over-the-Counter Derivatives Markets Act in August 2009.\footnote{225} These reforms would ultimately be enacted in July 2010 as part of the Dodd-Frank Wall Street Reform and Consumer Protection Act.\footnote{226}

The Obama Administration has characterized the objectives of the new U.S. regime as to: (1) guard against the build-up of systemic risk; (2) promote transparency and efficiency; (3) thwart market manipulation, fraud, insider trading and other abuse, and (4) prevent inappropriate marketing to unsophisticated counterparties.\footnote{227} Title VII of the Dodd-Frank Act employs four primary mechanisms in pursuit of these objectives.\footnote{228} First, it confers upon the CFTC and SEC the authority to mandate that financial instruments falling within the definition of either a “swap” or “security-


\footnote{223} Which stands for the European Market Infrastructure Directive.

\footnote{224} SEC(2010) 1058 and 1059 (September 15, 2010). EMIR is not scheduled to come into full force and effect until December 31, 2012. The U.K. is obligated under E.U. law to implement EMIR.


\footnote{226} While Title VII of the Dodd-Frank Act (governing OTC derivatives) technically came into force on July 16, 2011, the effective date of the vast majority of the contemplated reforms has been delayed pending the completion of the requisite rulemaking process. Each of these reforms will take effect 60 days following the publication of the relevant final rule; Dodd-Frank Act, s. 754.

\footnote{227} Treasury Department (n 225).

\footnote{228} Not including (1) the ‘push out’ of (most) derivatives activities conducted by federally insured banks to separate non-bank affiliates; see Dodd-Frank Act, s. 716 or (2) the so-called ‘Volcker Rule’ limiting the proprietary trading activities of bank holding companies; ibid., s. 619.
based swap" be centrally cleared through CFTC-regulated derivatives clearing organizations or SEC-regulated securities clearing agencies (collectively, CCPs). In very broad terms, CCPs interpose themselves between the counterparties to bilateral OTC transactions, effectively assuming the obligations of each party to the other. The principle advantage of centralized clearing and settlement through CCPs is the potential mitigation of both counterparty credit and systemic risk via the (1) multilateral netting of exposures; (2) collateralization of residual net exposures; (3) enforcement of robust risk management standards, and (4) mutualization of

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229 Taken together, the definitions of swap and security-based swap encompass the vast majority of OTC derivatives instruments; see ibid., s. 721 and 761. That said, the dividing line between swaps and security-based swaps is not altogether clear under the Dodd-Frank Act, especially with respect to swaps based on a portfolio of assets, such as those which often form the subject matter of structured finance transactions.

230 Dodd-Frank Act, s. 723 and 763. Unless otherwise indicated, all subsequent references to “swap” shall, for the purposes of this description of the operative provisions of Title VII of the Dodd-Frank Act, be construed so as to include a “security-based swap”. The process for determining whether a particular group, category, type or class of swap be subject to the central clearing and exchange-trading requirements can be initiated by either a CCP or the relevant regulator; ibid., s. 723(a)(3). CCPs are required to submit to the CFTC or SEC, as applicable, “any group, category, type, or class of [security-based] swap” it intends to accept for clearing and provide notice of this submission to its members; ibid. In reviewing a submission, the CFTC or SEC will determine whether the submission is consistent with the core principles of the relevant CCP; ibid. The relevant regulator is also required to take into account the following factors: (1) “the existence of significant outstanding notional exposures, trading liquidity, and adequate pricing data”; (2) “the availability of a rule framework, capacity, operational expertise and resources, and credit support infrastructure to clear the contract on terms that are consistent with the material terms and trading conventions on which the contract is then traded”; (3) “the effect on the mitigation of systemic risk, taking into account the size of the market for such contract and the resources of the CCP available to clear the contract”; (4) “the effect on competition, including appropriate fees and charges applied to clearing”, and (5) “the existence of reasonable legal certainty in the event of the insolvency of the relevant CCP or one or more of its clearing members with regard to the treatment of customer and swap counterparty positions, funds, and property.”; ibid.

231 Duffie et. al (n 156) at 5. As Duffie and his co-authors explain, CCPs in effect “act as the seller to the original buyer, and as the buyer to the original seller.”; ibid. See also BIS and the Technical Committee of the International Organization of Securities Commissions (IOSCO), “Guidance on the Application of the 2004 CPSS-IOSCO Recommendations for Central Counterparties to OTC Derivatives CCPs”, Consultative Report (May 2010) at 1, available at www.bis.org.

