ARTICLES

A NORMATIVE ANALYSIS OF NEW FINANCIALLY ENGINEERED DERIVATIVES

PETER H. HUANG*

* Assistant Professor, University of Pennsylvania Law School. A.B., Princeton University; Ph.D., Harvard University; J.D., Stanford University. Thanks to Lucian Bebchuk, Bernie Black, Jason Johnston, Avery Katz, Leo Katz, Michael Knoll, Kevin Kordana, Seth Kreimer, Lawrence Mitchell, Ed Rock, Roberta Romano, Warren Schwartz, Steven Seelig, Matt Spitzer, Lynn Stout, Bill Tyson, Ho-Mou Wu, and audience members at the Corporations, Securities Law, and Banking II session of the 1999 American Law and Economics Association meetings; the Georgetown University Law Center Olin Law and Economics Workshop; the fourth Washington Area Finance Association Conference; and Northwestern University Law School for comments on earlier versions of this Article. Special thanks to Jennifer Arlen, Kimberly D. Krawiec, and Frank Partnoy for immensely helpful written advice, questions and suggestions regarding the financial, legal and regulatory implications of this Article. Barbara Burns (Penn Law School Class of 2000) provided superb research assistance.

> An old man and his son lived in an abandoned fortress on the side of a hill. Their only possession of value was a horse.
>
> One day, the horse ran away. The neighbors came by to offer sympathy. "That's really bad!" they said. "How do you know?" asked the old man.
>
> The next day, the horse returned, bringing with it several wild horses. The old man and his son shut them all inside the gate. The neighbors hurried over. "That's really good!" they said. "How do you know?" asked the old man.
>
> The following day, the son tried riding one of the wild horses, fell off, and broke his leg. The neighbors came around as soon as they heard the news. "That's really bad!" they said. "How do you know?" asked the old man.
>
> The day after that, the army came through, forcing the local young men into service to fight a faraway battle against the northern barbarians. Many of them would never return. But the son couldn't go, because he'd broken his leg.
>
> —Benjamin Hoff, *The Te of Piglet*

I. INTRODUCTION

The above quotation from the "sequel" to *The Tao of Pooh* is a shortened version of a famous tale attributed to the Taoist writer Liu An, also reverently known as Huai Nan Tse. The story does not stand for the proposition that it is impossible to judge any given situation as good or bad.[1] Instead, the parable aptly symbolizes how difficult it can be to determine whether a particular change in circumstances makes things better or worse. The reason that such a normative inquiry can be complex is that a particular change often produces a series of related changes that have their own consequences. Thus, thoroughly evaluating a particular change entails appraising not only that particular change, but also assessing an entire sequence of related changes. This Article demonstrates that

1. A major theme of behavioral decision theory is that one's preference varies depending on how it is elicited. *See* Paul Slovic, *The Construction of Preference*, 50 AM. PSYCHOL. 364 (1995). Even when individuals have fixed preference orderings, constructing a social preference ordering from them can be impossible. *See generally* KENNETH JOSEPH ARROW, SOCIAL CHOICE AND INDIVIDUAL VALUES (1951).

derivative assets in a society can be like the wild horses in the above parable.

This Article analyzes whether the introduction of new derivative assets makes a society better or worse off. Because trading such non-redundant derivatives produces new distributions of income across time and over possible future contingencies, individuals can utilize such financial instruments to hedge risks not possible before the introduction of these assets. Thus, it may seem that new derivatives unambiguously benefit society. In fact, introducing sufficiently many new derivatives completes asset markets. Asset markets are complete if trading on them can attain every possible payoff pattern of wealth across time and over possible future contingencies. The first fundamental theorem of welfare economics provides that if asset markets are complete and perfectly competitive, the resulting equilibrium allocation of assets, commodities, and risk is Pareto-efficient. Thus, new derivatives that complete asset markets are unambiguously socially desirable. But, from the perspective of most households, the empirical reality is that asset markets are severely incomplete. Trading on incomplete asset markets cannot achieve some distributions of money across time and over possible future contingencies.

The recognition that asset markets are incomplete has three far-reaching implications for regulatory policy towards new derivatives. First, for most societies, the addition of new derivatives to sufficiently incomplete asset markets can make all households worse off. Second, for most societies, a regulator can make all households better off by reallocating existing asset portfolios without introducing any new assets. Third, although government regulation can in principle improve the social allocation of risk and the resulting levels of households' utilities, it may not due to informational, decisional or political limitations on real world regulators. These important normative implications of an incomplete asset markets analysis inform the debate over how to regulate new derivatives.

First, because the current proliferation of new derivatives offers households more choices, the popular economic and regulatory paradigm is quite laissez-faire towards the introduction of new derivatives, if not even biased in favor of them. But, because asset markets are incomplete for the average person, new derivatives will typically have ambiguous normative consequences on households. The reason for this conclusion is that with incomplete asset markets, an increase in both hedging opportunities and people utilizing such new opportunities affects the set of existing hedging opportunities by changing existing asset and commodity prices. Those price changes usually have indeterminate welfare implications for

households. In other words, new derivatives that do not complete asset markets can harm, benefit, or have no impact on consumers. More precisely, for most economies, new derivatives can make everyone better off, everyone worse off, or some people better off while other people worse off. While lack of consumer demand may eliminate some useless or harmful new derivatives, market forces will not necessarily discipline all new derivatives because people who suffer the negative consequences may not be among those who trade in derivatives. Thus, some new derivatives may generate market failures in the form of externalities that regulators can remedy by stepping in and more actively monitoring the introduction of new derivatives.

Second, because asset markets are incomplete, market forces alone cannot be counted on to arrive at a socially efficient allocation of risk that normally occurs when asset markets are complete. In fact, with incomplete asset markets, competitive equilibrium allocations are not only Pareto-inefficient, but also usually constrained Pareto-inefficient. This result means that for a typical economy, regulators have an opportunity to improve societal welfare through market intervention. There are two ways to accomplish such improvements. A benevolent regulator could utilize taxes and subsidies on assets to reallocate portfolio holdings of existing assets. Such a reallocation alters spot commodity market prices and in turn causes a redistribution of income not attainable by trading in existing asset markets alone. Alternatively, a benevolent regulator could utilize price ceilings or floors to regulate spot commodity market prices.

Third, both of the above normative results about how a regulator can improve upon the performance of incomplete asset markets require that even a benevolent regulator be informed of individual households' tastes and endowments. The reality of informational and political economy constraints may substantially weaken the case for government intervention. Thus, while regulatory improvements are possible in principle, at least for now, because of informational, decisional or political limitations, they may be difficult if not impossible to implement. Nonetheless, it is important to realize that regulation may be undesirable because of informational or political economy reasons and not because markets produce a socially optimal allocation of risk bearing.

The above conclusions apply to new derivatives that have linear payoffs, such as forwards, futures, or swaps. Recent financial research extends the above conclusions to new derivatives that have non-linear payoffs, such as European options. Lately, Over the Counter (OTC) derivatives have generated increasing controversy and scrutiny. OTC

derivatives evolved from a standing start fifteen years ago to an underlying or notional value of $80 trillion at the start of 1999 as estimated by the Bank for International Settlements. OTC derivative markets are not only large and expanding, but are also global. Unlike exchange traded derivatives, OTC derivative markets do not occur at fixed locations and thus are not regulated by any single government agency of any particular country. In November 1999, the President's Working Group on Financial Markets recommended changing the Commodity Exchange Act (CEA) to promote innovation in OTC derivative markets by providing certainty regarding the legality of OTC derivatives. The above theoretical findings have implications for the approval of new OTC derivatives and retail consumer derivative products.

This Article examines the introduction of derivative products from a normative perspective. A vast literature already exists about new derivatives and the related field of financial engineering from a positive, that is, descriptive perspective.[2] Several legal symposia deal with the regulation of derivatives.[3] There are up-to-date books concerning derivatives for legal practitioners,[4] non-specialist managers,[5] regulators and traders and bankers,[6] second year MBAs who are specializing in risk management,[7] and business executives and practicing lawyers.[8] There is even a unique state-of-the-art, multimedia introduction to derivatives.[9] Finally, a growing body of theoretical and empirical research in financial economics focuses on the process of asset innovation and the diffusion of new financial products.[10]

---

2. *See, e.g.*, JULIAN WALMSLEY, NEW FINANCIAL INSTRUMENTS (2d ed. 1998) (providing a comparative, systematic and comprehensive guide to the latest financial tools and techniques).

3. *See, e.g.*, Symposium, *Derivatives & Risk Management Symposium on Stability in World Financial Markets*, 4 FORDHAM FIN. SEC. & TAX L.F. 1 (1999); Symposium, *Derivative Securities*, 21 J. CORP. L. 1 (1995).

4. *See, e.g.*, KENNETH M. RAISLER & ALISON M. GREGORY, SWAPS & OTHER DERIVATIVES IN 1999 (PLI Corp. Law and Prac. Course Handbook Series No. B-1147, 1999).

5. *See, e.g.*, PHILIP McBRIDE JOHNSON, DERIVATIVES: A MANAGER'S GUIDE TO THE WORLD'S MOST POWERFUL FINANCIAL INSTRUMENTS (1999).

6. *See, e.g.*, ALFRED STEINHERR, DERIVATIVES: THE WILD BEAST OF FINANCE (1998).

7. *See, e.g.*, DON M. CHANCE, AN INTRODUCTION TO DERIVATIVES (4th ed. 1998).

8. *See, e.g.*, ROBERT M. MCLAUGHLIN, OTC DERIVATIVE PRODUCTS: A GUIDE TO BUSINESS AND LEGAL RISK MANAGEMENT AND DOCUMENTATION (1999).