232 Multilateral netting involves eliminating offsetting or redundant positions via, *inter alia*, the utilization of portfolio compression or so-called ‘tear up’ procedures.

233 Effectively creating a first loss position which serves as a capital buffer in the event of counterparty default.

234 By prescribing rules respecting, for example, capital; initial and variation margin; collateral; position portability; segregation of client assets, and stress testing.
losses resulting from the failure a clearing member. Simultaneously, of course, CCPs concentrate counterparty credit – and thus systemic – risk.

The Dodd-Frank Act contemplates an exemption from the clearing requirement if one of the counterparties (1) is not a “financial entity”; (2) is using the instrument to “hedge or mitigate commercial risk”, and (3) provides prescribed information to the relevant regulator respecting how it meets its financial obligations in connection with un-cleared swaps. For the purposes of this commercial end-user exemption, a financial entity includes a swap dealer, major swap participant, and certain other identified classes of financial institution. In order to incentivize greater utilization of centrally-cleared derivatives, it is likely that the new regime will ultimately impose higher capital and margin requirements on both swap dealers and major swap participants in connection with un-cleared swaps.


236 Dodd-Frank Act, s. 723(a)(3). The non-financial or hedging counterparty retains the option to require that the instrument be centrally cleared; ibid.

237 Section 721(a) of the Dodd-Frank Act and section 3(a)(71) of the Exchange Act define a swap dealer as: “any person who—(i) holds itself out as a dealer in [security-based] swaps; (ii) makes a market in [security-based] swaps; (iii) regularly enters into [security-based] swaps . . . ; or (iv) engages in any activity causing the person to be commonly known in the trade as a dealer or market maker in [security-based] swaps”. This definition does not include a person who enters into swaps for their own account (or in a fiduciary capacity), but does not do so as part of a regular business; ibid.

238 Section 721(a) and 761(a) of the Dodd-Frank Act define a major swap participant as: “any person who is not a [security-based] swap dealer and—(i) maintains a substantial [net] position in swaps for any of the major swap categories as determined by the [relevant regulator], excluding (I) positions held for hedging or mitigating commercial risk. . . (ii) whose outstanding swaps create substantial counterparty exposure that could have serious adverse effects on the financial stability of the United States banking system or financial markets.” The definition also includes a financial institution falling under the definition of financial entity as set out in the Dodd-Frank Act that is (1) highly leveraged; (2) not subject to capital requirements, and (3) maintains a substantial net position in outstanding swaps for any of the major swap categories as determined by the relevant regulator; ibid. The definition of a “substantial position” is left to be defined by the relevant regulators; ibid.

239 See Dodd-Frank Act, s. 723(a)(3).

240 See Treasury Department (n 225). Ultimately, however, the Dodd-Frank Act only mandates that the CFTC, SEC, and federal banking regulators, as applicable, set minimum capital and margin requirements; Dodd-Frank Act, s. 731 and 764. See CFTC, Proposed Rules Respecting Margin Requirements for Uncleared Swaps for Swap Dealers and Major Swap Participants, 76 Fed. Reg. 23,732-23,749 (April 28, 2011) and CFTC, Notice of Proposed Rulemaking Respecting Capital Requirements for Major Swap Participants (April 28, 2011).
Second, the \textit{Dodd-Frank Act} gives regulators the authority to require that any swap subject to the clearing requirement also trade on a regulated board of trade, exchange, or alternative swap execution facility.\textsuperscript{241} This execution requirement will not apply, however, where (1) no board of trade, exchange or swap execution facility makes the swap available to trade or (2) one of the counterparties to the swap falls within the commercial end-user exemption to the clearing requirement.\textsuperscript{242} Where swaps are subject to this execution requirement, the expectation is that this will enhance price discovery, promote greater market transparency and curb opportunities for market abuse.

Third, the \textit{Dodd-Frank Act} requires all swap dealers\textsuperscript{243}, major swap participants\textsuperscript{244}, CCPs\textsuperscript{245}, swap execution facilities\textsuperscript{246} and swap data repositories (SDRs)\textsuperscript{247} to register with the SEC, CFTC, and/or federal banking regulators. Once registered, swap dealers and major swap participants are subject to, \textit{inter alia}, capital; margin; reporting; recordkeeping, and business conduct requirements.\textsuperscript{248} CCPs registered with the CFTC, swap execution facilities and SDRs, meanwhile, are required to (1) comply with a set of ‘core principles’ and other requirements and (2)
design, implement, monitor, and enforce technical regulation in furtherance of these principles. While the *Dodd-Frank Act* does not articulate a similar set of core principles for CCPs registered with the SEC, it does mandate that the two agencies adopt consistent and comparable rules governing these registrants.

Finally, the *Dodd-Frank Act* imposes extensive recordkeeping and reporting requirements on these new registrants. Swap counterparties are required to report all centrally cleared and un-cleared swaps to an SDR. SDRs, CCPs and swap execution facilities are then obligated to provide granular counterparty and transaction information to the relevant regulators. These regulators are, in turn, required to publically disseminate anonymized transaction and pricing data on a “real time” basis. This public reporting requirement is explicitly designed to enhance price discovery. More broadly, these requirements are designed to leverage the centralization of transaction data within SDRs, CCPs, swap execution facilities and other institutions with a view to generating greater market transparency and, as a consequence, enabling regulators to more effectively monitor the location, nature and extent of potential systemic risks.

The *Dodd-Frank Act* carves up jurisdiction over bilateral OTC derivatives on the basis of a distinction between (1) contracts for the sale of a commodity for future delivery and swaps (subject to CFTC jurisdiction) and (2) security-based swaps

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249 Ibid., s. 725, 728, 733 and 763.
250 Ibid., s. 712(a)(7).
251 Ibid., s. 727, 729 and 766. These provisions set out rules respecting *which* counterparty is required to report the swap. In the circumstance where no SDR will accept the swap, it must be reported directly to the relevant regulator; ibid., s. 729 and 766. Notably, this reporting obligation also applies to swaps entered into prior to the enactment of the *Dodd-Frank Act*; ibid.
252 Ibid., s. 725, 728 and 733.
253 Ibid., s. 727. For the purpose of these requirements, reporting on a “real time” basis refers to reporting within a time frame which is “technologically practicable”; ibid.
254 Ibid.
255 See IMF (n 235) at 105–106.
Simultaneously, however, it mandates consistency and comparability between SEC and CFTC rules and regulations governing functionally or economically similar products and registrants. To this end, the SEC and CFTC have been handed joint responsibility for fleshing out the innumerable technical details of the new regime. The two agencies are thus currently engaged in the monumental task of issuing proposed and final rules respecting, inter alia, the process by which regulators determine whether a swap will be subject to the clearing requirement; risk management and business conduct standards for CCPs, SDRs, swap dealers and major swap participants; margin and capital requirements for swap dealers and major swap participants, and ownership limitations and

256 Dodd-Frank Act, s. 712, 722 and 761–763.
257 Ibid., s. 712(a).
258 Ibid., s. 712(d)(1). Including the definitions of swap; security-based swap; swap dealer; security-based swap dealer; major swap participant; major security-based swap participant, and eligible contract participant; ibid. The Obama Administration has requested and received a joint plan for harmonizing the regulation of OTC derivatives markets; see CFTC and SEC, Joint Report of the SEC and the CFTC on Harmonization of Regulation (October 16, 2009), available at www.sec.gov.
261 See CFTC (n 261).
governance requirements for CCPs, designated contract markets, exchanges and swap execution facilities.262

The Dodd-Frank Act also seeks to enhance the regulation of ABS and other securitizations – including, importantly, those offered under exemptions from the prospectus and registration requirements under the Securities Act.263 First, it requires issuers of ABS and other securitizations to disclose information respecting the quality of the assets backing each tranche or class of security.264 Where necessary for investors to perform independent due diligence, issuers must also disclose more detailed asset or loan-level data.265 Second, it requires “securitizers”266 to disclose fulfilled and unfulfilled repurchase requests across all trusts aggregated by the securitizer.267 Third, it compels credit rating agencies to include information in their rating reports respecting the representations, warranties and enforcement mechanisms available to investors in connection with a securitization and, importantly, how these


263 Section 943 of the Dodd-Frank Act introduced s. 3(a)(77) of the Exchange Act, which defines an “asset-backed security” as a fixed income or other security collateralized by any type of self-liquidating financial asset that allows the holder of the security to receive payments which depend primarily on the cash flows from that asset. Notably, the definition expressly includes both CDOs and CDO-squared.

264 Ibid., s. 942(b). The Dodd-Frank Act then requires the SEC to adopt regulations prescribing the specific format and content of these disclosures; ibid.