9. *See, e.g.*, MARK RUBINSTEIN, DERIVATIVES: A POWERPLUS PICTURE BOOK: VOLUME I FUTURES, OPTIONS AND DYNAMIC STRATEGIES (1998). See the book's related website <http://www.in-the-money.com> (last modified Dec. 12, 1999), for a detailed description of the book and its novel features.

10. *See generally* PHILIP MOLYNEUX & NIDAL SHAMROUKH, FINANCIAL INNOVATION (1999) (providing a detailed review of this literature).

A pioneer in financial engineering and the pricing of derivatives once noted that "[t]here are so many ways to use derivatives that I'm almost surprised when someone doesn't use them. Producers and consumers, investors and issuers, hedgers and speculators, governments and financial institutions: almost everyone can use them."[11] This Article applies recent research in financial economic theory to examine the impact of new derivatives not so much on the profitability of investment banks and corporations whose stocks and bonds are traded on Wall Street, but instead on the economic well-being of a typical household living on Main Street. To relate sophisticated financial innovations like derivatives to average families, this Article focuses on individuals trading in derivatives either directly or indirectly via such financial intermediaries as their mutual funds or pension funds. Another way that individuals can indirectly invest in derivatives is by being shareholders of corporations that use derivatives to hedge financial risks. Even diversified shareholders derive substantial benefits from corporate hedging utilizing derivatives.[12]

New assets create and provide new opportunities for sharing risks and smoothing out fiuctuations in expenses and income over time. Broadly conceived, the phrase "financial innovation" includes not only the introduction of new assets, but also the introduction of new financial products that are not assets.[13] The phrase "asset innovation" encompasses a plethora of new assets including corporate bonds, stocks, convertibles, hybrids, floating-rate debt, floating-rate preferred stock, zero-coupon bonds, primes, scores, poison pills, dual-cnrrency bonds, transferable loan

11. Fischer Black, *Foreword: The Many Faces of Derivatives* to THE HANDBOOK OF EQUITY DERIVATIVES, at ix (Jack Clark Francis, William W. Toy & J. Gregg Whittaker eds., 2000).

12. *See* Kimberly D. Krawiec, *Derivatives, Corporate Hedging, and Shareholder Wealth: Modigliani-Miller Forty Years Later*, 1998 U. ILL. L. REV. 1039 (demonstrating this conclusion by thorough empirical and theoretical analyses).

13. *See* FRANKLIN ALLEN & DOUGLAS GALE, FINANCIAL INNOVATION AND RISK SHARING 5 (1994) (proposing a broad conception of financial innovation). Much of this introduction draws heavily on their wonderful description of the history and practice of asset innovation. This Article uses the narrower term "asset innovation" rather than the broader term "financial innovation" because financial innovation includes innovation in many other forms besides the introduction of new assets. Examples of non-asset financial innovation are real-time financial news services, electronic trading opportunities, on-line personalized financial advice services and modern investment planning software. A specific example of an on-line personalized financial advice service is Net-based Financial Engines, Inc. that offers individual households user-friendly but customized and sophisticated advice regarding their 401(k) plans based on the Nobel Prize-winning economist William F. Sharpe's asset allocation model. *See* Financial Engines (visited February 4, 2000) <http://www.financialengines.com/>. A specific example of analytically sophisticated retirement planning software is Economic Security Planning, Inc.'s ESPlanner that implements Nobel Prize-winning economist Franco Modigliani's life cycle consumption smoothing model. *See* MIT Press, ESPlanner (visited February 4, 2000) <http://mitpress.mit.edu/esplanner/info.html>.

instruments, mortgage and asset-backed securities, structured notes, and index-linked bonds.[14] The term "financial engineering" refers to creating tailor-made solutions to highly complex problems in managing the financial risk of price fluctuations.[15] Indeed, financial engineering has been defined as "the development and the creative application of financial technology to solve problems in finance and to exploit financial opportunities."[16] Financial engineers often synthetically create new financial products that are known as exotic (as opposed to so-called plain vanilla) derivatives that do not exist in the marketplace to help end-users hedge against or profit from financial volatility.[17] The financial economic theory underlying financial engineering is that every asset can be replicated by a suitably chosen portfolio of options written on some index of assets.[18] Financial engineers derive their name from the fact that modern derivatives pricing and valuation models utilize the same type of advanced mathematics that is also used to describe the random, irregular motion of small particles in gases or liquids, namely stochastic differential equations.[19] Of course, the phrase "financial engineer" suggests another profession, that of genetic engineer. Indeed, one legal scholar invoked the vision of derivatives inhabiting a financial *Jurassic Park* with the implication that financial engineers have the potential to create financial products that could end up destroying civilization.[20] The analogy is not quite apposite for the reason that some forms of life exist in nature or existed in nature (as in the case of dinosaurs), while no assets exist in nature because all assets are human creations. In addition, analogizing financial engineering to genetic engineering raises visceral fears and

14. *See* ALLEN & GALE, *supra* note 13, at 16 tbl.2.1, 17-31 (listing and describing examples of asset innovation).

15. *See* ROBERT W. KOLB, FINANCIAL DERIVATIVES 10 (2d ed. 1996) (defining financial engineering).

16. *International Association of Financial Engineers*, 1 J. FIN. ENGINEERING 1 (1992).

17. *See* William F. Sharpe, *Nuclear Financial Economics*, *in* RISK MANAGEMENT: PROBLEMS AND SOLUTIONS 17, 34 (William H. Beaver & George Parker eds., 1995) (describing what financial engineers do).

18. *See* Fred D. Arditti & John Kose, *Spanning the State Space with Options*, 15 J. FIN. & QUANTITATIVE ANALYSIS 1 (1980) (proving this technical result).

19. *See, e.g.*, YUE-KUEN KWOK, MATHEMATICAL MODELS OF FINANCIAL DERIVATIVES 25 (1998) (describing Brownian motion and the random walk model); BERNT ØKSENDAL, STOCHASTIC DIFFERENTIAL EQUATIONS: AN INTRODUCTION WITH APPLICATIONS 120-88 (5th ed. 1998) (describing various applications).

20. *See* Henry T.C. Hu, *Hedging Expectations: "Derivative Reality" and the Law and Finance of the Corporate Objective*, 21 J. CORP. L. 3, 10-11 (1995).

images from popular culture about humans tampering with a natural order.[21]

There is a strong temptation to conclude from the large number of recent derivative innovations and the increased utilization of financial engineering that we live in a world with complete asset markets. Asset markets are complete if trading on asset markets can generate any conceivable pattern of payoffs over time and under alternative future scenarios. Households can insure against all financial risks by trading on complete asset markets. Indeed, under certain technical conditions, sufficiently frequent trading of a few judiciously chosen assets can substitute for assets that do not actually exist in the marketplace.[22] But, upon even a moment's reflection on the universe of Main Street instead of the world of Wall Street, it becomes clear that a typical household faces asset markets that are woefully incomplete. An average family can do little to insure against reversals in their employers' fortunes,[23] real estate prices,[24] national income levels,[25] employer provided health insurance coverages,[26] and inflation.[27] The same is true even of nonfinancial businesses that remain uninsured with respect to macroeconomic and sector-specific shocks.[28]

The rate new derivatives are introduced and the scope of financial engineering have dramatically exploded recently in response to demands by sophisticated parties on Wall Street to hedge against or profit from capital market risks.[29] Modern capital markets increasingly experience short-term

21. *See* Peter H. Huang, *Herd Behavior in Designer Genes*, 34 WAKE FOREST L. REV. 639, 656-57 (1999) (providing examples from popular culture of images that genetic engineering is dangerous, ranging from movies such as *Blade Runner* to *The Matrix*).

22. *See* Darrell Duffie & Chi-Fu Huang, *Implementing Arrow-Debreu Equilibria by Continuous Trading of Few Long-Lived Securities*, 53 ECONOMETRICA 1337 (1985) (proving this technical result).

23. *See* ALLEN & GALE, *supra* note 13, at 3 (describing lack of much insurance against employer's financial health).

24. *See* ROBERT J. SHILLER, MACRO MARKETS: CREATING INSTITUTIONS FOR MANAGING SOCIETY'S LARGEST ECONOMIC RISKS 78 (1993) (describing lack of much insurance against adverse fluctuations in housing prices).

25. *See id.* at 52 (describing lack of much insurance against adverse changes in national income).

26. *See* ALLEN & GALE, *supra* note 13, at 4 (describing lack of much insurance against loss of employer health coverage).

27. *See* SHILLER, *supra* note 24, at 94 (describing lack of much insurance against rising inflation).

28. *See* ALLEN & GALE, *supra* note 13, at 4 (describing lack of much insurance against macroeconomic and industry-specific shocks).

29. Another driving impetus for asset innovation is tax arbitrage. *See* James C. Van Horne, *Of Financial Innovation and Excesses*, 32 J. FIN. 621, 628 (1985) (describing how Adjustable Rate Preferred Stocks (ARPS) and Convertible Adjustable Preferred Stocks (CAPS) allowed corporate investors to take advantage of an 85% tax exemption for dividend income). *See also, e.g.*, Lawrence

volatility and global interconnections.[30] Capital markets provide vital intermediaries between the saving decisions of households and the investment decisions of the private and public sectors. We live in the dawn of the age of digital capitalism where capital flows almost instantaneously and respects no international or jurisdictional boundaries.[31] Advances in information computing technologies and telecommunications have increased the speed of derivatives innovation and the range of financial engineering because those advances permit faster and more accurate inputs and outputs to derivatives pricing and valuation models than before. Many observers are concerned that global asset markets and the financial services industry are more fragile and linked than ever before due to fundamental changes in communications and computing technologies.[32] In such an interdependent financial environment, financial engineering creates new derivatives that are powerful tools for effectively addressing the increasingly sophisticated and changing demands of capital market participants to manage the volatility of capital market prices.