265 Ibid.

266 The Dodd-Frank Act defines a securitizer as (1) an issuer of an ABS or other securitization or (2) a person who organizes and initiates an ABS transaction by selling or transferring assets, either directly or indirectly, to the issuer; ibid., s. 941(b).

267 Ibid., s. 943(2). The Dodd-Frank Act characterizes the objective of this provision as to make it easier for investors to identify asset originators with clear underwriting deficiencies; ibid. This obligation only applies, however, where the transaction documentation contains a covenant to repurchase an asset; see SEC Rule 15Ga-1 and SEC Release 33-9175, Final Rules Respecting Disclosure for Asset-Backed Securities Required By Section 943 of the Wall Street Reform and Consumer Protection Act, 76 Fed. Reg. 4489-4515 (January 26, 2011), available at www.sec.gov.
provisions differ from other offerings of similar securities.268 Finally, it imposes risk retention requirements on securitizers: mandating that, in certain prescribed circumstances269, they maintain at least 5% of the credit risk in connection with any assets they sell into a securitization.270, 271 As with the new regime governing swaps, the securitization provisions of the Dodd-Frank Act contemplate substantial post-enactment rulemaking.272

The scope and substantive requirements of the new European regime are broadly consistent with Title VII of the Dodd-Frank Act.273 EMIR mandates that all “eligible”274 OTC derivatives between “financial counterparties”275 be cleared and settled through a CCP.276 This mandatory clearing requirement also applies to non-financial counterparties whose derivatives positions – excluding those objectively linked to the counterparty’s commercial activities – exceed a prescribed threshold.277.

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268 Dodd-Frank Act, s. 943(1) and SEC Rule 15Ga-1.
269 Specifically, the risk retention requirements may be reduced where the underwriting standards employed by the originator indicate that those assets manifest less credit risk. In addition, these requirements do not apply in respect of ABS collateralized exclusively by certain “qualified residential mortgages”, ibid., s. 941(b).
270 Ibid.
271 These risk retention requirements must also be viewed in conjunction with Basel III which, when effective, will impose more conservative capital requirements in respect of some securitization exposures. For an overview of these requirements, see Standard & Poors, “Tougher Capital Requirements Under Basel III Could Raise the Costs of Securitization” (November 17, 2010), available at www2.standardandpoors.com.
272 The OCC, Federal Reserve Board, FDIC and SEC are responsible for promulgating regulation in respect of the risk retention requirements. The SEC, meanwhile, is responsible for adopting regulation in respect of the disclosure requirements.
273 Although, as will be explored in greater detail below, there is considerable scope for substantive divergence.
274 Much like the new U.S. regime, EMIR establishes a process for determining whether an instrument is eligible for centralized clearing. This process can unfold in one of two ways. The first way is a ‘bottom-up’ process, pursuant to which a CCP applies to the European Securities and Markets Authority (ESMA) for a determination; Art 4(1). The second ‘top-down’ process involves ESMA, in conjunction with the European Systemic Risk Board (ESRB), determining that a contract should be subject to the mandatory clearing requirement; Art. 4(5).
275 A financial counterparty is defined as including a bank; investment bank; insurance company; UCITS fund; pension fund, or alternative investment fund manager; ibid., Art. 2(6).
276 Ibid., Art . 3.
277 There are actually two thresholds: an information threshold and a clearing threshold. Non-financial counterparties exceeding the information threshold are required to report the details of any OTC derivatives instrument to a trade repository; ibid., Arts. 6(1) and 7(1). Non-financial counterparties exceeding the clearing threshold are subject to the mandatory clearing requirement; ibid., Art. 7(2).
Both financial and non-financial counterparties entering into OTC derivatives not subject to the mandatory clearing requirement, meanwhile, are required to hold “appropriate and proportionate” capital and ensure that they have put in place appropriate procedures and arrangements to “measure, monitor and mitigate operational and credit risk”.

EMIR also establishes a uniform authorization requirement for CCPs. While these CCPs will continue to be registered and supervised at the national level, the Regulation empowers ESMA to develop technical standards and to ensure the uniform and objective application of these standards across the E.U. To this end, it imposes organizational and conduct of business requirements on CCPs respecting, *inter alia*, initial capital, governance; ownership; access; transparency;

Instruments that are objectively ascertained to be linked to a non-financial counterparty’s commercial activities will not be taken into account in determining whether the counterparty has exceeded the clearing threshold; ibid., Art. 3(4). ESMA and the ESRB have been handed primary responsibility for articulating the substance of both thresholds no later than June 30, 2012; ibid., Art. 7(3).