New derivatives and financial engineering can improve the allocation of risks in society by allowing people to shift risks by getting rid of unwanted risks and taking on desired risks. "At this point, it might be helpful to ask more specifically what is the social usefulness of markets for shifting risks?"[33] An answer is that "[t]he possibility of shifting risks, of insurance in the broadest sense, permits individuals to engage in risky activities which they would not otherwise undertake" and undertaking

---

Fisher, Ivan E. Brick & Francis K.W. Ng, *Tax Incentives and Financial Innovation: The Case of Zero-Coupon Bonds and Other Deep-Discount Corporate Bonds*, 18 FIN. REV. 292 (1983) (describing the tax advantage to corporations of issuing Original-Issue-Discount (OID) bonds until passage of the Tax Equity and Fiscal Responsibility Act of 1982). *See generally* MYRON S. SCHOLES & MARK A. WOLFSON, TAXES AND BUSINESS STRATEGY: A PLANNING APPROACH (1992); Michael S. Knoll, *Financial Innovation, Tax Arbitrage, and Retrospective Taxation: The Problem with Passive Government Lending*, 52 TAX L. REV. 199 (1997); Reed H. Shuldiner, *A General Approach to the Taxation of Financial Instruments*, 71 TEX. L. REV. 243 (1992); Jeff Strnad, *Taxing New Financial Products: A Conceptual Framework*, 46 STAN. L. REV. 569 (1994).

30. *See* Alan Greenspan, *The Globalization of Finance*, 17 CATO J. 243, 244, 247 (1998) (discussing interdependencies among financial markets and the spread of contagion effects across national boundaries).

31. ELINOR HARRIS SOLOMON, VIRTUAL MONEY: UNDERSTANDING THE POWER AND RISKS OF MONEY'S HIGH-SPEED JOURNEY INTO ELECTRONIC SPACE 151, 159-65 (1997) (describing such a world).

32. *But see* David E. Van Zandt, *The Regulatory and Institutional Conditions for an International Securities Market*, 32 VA. J. INT'L L. 47, 49-54 (1991) (proposing a "test of one price" to determine whether securities markets are truly global and utilizing that test to argue they are not yet).

33. Kenneth Joseph Arrow, *Insurance, Risk, and Resource Allocation*, *in* ESSAYS IN THE THEORY OF RISK-BEARING 134, 137 (1971).

those risky projects means that "society will be better off by the increased production."[34]

In addition, introducing derivatives to different groups of individuals democratizes access to financial and capital markets. Although individuals in the United States and the western European countries enjoy high average standards of living, the distribution of income varies substantially across their populations and over time. People can enjoy higher standards of living by pursuing opportunities to reallocate or share risk. Historically, there have been many different methods for smoothing incomes over time and sharing financial risks. In ancient China, individuals received support in bad times from their families and in their old age from their children. Rotating credit associations are another institution for the sharing of risks in developing countries or among immigrants to developed countries. Residents in the United States and England can manage their financial risks by trading from a diverse menu of assets that includes a plethora of mutual funds. Residents in other countries primarily manage their financial risks through various financial intermediaries, such as banks. Countries also differ in the scope of safety net or welfare programs their governments provide to cope with financial risks. In the United States, while people have primary responsibility for and freedom in their decisions about how to manage their financial risks, federal and state governments engage in such risk-sharing programs as unemployment insurance, Medicare, Medicaid, and Social Security. There has been much recent discussion about how to reform and/or privatize our Social Security program.[35] Much of the current debate about proposed Social Security program reforms hinges on the question of how to share macroeconomic financial risks across generations in a socially optimal fashion.

The preceding discussion suggests that the allocation of risk in a society is just as important, if not more, than the more familiar allocation of commodities and services in an economy. A less than socially optimal allocation of risk is unfortunate because it means that society could improve the welfare of its members by reallocating the distribution of risks and risk bearing across society. An inefficient allocation of risk is also unnecessary if a government regulator can redistribute the distribution of risks and risk bearing across the population. The allocation of risk and risk bearing directly affect not only the income and welfare of households, but

34. *Id.* at 137-38.

35. *See, e.g.*, THOMAS E. MACURDY & JOHN B. SHOVEN, ASSET ALLOCATION AND RISK ALLOCATION: CAN SOCIAL SECURITY IMPROVE ITS FUTURE SOLVENCY PROBLEM BY INVESTING IN PRIVATE SECURITIES? (National Bureau Econ. Res. Working Paper No. 7015, 1999).

also indirectly affect consumer income and welfare via its effect on corporate profits, research and development, and real investments.

To date, the most direct impacts of new derivatives and financial engineering have been on the commercial financial sector and the community of sophisticated and wealthy investors. But new derivatives and financial engineering have also created many spillovers or trickle-down effects. Even the average person in the United States today has access to a dizzying array of assets and financial services that were not available until only recently. Today's investors can select from a surfeit of retail choices including commodity futures, currency options, and mutual or pension funds. But, despite all of the possible financial instruments that households can utilize to manage financial risk, the average family cannot hedge or diversify against every single conceivable financial risk. In other words, people face incomplete asset markets.

A novel feature of this Article is that it explains and builds on the insights of recent advances in theoretical financial economics that focus on incomplete asset markets. In such environments, the assets that are unavailable severely constrain the well-being of households. If some asset markets are missing, the remaining asset markets cannot make up for them. In other words, a society with incomplete asset markets cannot attain a socially efficient allocation of risk that can be attained with complete asset markets. This is not a surprising result because some risk allocations are unattainable with incomplete asset markets. But, what might be a surprising result is that usually new derivatives have indeterminate welfare consequences for households. In other words, new derivatives can make all households worse off or better off, or some households worse off and others better off. Perhaps even more surprising is the result that an incomplete asset market economy will typically possess competitive equilibria that can be improved upon by a benevolent regulator reallocating existing assets without completing asset markets.

The rest of this Article is organized as follows. Part II offers a very brief overview of the financial, legal and regulatory environment facing new derivatives in the United States. Part III describes the general equilibrium theory of incomplete asset markets. Part III.A explains why new derivatives will typically have ambiguous normative implications. Part III.B explains why incomplete asset market equilibrium allocations are not only inefficient, but also typically constrained inefficient. Part IV considers the implications of the results in Part III for regulatory approval of both new OTC derivatives and retail consumer derivative products. Part V discusses other regulatory proposals for government intervention in

terms of reallocating assets or regulating underlying spot market prices. Part VI concludes with final thoughts about how new derivatives affect households. The Appendix contains the simplest numerical example of a regulator improving the allocation of risk in a society with incomplete asset markets by reallocating an existing derivative in that economy without completing asset markets.

II. THE FINANCIAL AND U.S. LEGAL/REGULATORY LANDSCAPE OF DERIVATIVES

Asset innovation and financial engineering often involve creating derivatives that do not exist in the marketplace and/or using derivatives that do exist in the marketplace to create other assets. This Part thus presents a very brief overview of the financial landscape and the U.S. legal and regulatory environment that innovators of derivatives face. Derivatives have received a great deal of negative coverage in the media.[36] The Long-Term Capital Management (LTCM) hedge fund reportedly lost $4.4 billion during August and September of 1998 from trading in derivatives.[37] Many of the popular accounts in the financial press about LTCM's troubles implied that irresponsible exotic speculation using derivatives by a breed of young former finance professors caused these losses.[38] Many people, including legal academics, regulators, and taxpayers, have an inaccurate and misleading impression of derivatives without really knowing much about, or even really beginning to understand them. The controversy over derivatives would benefit from "unbundling and identifying the risks associated with derivative financial instruments, and then asking if regulation, in particular investor protection regulation, is being appropriately directed at those risks."[39] Since then, exactly such an

36. *See, e.g., 60 Minutes: Derivatives* (CBS television broadcast, Mar. 5, 1995) (15 minute segment reporting on derivatives losses). *But see* G. Bruce Kneeht, *TV: Derivatives on '60 Minutes'*, WALL ST. J., Mar. 8, 1995, at A18 (providing a justifiably negative review of the program). *See also NOVA: Trillion Dollar Bet* (PBS television broadcast, Feb. 8, 2000) (one hour program describing the discovery of the Black-Scholes option pricing formula and its use in derivatives trading) and the related website (visited February 25, 2000) <http://www.pbs.org/wgbh/nova/transcripts/2704stockmarket.html> (providing a transcript of the program).

37. *See* Michael Lewis, *How the Egghead Cracked*, N.Y. TIMES, Jan. 24, 1999, § 6 (Magazine), at 24 (reporting on the failure of LTCM).

38. *See id.* at 24; Steven Lipin, *How a Big Hedge Fund Marketed Its Expertise and Shrouded Its Risks*, WALL ST. J., Sept. 25, 1998, at A1 (reporting on LTCM and speculating on the causes for its losses).

39. Joanna Gray & Elspeth Fennell, *Derivative Financial Instruments, Risk, Regulation and Investor Protection*, *in* LAW AND UNCERTAINTY: RISKS AND LEGAL PROCESSES 155 (Robert Baldwin ed., 1997).

unbundling of the various risks that derivatives pose and the regulatory recommendations that follow from such a risk-based perspective have appeared in the legal academic literature.[40]

So, "[w]hat are derivatives anyway, and why are people saying such terrible things about them?"[41] Those readers who are familiar with derivatives may wish to skip to Part III of the Article. Those readers who are unfamiliar with derivatives may wish to also consult additional overviews of derivatives.[42] A derivative can be formally defined as a financial contract with a payoff value on its expiration date, denoted by T, that is derived from the market price at T of an underlying cash instrument.[43] There are five major categories of underlying cash instruments: stocks, currencies, interest rates, indices and commodities.[44] But there are only two canonical types of derivatives: forwards and options. A forward is a contract that obligates its holder to buy or sell an underlying asset at a preset price, known as the forward price, on a preset date.[45] A specific example is a forward contract to buy a puppy for $400 to be born by a highly prized St. Beruard in six weeks.[46] An option is a contract that provides its holder with the right, but not the obligation, to buy or sell an underlying asset at a preset price, known as the strike or exercise price, on or before a preset date.[47] A specific example is an option contract to buy 100 shares of Time-Warner stock for $130 per share in two months.

All other derivatives are either variations or combinations of these fundamental derivatives.[48] Futures, for example, are forwards which are traded on organized exchanges with standardized contractual terms and exchange-guaranteed contractual performance. A swap is defined to be the simultaneous exchange of cash flows derived from an underlying asset. Any swap is thus a series of forwards.[49] A fixed interest rate home

40. *See* Kimberly D. Krawiec, *More Than Just "New Financial Bingo": A Risk-Based Approach to Understanding Derivatives*, 23 J. CORP. L. 1, 17-63 (1997).

41. Lee Burton, *Understanding the Complex World of Derivatives*, WALL ST. J., June 14, 1994, at C1 (asking that and related questions and providing answers).

42. *See generally* Krawiec, *supra* note 40, at 6-14 (presenting a lucid and masterful synopsis of derivatives emphasizing the dichotomy between forward-based and option-based derivatives).

43. *See* JONATHAN E. INGERSOLL, JR., THEORY OF FINANCIAL DECISION MAKING 50 (1987) (providing a formal definition of a derivative).

44. *See* SALICH N. NEFTCI, AN INTRODUCTION TO THE MATHEMATICS OF FINANCIAL DERIVATIVES 2-3 (1996) (providing a list of underlying instruments).

45. *See id.* at 5 (defining a forward contract).

46. This example is taken from ROBERT W. KOLB, FUTURES, OPTIONS, & SWAPS 2 (2d ed. 1997).

47. *See* NEFTCI, *supra* note 44, at 7.

48. *See id.* at 5.

49. *See id.* at 9.

mortgage without penalty for early prepayment, for example, provides a homeowner with an option to refinance at lower mortgage rates. Such prepayment options motivated the development of collateralized mortgage obligations (CMOs) that are assets based on the pooling of mortgages.[50] Forwards and options are the basic building blocks of not only other derivatives, but also all assets because any asset—not just a derivative—can be synthesized by constructing a portfolio of the appropriate forwards and options.

By their very definition, derivatives are financial instruments whose payoffs depend on prices of underlying commodities or cash instruments. Thus, by trading in derivatives, economic agents can manage the risk of underlying market price volatility by shifting all or part of that risk to counter-parties who are more willing to assume or bear that risk.[51] Of course, economic agents may also trade in derivatives to speculate on the risk of underlying market price volatility by shifting all or part of that risk from counter-parties who are less willing to assume or bear that risk. This traditional account of the desirable role that derivatives can play in our financial system emphasizes their use in hedging underlying price risk.[52]

While primitive assets such as bonds and stocks help to allocate capital in an economy, derivatives help to allocate the risk from primitive asset price volatility. Derivatives "benefit the entire financial system by 'completing' markets (offering investors and traders risk and return patterns that previously were either unavailable or too costly)."[53] The debate over how to regulate derivatives requires a comparison of the important economic benefits that derivatives provide society with the real and not imagined costs they impose on society.[54] It is therefore imperative that policymakers have an "understanding of the costs and benefits associated with altering the pattern and practices of risk allocation in the economy. The implications of actions to regulate workings of the

50. *See, e.g.*, DAVID G. LUENBERGER, INVESTMENT SCIENCE 402-06 (1998) (providing more details about CMOs).

51. *See* George Parker, *Dimensions of Risk Management: Definition and Implications for Financial Services*, *in* RISK MANAGEMENT: PROBLEMS AND SOLUTIONS 1, 13 (William H. Beaver & George Parker eds., 1995) (explaining how derivatives reallocate risk).

52. *See* CHARLES W. SMITHSON & CLIFFORD W. SMITH, JR., MANAGING FINANCIAL RISK: A GUIDE TO DERIVATIVE PRODUCTS, FINANCIAL ENGINEERING, AND VALUE MAXIMIZATION 65 (1995) (explaining how derivatives hedge against unwanted risk).

53. Frank Partnoy, *Financial Derivatives and the Costs of Regulatory Arbitrage*, 22 J. CORP. L. 211, 213 (1997).

54. *See* Roberta Romano, *A Thumbnail Sketch of Derivative Securities and Their Regulation*, 55 MD. L. REV. 1, 5 (1996) (explaining that derivatives "serve important economic functions that cannot be overemphasized").

derivatives markets could be far-reaching."[55] This Article highlights a bona fide pecuniary externality cost of introducing new derivatives that is currently overlooked in legal and regulatory assessments of derivative innovations.[56]

In most countries, how derivatives are regulated depends on whether they are traded on or off exchanges. Derivatives traded on exchanges are regulated by government agencies. In the U.S., distinct federal agencies have jurisdiction over different kinds of derivatives with the Commodities Futures Trading Commission (CFTC) regulating futures contracts and the Securities and Exchange Commission (SEC) regulating securities and exchange-traded options. Derivatives traded off exchanges are also known as OTC derivatives. There are other differences between derivatives traded on exchanges and OTC derivatives besides where they are traded.[57] The acronym OTC standing for the phrase "Over the Counter" might suggest "standardized contracts sold like aspirins [sic] over a store counter."[58] But, in fact, the phrase "means exactly the opposite: specially tailored, bespoke derivatives cut to suit each customer. It is Saville Row to the futures exchanges' Oxford Street."[59] In other words, OTC derivatives are designer assets that are custom-made or financially engineered to meet—at least in principle—clients' specific requirements. OTC derivatives are not regulated or governed by any one particular government agency. But, as contracts, OTC derivatives are still governed by standard contract law principles. In addition, the International Swap and Derivatives Association (ISDA) is a trade association that oversees the swaps market by standardizing swap contractual terms.[60] Thus, ISDA lowers the transaction costs of initiating swaps, facilitates the swap transfer process, and permits a swap dealer to enter a position despite no immediate party being on the other side of the deal. The global markets for OTC derivatives evolved from a standing start fifteen years ago with total contract or notional value

55. Scott P. Mason, *The Allocation of Risk*, *in* THE GLOBAL FINANCIAL SYSTEM: A FUNCTIONAL PERSPECTIVE 153, 192 (Harvard Bus. Sch. Global Fin. Sys. Project ed., 1995).

56. *See infra* Part III.A.

57. *See* Mark A. Zurack, *Applications of OTC Options and Other Structured Products*, *in* THE HANDBOOK OF EQUITY DERIVATIVES, *supra* note 11, at 281, 282 tbl.13.1.

58. RICHARD THOMSON, APOCALYPSE ROULETTE: THE LETHAL WORLD OF DERIVATIVES 81 (1998).

59. *Id.*

60. *See, e.g.*, Alison M. Gregory, *Selected Issues: ISDA Master Agreement*, *in* SWAPS AND OTHER DERIVATIVES IN 1999, *supra* note 4, at 35.

increasing to $7 trillion in 1989 and to $56 trillion in 1995.[61] The Bank for International Settlements estimated notional value was $80 trillion at the start of 1999.[62] But, it is worth repeating that the value at risk for OTC derivatives is a mere fraction of their principal or notional value (only 4.6%) because the principal or notional amount does not usually change hands.[63]

The LTCM episode described in the introduction of this Part was only the latest in a series of well-publicized huge losses involving derivatives.[64] These losses total over $12 billion and seem to suggest that derivatives are inhereutly dangerous and/or too complex for at least some of their end-users to understand them and the various risks they involve. But the mere fact that some relatively wealthy and sophisticated parties have lost vast sums of money from trading in derivatives is not by itself a cause for social concern. This is because derivative transactions are what are called zero-sum games. In other words, the sum of the payoffs to a buyer and a seller in any derivatives trade is zero. Thus, any loss that is suffered by one side of a trade involving a derivative is exactly offset by a corresponding gain for the other side. This basic accounting fact is usually not mentioned in media and popular press accounts of losses from derivatives trading. What might be a cause for social concern is the alleged possibility that huge losses from trading in derivative assets could trigger a domino effect of bank collapses leading to systemic failure of global capital markets.[65] Such a rationale lies behind proposals for more prudential margins and minimum capital requirements for trading derivatives than currently exist. This is also the rationale behind the infusion of cash from a consortium of investment and commercial banks that the New York Federal Reserve

61. *See* Roberta Romano, *Derivative Securities Regulation*, *in* 1 THE NEW PALGRAVE DICTIONARY OF ECONOMICS AND THE LAW 590 (Peter Newman ed., 1998) [hereinafter THE NEW PALGRAVE].

62. *See* THE PRESIDENT'S WORKING GROUP ON FINANCIAL MARKETS, OVER-THE-COUNTER DERIVATIVES MARKETS AND THE COMMODITY EXCHANGE ACT 1, 3 (1999) (available at <http://www.treas.gov/press/releases/ps224.html>) (visited February 25, 2000).