It is not clear on the face of this provision how transactions between a financial and non-financial counterparty not exceeding either the information or clearing tests would be treated. If EMIR is to be consistent with Title VII of the *Dodd-Frank Act*, however, such transactions should be exempt.

EMIR, Art. 8(1). The European Commission is empowered under EMIR to adopt technical regulation specifying the amount of capital necessary to comply with Art. 8(1); ibid., Art. 8(2).

Ibid.

Ibid., Art. 10. CCPs, derivatives exchanges and alternative execution facilities are already subject to E.U. regulation under MiFID. The E.U. has launched a consultation which is seeking to, *inter alia*, determine how MiFID should be updated to reflect emerging trends in this area; see E.U. Press Release IP/10/1677, “Financial Services: Improving European Rules for a More Robust Framework for All Financial Actors and Instruments” (December 8, 2010), available at http://europa.eu.

See Explanatory Memorandum accompanying EMIR at 9.

All CCPs are required to have permanent, available and separate capital of at least EUR 5 million; EMIR, Art. 12(1).

Ibid., Arts. 24, 25, 26 and 31. These governance requirements contemplate, amongst many other matters: (1) clear separation between the reporting lines for risk management and other operations; (2) remuneration policies designed to support sound risk management; (3) frequent and independent audits, and (4) the establishment of an independent risk committee to advise the board of directors on any arrangements that may impact the risk management of the CCP.

Ibid., Art. 28.

Ibid., Art. 35. Most importantly, CCPs must establish non-discriminatory, transparent and objective criteria for ensuring fair and open access to the CCP.

Ibid., Art. 36. Notably, in certain prescribed circumstances, these requirements empower national regulatory authorities to refuse authorization and/or “take other appropriate measures” in response to issues surrounding the identity, influence or holdings of a CCP’s owners.
outsourcing; segregation; position portability, and interoperability. It also imposes prudential requirements respecting, *inter alia*, margin and collateral mechanisms; permitted investments; default waterfalls, funds and other procedures, and risk modeling, stress testing and back testing.

Lastly, EMIR requires all “trade repositories” (TRs) to register with ESMA. It then subjects this new class of registrants to organizational and operational requirements respecting, *inter alia*, governance, access, information safeguarding, transparency, and data availability. Financial counterparties, along with non-financial counterparties whose derivatives positions exceed a prescribed information threshold, are required to report all OTC derivatives transactions to a registered TR. TRs are in turn required to make this information available to both ESMA and the relevant national authorities and to publicly disclose aggregate derivatives positions broken down by class.

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288 Ibid., Art. 33.
289 Ibid., Art. 37.
290 Ibid.
291 Ibid., Arts. 48, 49 and 50.
292 Ibid., Arts. 39 and 43.
293 Ibid., Art. 44. These requirements are designed to ensure that a CCP will only invest in highly liquid assets to which it enjoys prompt and non-discriminatory access.
294 Ibid., Arts. 40, 42 and 45. These requirements prescribe, *inter alia*, (1) that a CCP shall maintain a fund to cover losses arising from the default of a clearing member; (2) the order in which the financial resources of a CCP shall be deployed in the event of default, and (3) that a CCP shall have in place procedures to be followed in various default scenarios.
295 Ibid., Art. 46. Specifically, a CCP must regularly review its models and parameters and subject its models to rigorous and frequent stress tests to evaluate their resilience in extreme but plausible market conditions. It must also perform back-tests to evaluate the reliability of the methodology adopted. The results of these tests must be reported to the relevant national authority.
296 Ibid., Art. 1(2). TRs are the E.U. equivalent of SDRs under the *Dodd-Frank Act*.
297 Ibid., Art. 51.
298 Ibid., Art. 64(1)-(4).
299 Ibid., Art. 64(5).
300 Ibid., Art. 66.
301 Ibid., Art. 67.
302 Ibid.
303 Ibid., Arts. 6 and 7(1).
304 Ibid., Art. 67.
Together, the *Dodd-Frank Act* and EMIR represent a wholesale shift in terms of the regulation of OTC derivatives markets. *But how far do these reforms go in responding to the risks and regulatory challenges stemming from complexity and financial innovation?* On one level, these reforms can be viewed as holding out considerable promise. In particular, the aggregation of trading data within CCPs and SDRs/TRs, combined with more robust regulatory reporting and disclosure requirements, will undoubtedly enhance market transparency – leveling the informational playing field for both market participants and financial regulators.\footnote{305 Although, simultaneously, it is likely to dramatically increase the volume of available data; see \url{http://www.cftclaw.com/2011/08/derivatives-data-quadruple}.
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The utilization of CCPs also manifests the potential to simplify the intricate latticework of interconnections between financial institutions.\footnote{306 Gai et. al. (n 22) at 22-24. At the same time, however, the prospect of interoperability and the fact that counterparties often utilize multiple CCPs arguably cut against this simplicity.
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Broadly speaking, this new infrastructure should promote more informed contracting; help ameliorate agency cost problems vis-à-vis dealers and their clients, and enable regulators to more effectively police OTC derivatives markets.