63. *See* GENERAL ACCOUNTING OFFICE, FINANCIAL DERIVATIVES-ACTIONS TAKEN OR PROPOSED SINCE MAY 1994, at 5 (1996), *available in* 1996 WL 660583.

64. A partial list of investors who have suffered big public losses involving derivatives includes: Barrings Bank; Orange County, California; Metallgesellschaft A.G.; Dell Computer; San Diego County; Askin Capital Management; Odessa College; Municipal Electric Authority of Georgia; Showa Shell Sekiyu; Kashima Oil; Pacific Horizon Funds of Bank of America; Procter & Gamble; Community Bankers U.S. Government Money Market Fund; Gibson Greetings; and Air Products and Chemicals. *See* Brandon Becker & Jennifer Yoon, *Derivative Financial Losses*, 21 J. CORP. L. 215 (1995) (listing over 100 instances of what the popular press identifies as financial losses involving derivatives).

65. *See* Krawiec, *supra* note 40, at 47 (containing a thoughtful discussion of the systemic risk in derivatives trading and markets).

brokered together to buy out LTCM.[66] Of course, this event only fueled criticism that it was high time to impose tight regulatory controls over OTC derivatives to prevent similar crises. Some legal scholars fear that colorful depictions of such crises will cause knee-jerk regulatory overreactions.[67] Fortunately, there have not been any hasty statutory reforms thus far. Certainly, the recent headline-making losses involving OTC derivatives prompted another round of academic studies and government reports regarding OTC derivatives markets. Regulatory proposals included the CFTC serving as a gatekeeper for OTC derivatives or the CFTC using the Commodities Exchange Act (CEA) to declare OTC derivatives legally unenforceable.[68]

Derivatives permit global capital market participants to hedge volatility in those underlying financial markets. Yet many past and current U.S. regulatory debates about derivatives only pay lip service to hedging risks efficiently and instead revolve around political or jurisdictional turf battles. This type of interagency fighting is a product of our country's path-dependent financial regulatory maze. Whether a new derivative is classified as a futures contract or a security determines whether the CFTC or the SEC, respectively, regulates that new derivative. The United States might some day adopt a functional approach to financial regulation instead of the prevailing division of the "pizza pie" of assets that results from squeezing assets into prescribed legal pigeonholes. Recent legislation "allows banks, securities firms and insurance companies to form one-stop financial conglomerates marketing a range of financial products such as annuities, certificates of deposit, stocks, and bonds."[69] This essential repeal of the Glass-Steagall Act of 1933[70] may be a harbinger of things to come. But, in the meantime, derivatives regulation is a complicated regime consisting of a messy "patchwork quilt" of agency decisions, case law, regulations, and statutes that are the "product of a political compromise in a longstanding jurisdictional turf battle between the SEC and the CFTC and

66. *See* Lewis, *supra* note 37, at 71; Anita Raghavan & Mitchell Pacelle, *A Hedge Fund Falters and Big Banks Agree To Ante Up $3.5 Billion*, WALL ST. J., Sept. 24, 1998, at A1 (reporting on the fear of systemic risk as motivating the Federal Reserve's involvement).

67. *See* Jonathan R. Macey, *Wall Street Versus Main Street: How Ignorance, Hyperbole, and Fear Lead to Regulation*, 65 U. CHI. L. REV. 1487, 1509 (1998) (reviewing FRANK PARTNOY, F.I.A.S.C.O.: THE INSIDE STORY OF A WALL STREET TRADER (1999)).

68. *See* Lynn A. Stout, *Why the Law Hates Speculators: Regulation and Private Ordering in the Market for OTC Derivatives*, 48 DUKE L.J. 701, 767, 775 (1999) (proposing regulatory intervention in OTC derivatives markets).

69. Michael Schroeder, *Clinton Signs Financial-Services Bill, But Cautions About Privacy Shortfalls*, WALL ST. J., Nov. 15, 1999, at A41.

70. 12 U.S.C. §§ 24, 78, 377, 378 (1994).

their clientele exchanges."[71] Innovators of derivatives in the U.S. face a host of legal and regulatory uncertainties that result from our tangled definitional web approach to regulating assets.[72] There are many excellent detailed accounts of the current U.S. classification-based, compartmentalized and overlapping regulations of derivatives.[73] Although many commentators bemoan such a hodge-podge and prefer a single financial super-regulator, other commentators believe that jurisdictional competition promotes efficiency in regulation.[74]

It is often claimed that derivatives are merely instruments for speculation. In contrast, the primary markets for primitive assets, such as bonds and stock, allow households to save or invest and permit corporations to raise capital. While derivatives permit individuals and organizations to insure against fluctuations in the prices of primitive assets, derivatives also facilitate betting on primitive asset prices. The fact that trading in derivatives is a zero-sum game between the counter-parties and an analogy to gambling is probably responsible for the view that derivative asset markets are just like huge organized casinos.[75] Of course, this analogy underplays the important social benefits that derivatives markets provide not only in terms of additional hedging opportunities, but also in terms of the primitive assets' increased liquidity and public price information.

But, secondary market trading for even primitive assets can be the result of differences in any of the following: tastes for risk and for patience, random initial endowments over time, productivity in transforming initial endowments into marketable commodities, or beliefs concerning the future

71. Romano, *supra* note 54, at 44.

72. *See* Thomas A. Russo & Marlisa Vinciguerra, *Financial Innovation and Uncertain Regulation: Selected Issues Regarding New Product Development*, 69 TEX. L. REV. 1431, 1460 (1991).

73. *See* MCLAUGHLIN, *supra* note 8, at 181-227; Thomas A. Russo & Marlisa Vinciguerra, *Developments in U.S. Derivatives Regulation*, *in* THE HANDBOOK OF EQUITY DERIVATIVES, *supra* note 11, at 609; Thomas A. Russo & Marlisa Vinciguerra, *Financial Regulation and Title V of the Futures Trading Practices Act of 1992*, FUTURES INT'L L. LETTER, Nov.-Dec. 1992, at 11-19. *See, e.g.*, EDWARD F. GREENE, ALAN L. BELLER, GEORGE M. COHEN, MANLY O. HUDSON, JR. & EDWARD J. ROSEN, 2 U.S. REGULATION OF THE INTERNATIONAL SECURITIES AND DERIVATIVES MARKETS §§ 13.01-.06 (4th ed. 1998); Joanne T. Medero, *Swaps and Other Derivatives: Regulatory and Legislative Developments*, 10 REV. BANKING & FIN. SERVICES 117 (1994).

74. *See* Edward J. Kane, *Regulatory Structure in Futures Markets: Jurisdictional Competition Between the SEC, the CFTC, and Other Agencies*, 4 J. FUTURES MARKETS 367, 383 (1984); Gary L. Seevers, *Comments on "Innovation, Competition and New Contract Design in Futures Markets"*, 1 J. FUTURES MARKETS 157, 158 (1981) (arguing that jurisdictional competition may result in efficiency benefits and regulation more responsive to market participants and exchanges).

75. *See* Lynn A. Stout, *Are Stock Markets Costly Casinos? Disagreement, Market Failure, and Securities Regulation*, 81 VA. L. REV. 611, 705 (1995).

states of the world. The observed volume and price volatility of both primitive and derivative asset trading seems to be much greater than can be explained by differences in preferences, income, or capabilities. However, if a significant amount of asset trading is due to differences in traders' expectations, there are two puzzles. First, why do investors have diverse beliefs? Second, if the answer to the first question is that expectations vary due to differential knowledge, then why do informational disparities persist? In other words, why does one trader's willingness to trade not lead the other trader to suspect that the former has private knowledge and thus lead the latter to refuse to trade on the proposed terms?[76]

Such no-trade results are memorably called "Groucho Marx" propositions in which a rational trader is never willing to trade with another rational trader who is willing to trade with that first trader on the proposed terms.[77] There are necessary and sufficient conditions on the degree of irrationality traders must exhibit for those traders to bet, speculate, or agree to disagree with each other.[78] Thus, if we observe speculation involving derivatives and the conditions of these formal results apply, then we may logically conclude from these necessary and sufficient conditions that some traders experience certain specific types of information processing difficulties. That conclusion in turn has implications for regnlating derivatives markets. Much of the current U.S. federal securities regnlatory philosophy is based on a model of consumer sovereignty. In contrast to the merit-based regnlation of some state blue-sky securities laws, our federal securities laws are based on an overall principle of disclosure regnlation. Such a nonpaternalistic policy assumes that investors not only can, but also do process disclosed information by and large in a uniform and unbiased fashion. Yet, evidence from behavioral economics and behavioral finance suggests that cognitive biases most likely permeate human processing of

76. For formal statements of the no-trade results, see John D. Geanakoplos & Heraklis M. Polemarchakis, *We Can't Disagree Forever*, 28 J. ECON. THEORY 192 (1982); Paul Milgrom & Nancy Stokey, *Information, Trade and Common Knowledge*, 26 J. ECON. THEORY 17 (1982). For the applicability to legal policy about speculation, see Paul G. Mahoney, *Is There A Cure for "Excessive" Trading?*, 81 VA. L. REV. 713 (1995) (proposing agency costs as an alternative rationale for excessive trading); Lynn A. Stout, *Agreeing To Disagree over Excessive Trading*, 81 VA. L. REV. 751 (1995) (arguing that excessive trading is due to heterogeneous beliefs).

77. Groucho Marx reportedly said that he would never date any woman who would be willing to date him nor join a club that would accept him as a member.

78. For articles stating and proving such conditions, see John D. Geanakoplos, Game Theory Without Partitions and Applications to Speculation and Consensus (1989) (unpublished manuscript, Cowles Found. Discussion Paper 914, Yale University, on file with author); Dov Samet, *Ignoring Ignorance and Agreeing to Disagree*, 60 J. ECON. THEORY 1 (1990).

information.[79] Certain aspects of the federal securities registration process, such as the quiet period and the prohibitions against conditioning the market by gun-jumping, are best understood as responses to behavioral heuristics.[80] Finally, the multidimensional nature of risks can overwhelm learning by asset market participants and lead to herding, informational cascades and price bubbles.[81] As the number of dimensions or sources of risk increase, so does the likelihood that asset markets are incomplete. But, derivatives provide a source of multidimensionality in prices that might in turn reduce herding and price bubbles.[82]

Professor Lynn Stout argues that recent financial theoretical models of investors with heterogeneous beliefs have anti-speculative implications for regulating OTC derivatives.[83] The recent study of investors with rational but heterogeneous beliefs is beginning to generate much renewed interest among economists.[84] Thus, it might be important for legal scholars to understand the implications for securities regulation of models inhabited by investors who have diverse but rational beliefs. In a series of articles, Stout argues that models involving heterogeneous expectations provide novel insights about derivatives trading,[85] excessive trading,[86] mandatory

79. *See generally* GARY BELSKY & THOMAS GILOVICH, WHY SMART PEOPLE MAKE BIG MONEY MISATKES AND HOW TO CORRECT THEM: LESSONS FROM THE NEW SCIENCE OF BEHAVIORAL ECONOMICS (1999); HERSH SHEFRIN, BEYOND GREED AND FEAR: UNDERSTANDING BEHAVIORAL FINANCE AND THE PSYCHOLOGY OF INVESTING (2000).

80. *See* Robert B. Thompson, *Securities Regulation in an Electronic Age: The Impact of Cognitive Psychology*, 75 WASH. U. L.Q. 779, 783 (1997).

81. *See* Christopher Avery & Peter Zemsky, *Multidimensional Uncertainty and Herd Behavior in Financial Markets*, 88 AM. ECON. REV. 724, 731-36, 740 (1998) (demonstrating the possibility of herd behavior, informational cascades and price bubbles when there are several dimensions of risk).

82. *See id.* at 741 (conjecturing that multidimensional prices lead to less pronounced herding and price bubbles and noting that derivatives such as options provide a natural source of multidimensional prices).

83. *See* Stout, *supra* note 68, at 741 (discussing regulatory implications of investors with heterogeneous beliefs).

84. *See* SERGIO FOCARDI & CAROLINE JONAS, MODELING THE MARKET: NEW THEORIES AND TECHNIQUES 10 (1997) (describing potential forecasting applications of Kurz's research). *See also, e.g.*, ENDOGENOUS ECONOMIC FLUCTUATIONS: STUDIES IN THE THEORY OF RATIONAL BELIEFS (Mordecai Kurz ed., 1997) (describing this research).

85. *See generally* Lynn A. Stout, *Betting the Bank: How Derivatives Trading Under Conditions of Uncertainty Can Increase Risks and Erode Returns in Financial Markets*, 21 J. CORP. L. 53 (1995) (arguing that derivatives trading can be socially harmful).

86. *See* Stout, *supra* note 76, at 755; Lynn A. Stout, *Irrational Expectations*, 3 LEGAL THEORY 227, 239-47 (1997) (criticizing rational expectations models and no-trade results for their theoretical and empirical weaknesses). *But see* Mahoney, *supra* note 76, at 715 (providing an alternative reason for excessive trading).

disclosure,[87] corporate financial behavior,[88] and legal rules against speculation.[89]

Even if some people use derivatives to speculate on underlying financial prices or volatility, other people can also use those same derivatives to realize a myriad of nonspeculative objectives. People can utilize derivatives to gain information, hedge, change their financial positions without trading, raise or invest cash, change yields, calm corporate customers, profit from relative mispricing, diversify, customize payoffs, and insure against disasters.[90] This Article focuses on the roles that derivatives play in diversifying or hedging risks, raising or investing cash, customizing payoffs, and insuring against financial disasters.

III. THE GENERAL EQUILIBRIUM THEORY OF INCOMPLETE ASSET MARKETS

The neoclassical financial economic theory of competitive asset markets is built upon a particular conception of individual decisionmaking. This conception is that of a rational actor making decisions in the face of risk. A well-known economist once distinguished "risk" from "uncertainty" as follows.[91] When facing risk, a decisionmaker faces randomness that involves quantifiable probability distributions.[92] When facing uncertainty, a decisionmaker faces randomness that is not quantifiable in terms of probability distributions. The moderu view of randomness as quantifiable risk is very much that of statistical decision theory.[93] The alternative viewpoint of randomness as uncertainty has its ardent supporters, including the famous macroeconomist John Maynard Keynes.[94] Indeed, the twists and turns of various attitudes toward, and

87. *See* Stout, *supra* note 75 (arguing for a different regulatory philosophy for the SEC).

88. *See* Lynn A. Stout, *How Efficient Markets Undervalue Stocks: CAPM and ECMH Under Conditions of Uncertainty and Disagreement*, 19 CARDOZO L. REV. 475, 475 (1997) (arguing for a different philosophy towards corporate takeover law).

89. *See* Stout, *supra* note 68, at 770-82 (arguing for anti-speculation based laws).

90. *See* Black, *supra* note 11, at ix-xi.

91. *See* FRANK KNIGHT, RISK, UNCERTAINTY, AND PROFIT 233 (1921) (distinguishing between risk and uncertainty).

92. *See id.*

93. *See generally* LEONARD J. SAVAGE, THE FOUNDATIONS OF STATISTICS (1954) (describing modern statistical decision theory).

94. *See* JOHN MAYNARD KEYNES, A TREATISE ON PROBABILITY 22-28 (1921) (discussing how insurance underwriting business practices and judicial opinions endorse the general position that much of economic randomness is difficult to quantify precisely); JOHN MAYNARD KEYNES, THE GENERAL THEORY OF EMPLOYMENT INTEREST AND MONEY 149-152 (1936) (arguing that expectations about long-term investments are ultimately based on precarious conventions rather than rational intuitions).

conceptions of, randomness are fascinating.[95] The pendulum of perception of randomness has alternated between intuitive feeling and quantitative measurement. The word "risk" comes from two sources: the Greek "rhiza" that relates to sailing around a cliff and the Italian "risicare" that means to dare.[96] While many laboratory experimental findings document that most people view randomness as uncertainty rather than risk, models of randomness as uncertainty instead of risk only recently appeared in the theoretical economics literature.[97]

In fact, theoretical economics is currently undergoing a renaissance of interest about uncertainty in the sense that Frank Knight used the term, namely to describe situations in which randomness entails unknown probabilities.[98] Theoretical financial applications of such uncertainty include the optimal choice of a portfolio,[99] excess volatility of stock prices,[100] inter-temporal asset pricing,[101] the information revealed by security prices,[102] and the incompleteness of contracts.[103] A legal and regulatory application of Knightian uncertainty explains the current United States regulation of derivatives as the result of what demanders and suppliers of such regulation desire.[104] A recent general equilibrium model formally shows how incomplete asset markets can occur endogenously due

95. *See* Peter L. Bernstein, *Risk as a History of Ideas*, FIN. ANALYSTS J., Jan.-Feb. 1995, at 10 (describing the history of humanity's perceptions of randomness).

96. *See id.* at 8.

97. *See generally* Colin Camerer & Martin Weber, *Recent Developments in Modeling Preferences: Uncertainty and Ambiguity*, 5 J. RISK & UNCERTAINTY 325 (1992) (providing an overview of the experimental and theoretical literature on ambiguity).

98. For a theoretical model of Knightian uncertainty, see David Schmeidler, *Subjective Probability and Expected Utility Without Additivity*, 57 ECONOMETRICA 571 (1989).

99. *See generally* James Dow & Sergio Ribeiro Da Costa Werlang, *Uncertainty, Risk Aversion, and the Optimal Choice of a Portfolio*, 60 ECONOMETRICA 197 (1992) (modeling an investor's portfolio choice problem in the presence of uncertainty).

100. *See generally* James Dow & Sergio Ribeiro Da Costa Werlang, *Excess Volatility of Stock Prices and Knightian Uncertainty*, 36 EUR. ECON. REV. 631 (1992) (modeling uncertainty as a cause of excess stock price volatility).

101. *See generally* Larry Epstein & Tan Wang, *Intertemporal Asset Pricing Under Knightian Uncertainty*, 62 ECONOMETRICA 283 (1994) (modeling multi-period asset pricing in the presence of uncertainty).

102. *See* Jean-Marc Tallon, *Asymmetric Information, Nonadditive Expected Utility, and the Information Revealed By Prices: An Example*, 39 INT'L ECON. REV. 329 (1998) (modeling how asset prices can reveal private information in the presence of uncertainty).

103. *See* Sujoy Mukerji, *Ambiguity Aversion and Incompleteness of Contractual Form*, 88 AM. ECON. REV. 1207, 1220 (1998) (modeling incomplete contracts in the presence of uncertainty).

104. *See* Christopher L. Culp, *Functional and Institutional Interaction, Regulatory Uncertainty, and the Economics of Derivatives Regulation*, *in* DERIVATIVES HANDBOOK: RISK MANAGEMENT AND CONTROL 458, 464-65, 486-87 (Robert J. Schwartz & Clifford W. Smith, Jr. eds., 1997).

to uncertainty-averse investors.[105] The motivation behind uncertainty-aversion is that decisionmakers often possess ambiguous or vague information concerning the randomness they face.[106] There are numerous experimental studies, such as Ellsberg's paradox,[107] finding that people are uncertainty averse. The intuition supporting these findings, all other things being equal, is that the more vague a decisionmaker's knowledge over the uncertainty she faces the more conservatively she acts. The long-awaited November 1999 report prepared by the President's Working Group on Financial Markets entitled "Over-The-Counter Derivatives Markets and the Commodity Exchange Act" recommended changing the CEA to promote innovation in OTC derivatives markets by providing legal certainty for OTC derivatives.[108] Uncertainty aversion on the part of OTC derivative transaction counter-parties offers cognitive and empirical reasons to support that recommendation.