On at least three other levels, however, the picture is somewhat less rosy. Both the *Dodd-Frank Act* and EMIR devolve significant frontline responsibility for systemic risk regulation to a small and (in some respects) unproven group of private actors: CCPs. While both regimes contemplate the imposition of governance requirements with a view to addressing the resulting agency cost problems, questions remain respecting how effective these requirements are likely to be in terms of ensuring that CCPs fully internalize the potentially enormous social costs which would be unleashed in the event of their failure.\footnote{307 Or, indeed, the failure of a systemically important clearing member.
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These questions are animated by two principal observations. First, ownership and control of CCPs is at present largely...
concentrated in the hands of OTC derivatives dealers. Second, public regulators charged with the task of supervising CCPs are likely to find themselves at a distinct disadvantage vis-à-vis their supervisees in terms of how to effectively manage the complex mix of counterparty credit, market, liquidity and other risks to which these unique institutions will invariably be exposed. Addressing these acute informational and incentive problems will necessitate that regulators devise strategies with a view to bridging this public-private divide.

More fundamentally, both the Dodd-Frank Act and EMIR appear to underestimate the regulatory challenges flowing from the nature and pace of financial innovation. Indeed, these nascent regimes may actually incentivize socially suboptimal over-innovation. More specifically, it is likely the case that many newer, less liquid and more bespoke instruments will be deemed unsuitable for central clearing. This in turn raises the prospect of innovation motivated by the desire to capture arbitrage gains manifest in the differences between the regulatory regimes governing centrally cleared and un-cleared instruments. Ultimately, how regulators discourage such innovation is part and parcel of a broader question respecting how to design regulation capable of responding to the dynamism and reflexivity of modern financial markets. In both regards, the Dodd-Frank Act and EMIR raise more questions than they provide answers.

Finally, despite initial appearances, there exists considerable scope for substantive divergence between the new U.S. and E.U. regimes. Compounding

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308 Essentially because the ‘markets’ for these instruments will be too small and illiquid to enable CCPs to (cost) effectively hedge their exposures.
309 This will ultimately hinge, of course, on the extent to which the expected gains (especially in terms of underwriting spreads and informational advantages) exceed the anticipated costs (stemming from, *inter alia*, the higher margin and capital requirements imposed on un-cleared instruments).
310 And, indeed, between the SEC and CFTC regimes.
matters, several notable jurisdictions – Hong Kong and Singapore among them – have made the strategic decision not to pursue regulatory reform. These realities raise uncomfortable questions respecting (1) the global interconnectedness of financial markets and institutions; (2) the omnipresent threat, and potentially corrosive effects, of regulatory arbitrage, and (3) whether national (and even supranational) regulatory regimes can effectively respond to what are, in the end, global problems. Ultimately, these questions highlight the imperative of a globally coordinated response to the risks arising within modern financial markets.

**VII. Conclusion**

Complexity and innovation define modern financial markets. Together, they also generate a host of regulatory challenges. These challenges stem from high information costs, deeply entrenched asymmetries of information and expertise and acute agency cost problems. The nature of these challenges underscores the need for mechanisms which subsidize the production and dissemination of information and align the incentives of both public and private actors with broader social welfare. These challenges also point to the desirability of regulation (and regulators) capable of responding to the dynamism of modern financial markets and, specifically, the nature and pace of financial innovation. Finally, they highlight the importance of global coordination in response to what are, increasingly, truly global risks. While recent regulatory reforms have gone some distance in addressing these challenges – in particular as they relate to OTC derivatives – considerably more work remains to be done before modern financial markets begin to resemble the perfect markets envisioned by conventional financial theory.