The canonical financial economic framework for studying the role of assets in allocating risk is the general competitive equilibrium model of asset markets developed by Nobel Prize-winning economist Kenneth J. Arrow.[109] His formulation of competitive asset markets has become the prototypical model *par excellence* of theoretical financial economics. Arrow studied a competitive economy with not only commodity markets, but also a complete set of state-contingent asset markets. The concept of a

105. *See* Sujoy Mukerji & Jean-Marc Tallon, Ambiguity Aversion and Incompleteness of Financial Markets (Oct. 1998) (unpublished manuscript, presented at the Economic Theory workshop, University of Pennsylvania, on file with the author) (modeling uncertainty as a cause for incomplete asset markets).

106. *See* SHEFRIN, *supra* note 79, at 20-21 (discussing aversion to ambiguity and fear of the unknown as its emotional aspect with an application to what motivated the participants in the private rescue of Long-Term Capital Management).

107. *See* Daniel Ellsberg, *Risk, Ambiguity, and the Savage Axioms*, 75 Q.J. ECON. 643 (1961). In the original description of this paradox, an urn contains 100 balls of the same weight and size. In fact, all 100 balls are indistinguishable except for color. The urn contains 30 red balls and 60 other balls that are blue and yellow in unknown proportions. One ball is drawn at random from this urn. Experiments find that many people will prefer to bet on that randomly drawn ball being red rather than blue and will prefer to bet on that randomly drawn ball being blue or yellow rather than red or yellow.

108. *See* THE PRESIDENT'S WORKING GROUP ON FINANCIAL MARKETS, *supra* note 62, at 3. *See also* Alan Greenspan, *Testimony Before the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate* (Feb. 10, 2000) (transcript available at <http://www.bog.frb.fed.us/boarddocs/testimony/2000/20000210.htm> (supporting recommendations of the President's Working Group on Financial Markets to modernize the CEA by removing legal uncertainties regarding OTC derivatives).

109. *See* Keuneth J. Arrow, *Le Role des Valeurs Boursieres Pour la Repartition la Meillure des Risques*, 40 ECONOMETRIE COLLOQUES INTERNATIONAUX DU CENTRE NATIONAL DE LA RESERCHERCHE SCIENTIFIQUE 41 (1953); Kenneth J. Arrow, *The Role of Securities in the Optimal Allocation of Risk Bearing*, 31 REV. ECON. STUD. 91 (1964) (providing a formal theoretical model of the role of complete and competitive asset markets in allocating risk).

state of the environment, or state of the world, or state of nature (not the Nature of property rights) represents the randomness of the world in terms of risk over which state of the world will occur. The states of the world form an exhaustive and mutually exclusive description of the risk that economic agents care about. Their exhaustiveness means that at least one state must occur, while their mutual exclusiveness means that at most one state will realize. Thus, a flip of a fair, unbiased coin will result in one of two possible states: heads or tails. Many financial valuation models are based on Arrow's paradigm of states of the world. Examples of such theories include the binomial or two-state option pricing models pioneered by Sharpe and extended by Cox, Ross, and Rubinstein, in which underlying prices are treated as exogenous states instead of as endogenous variables whose values are determined in an equilibrium model.[110]

Arrow assumed that there are as many asset markets as there are possible states of the world. This assumption is a very strong and counterfactual one. Introspection reveals that although there are many asset markets, there are far fewer asset markets than conceivable states. Complete asset markets mean that any possible payoff pattern over time and under alternative future scenarios can be achieved by trading on asset markets. Arrow's model of a complete set of competitive asset markets extends his and Gerard Debreu's neoclassical general equilibrium (GE) model of an economy under certainty with competitive commodity markets but no asset markets.[111] Not only did this canonical GE model clarify the precise minimal set of conditions for existence of a GE, but it also formalized Adam Smith's metaphor of an invisible hand.[112] Arrow and Debreu formally proved what have come to be known as the two fundamental theorems of welfare economics, namely that the GE of a system of competitive markets is Pareto-efficient (the first theorem) and conversely that any Pareto-efficient allocation is the GE of competitive markets after the government makes income transfers (the second

110. *See* WILLIAM F. SHARPE, INVESTMENTS ch. 16 (2d ed. 1981) (providing the first example of binomial option pricing). *See generally* James C. Cox, Stephen A. Ross & Mark Rubinstein, *Option Pricing: A Simplified Approach*, 7 J. FIN. ECON. 229 (1979); Richard J. Rendleman, Jr. & Brit J. Bartter, *Two-State Option Pricing*, 34 J. FIN. 1093 (1979) (building complete models based on Sharpe's insight).

111. *See generally* Kenneth J. Arrow & Gerard Debreu, *Existence of an Equilibrium for a Competitive Economy*, 22 ECONOMETRICA 265 (1954) (proving existence and Pareto efficiency of GE in a model of competitive commodity markets).

112. *See* ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 423 (Edwin Cannan ed., Modern Library 1937) (providing metaphor of an invisible hand).

theorem).[113] These results "stand as the cornerstone of postwar normative economics, and the Arrow and Debreu proofs contain perhaps the best known arguments in the history of formal economics. Part of the attraction of the theorems is that they seem to justify the sweeping market reforms that economists have long advocated."[114]

GE theory proceeded to provide a standard research paradigm for analyzing the equilibrium properties of a decentralized system of competitive markets. The archetypal research paradigm is to demonstrate that a competitive equilibrium satisfies five desirable properties: existence, Pareto-efficiency, uniqueness, stability, and robustness. Of course, the sufficient conditions for each of these properties can and usually will differ across the properties. Existence of a competitive equilibrium can be thought of as checking for the internal consistency of the model. Pareto-efficiency of a competitive equilibrium can be viewed as providing a minimal welfare criterion. Uniqueness of a competitive equilibrium requires quite restrictive hypotheses. But, local uniqueness or determinacy does not require such restrictive assumptions and it suffices to permit analysis of how a particular equilibrium changes as the parameters of a GE model vary.[115] Stability of a competitive equilibrium can refer to global or local stability. A GE is globally stable if it is the asymptotic limit of a dynamic adjustment process defined globally over the space of all possible prices. A GE is locally stable if small disturbances to it set in motion forces that will lead to a return to it. Finally, robustness, or structural stability, holds if a competitive equilibrium exists for most of typical parameter values of the model.[116] In other words, nonexistence of a competitive equilibrium is rare or accidental.

The adjective "general" distinguishes general equilibrium analysis from partial equilibrium analysis, which studies a particular market by itself in isolation from the rest of an economy. Thus, the demand and supply analysis taught in an introductory microeconomics principles course focuses on a discrete and insular competitive market, such as the market for artichokes or that for broccoli. Usually, demand and supply analysis only mentions in passing the notion of complements, such as tea and lemons,

113. *See generally* Kenneth J. Arrow, *An Extension of the Basic Theorems of Classical Welfare Economics, in* SECOND BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS & PROBABILITY (J. Neyman ed., 1951); Gerard Debreu, *The Coefficient of Resource Utilization*, 19 ECONOMETRICA 273 (1951).

114. MICHAEL MANDLER, DILEMMAS IN ECONOMIC THEORY: PERSISTING FOUNDATIONAL PROBLEMS OF MICROECONOMICS 151 (1999).

115. Economists refer to such an analysis as comparative statics.

116. Economists refer to robustness as regularity or genericity.

and the notion of substitutes, such as coffee and tea. It is only in an intermediate microeconomics course that students learn about GE theory, usually in preparation for covering the first and second fundamental theorems of welfare economics.[117] Although undergraduates are often caught up in the algebra of solving a system of simultaneous equations, the main conceptual point of GE analysis is that an economy is an interconnected systemic whole that cannot be simply decomposed into its individual component sectors or markets. A consumer's demand for any particular commodity x depends not only upon its own price, but also upon other commodity prices. Economists decompose such price dependencies into two components. First, when the price of a commodity y changes, there is a change in the rate at which the market permits a consumer to substitute between commodities x and y. This change in relative prices causes a change in a consumer's demand for commodity x. That change in consumer demand is known as the substitution effect,[118] so named because a consumer substitutes away from relatively more expensive commodities towards relatively more inexpensive commodities. Second, when the price of a commodity y changes, there is a change in a consumer's real (in contrast with nominal) income or purchasing power. This change in real income also causes a change in a consumer's demand for commodity x. That change in consumer demand is known as the income effect,[119] so named because a consumer has less real income when the price of a commodity y increases and more real income when the price of a commodity y decreases. Similarly, due to substitutability in production technologies, a firm's supply for any particular commodity depends not only upon the prices of other available commodities, but also upon the prices of inputs.

The above set of price interdependencies applies to markets for both commodities and assets. Indeed, the income and substitution effects for investors' demands and the substitution effects for the supply of assets will often be quite large in their magnitudes "because of the high degree of substitutability and low transaction costs that characterize modern capital markets."[120] Such income and substitution effects play key roles in explaining many of the phenomena that can occur in a GE model that cannot occur in partial equilibrium analysis.

117. *See, e.g.*, HAL R. VARIAN, INTERMEDIATE MICROECONOMICS: A MODERN APPROACH 522-23, 529 (5th ed. 1999) (providing an exposition of the first and second welfare theorems).

118. *See id.* at 137 (defining the substitution effect of a price change).

119. *See id.* at 141 (defining the income effect of a price change).

120. Joseph A. Grundfest, *The Limited Future of Unlimited Liability: A Capital Markets Perspective*, 102 YALE L.J. 387, 390 (1992).

Aside from being technically incorrect when speaking of a single market being in equilibrium because markets are interconnected, GE analysis is particularly appropriate for studying derivatives innovation and financial engineering because of capital markets' increasing globalization and linkages to derivatives markets. Advances in telecommunications and information technologies mean that derivative markets and their underlying asset markets are linked more than ever with each other. This includes the markets for derivatives and their underlying assets as well as asset markets in other countries. The Latin America debt problems, the Russian financial debacle, and the Asian currency crisis all had large impacts on capital and asset markets physically removed from those regions. In addition, advances in computing technologies make possible sophisticated quantitative trading and statistical arbitrage involving derivative assets, the underlying assets those derivatives are based upon, and foreign assets. The age of digital capitalism can be summarized by saying that capital is quite mobile in responding to relative prices between international asset markets, derivative asset markets and related underlying asset markets. This fluidity has increased in speed and scope over recent years. For all of these reasons, a GE approach to financial innovation and engineering is more descriptively realistic than any partial equilibrium analysis of those same phenomena.

A recent development in theoretical financial economics is modeling a society with competitive but incomplete asset markets.[121] An impetus for this flurry of research is that real world asset markets remain incomplete despite the fact that in the limit, adding enough options markets can effectively complete asset markets.[122] In other words, "[d]espite the dramatic advance of derivatives during recent years, the real world is still a far cry from the Arrow-Debreu benchmark. And, although derivatives will contribute to moving the real world closer to the theoretical ideal, it will always remain far removed."[123] When asset markets are incomplete, there are some profiles or distributions of payoffs across time and over possible futures that investors cannot realize by trading on the existing asset markets. The general equilibrium of incomplete asset markets (GEI) theory sheds light on the potential for and limits of asset innovation in hedging risk. This theory is now over a quarter of a century old and provides the

121. *See generally, e.g.*, MICHAEL MAGILL & MARTINE QUINZII, THEORY OF INCOMPLETE MARKETS (1996) (providing an exposition of GEI).

122. *See generally* Stephen A. Ross, *Options and Efficiency*, 90 Q.J. ECON. 75 (1976) (proving that introducing sufficiently many options markets complete asset markets).

123. STEINHERR, *supra* note 6, at 134.

foundation for a rigorous analysis of government regulatory policy towards derivatives. GEI theory answers three important distinct but related questions. First, are the incomplete asset markets that exist in a particular society the appropriate ones for that economy? In other words, do the benefits of introducing any particular new derivative market, such as a futures market written on a commodity, exceed the costs that derivative market would have on society? Second, even if a benevolent regulator is constrained to not introduce new assets and only utilize the existing set of asset markets, can that benevolent regulator make everyone better off by reallocating portfolio holdings of those existing incomplete set of assets? In other words, do market forces ensure that the existing incomplete asset markets function to their full potential? Third, for both of the above questions, there is a further implementation question. That is whether informational and political economy considerations render any theoretically beneficial government regulatory interventions unlikely. After all, "[t]he important issue is not whether some idealized notion of a 'free market' is superior to some idealized notion of 'regulation.'"[124]

A. GENERIC NORMATIVE INDETERMINACY OF DERIVATIVES INNOVATIONS

An early numerical example in the literature demonstrated that introducing new derivative asset markets could move society from one GEI to another that is Pareto-dominated by that original GEI.[125] The possibility that a particular GEI may Pareto-dominate another means that the process of derivative innovation does not necessarily increase societal welfare monotonically in the number of assets. A standard argument of those seeking approval from the CFTC to market a new futures contract is that the new asset expands the set of potential investments available to investors. Indeed, the new futures contract is presumably designed and test-marketed to address the hedging requirements of a particular group of investors. The fact that introducing additional assets brings asset markets closer to being complete probably explains the prevailing economic and regulatory orthodoxy that new derivatives should be routinely approved unless there are clearly problems from introducing those new derivatives. "[S]ince incomplete markets [sic] equilibria are in general suboptimal,

124. David E. Van Zandt, *The Market as a Property Institution: Rules for the Trading of Financial Assets*, 32 B.C. L. REV. 967, 1025 (1991).

125. *See* Oliver Hart, *On the Optimality of Equilibrium When the Market Structure Is Incomplete*, 11 J. ECON. THEORY 418, 439-42 (1975) (providing a counter-example to the proposition that adding assets to an incomplete asset market economy is always Pareto-improving).

there will be demand by agents for increased opportunities to manage risk, and fulfilling this demand should increase the welfare of everyone in the economy. After all, the argument runs, with more choices, how can anyone go wrong?"[126] While adding the last asset market before complete asset markets are achieved is clearly a Pareto-improvement over the situation where just one asset was missing, that same logic and reasoning does not apply when more than just one asset is missing.

Hart constructed a particular numerical example demonstrating that if more than one asset market is required to complete asset markets, as is most likely the case, then derivative innovation can decrease the welfare of all consumers and investors.[127] Economic theorists have only recently demonstrated the robustness and generality of the phenomenon captured by Hart's example. Sufficient conditions for asset innovations to be Pareto-improving are quite restrictive. For example, if an economy has only a single commodity, generically there is an asset whose introduction makes everybody better off.[128] But, for generic economies with at least two commodities, if asset markets are sufficiently incomplete, then derivative innovation can arbitrarily perturb households' equilibrium utilities.[129] In other words, new derivatives can make all households better off, all worse off, or however one's heart desires in terms of the distribution of welfare. This result might seem counterintuitive because derivative innovation enlarges the choice sets available to households by increasing their attainable span from trading in assets of income levels across different states of the world. But, such a result becomes intuitively clearer upon realizing that an increase in hedging opportunities and households utilizing such new opportunities affects the set of existing hedging opportunities including changing the prices of existing assets and commodities. Those asset market price changes effectively shift income over time while those commodity market price changes effectively transfer income across possible future states of the world when there is more than one commodity. Investors will typically disagree about how to value an extra amount of

126. Ronel Elul, *Welfare Effects of Financial Innovation in Incomplete Markets with Several Consumption Goods*, 11 J. ECON. THEORY 43, 43 (1995).

127. For an example of an economy with two consumers, two commodities, three dates, two states of the world, and no assets, in which opening a commodity futures market can make both consumers worse off than before that asset innovation, see Hart, *supra* note 125, at 439-42.

128. *See* Ronel Elul, *Welfare-Improving Financial Innovation with a Single Good*, 13 ECON. THEORY 25, 25-27, 33 (1999) (proving this result).

129. *See* David Cass & Alessandro Citanna, *Pareto Improving Financial Innovation in Incomplete Markets*, 11 ECON. THEORY 467, 469 (1998) (proving the welfare indeterminacy of generic financial innovation); Elul, *supra* note 126, at 55, 58-73 (proving that for generic economies it is possible to arbitrarily perturb investors' equilibrium utilities by asset innovation).

consumption across these states if asset markets are sufficiently incomplete. In other words, "prices will generally change when a new nonredundant asset is added to the market, even when the number of existing securities is large."[130]

B. GENERIC CONSTRAINED INEFFICIENCY OF INCOMPLETE ASSET MARKETS

A main lesson of GEI theory is that if asset markets are incomplete, they may work rather poorly. To extend Adam Smith's famous metaphor, an invisible hand with two fingers missing not only is not as effective as an invisible hand with all five fingers, but such a hand also does not even utilize its remaining three fingers as well as can be done.[131] Some of the properties of a complete asset market GE must be significantly modified for a GEI, while other properties of a complete asset market GE may fail to hold altogether for a GEI. An example of the latter is that a GEI will no longer exist for all possible values of the parameters describing an economy, such as tastes, initial resources, production technologies, and marketed assets. Instead, GEI only exist for most values of the parameters describing an economy. An example of the former is that when asset markets are incomplete, Pareto-efficiency is not an appropriate welfare criterion because when asset markets are missing, being unable to reach a first-best outcome is not surprising. Instead, the welfare criterion should be less demanding than unconstrained Pareto-efficiency. A possible welfare criterion is that of constrained Pareto-efficiency or allocating resources as efficiently as can be done utilizing the existing set of incomplete asset markets. When an economy has more than one commodity, a GEI usually fails to satisfy even such a limited concept of efficiency.[132] In other words, a GEI is constrained Pareto-inefficient for most or typical economies.

But, if asset markets remain incomplete in the face of derivative asset innovations, a benevolent regulator can in principle improve the utilities of investors by reallocating their portfolios of existing assets without

130. Nils H. Hakansson, *The Fantastic World of Finance: Progress and the Free Lunch*, 14 J. FIN. & QUANTITATIVE ANALYSIS 717, 723 (1979).

131. My colleague Seth Kreimer suggested this vivid metaphor.

132. Naturally, the case of an economy with just one commodity is unlikely. But in such an economy with just one commodity in each state of the world, an asset allocation determines a unique allocation for that commodity independent of individual preferences because there is only a single commodity for individuals to spend their income on and consume. Hence, such an economy is equivalent to an economy where preferences are defined on asset allocations directly instead of on allocations of that one commodity.

completing asset markets.[133] Such a result demonstrates that competitive but incomplete asset markets not only fail to achieve the first-best world that occurs under a complete set of competitive asset markets, but also they even fail to allocate resources and risk as efficiently as is possible given those incomplete asset markets. Thus, GEI models provide a theoretical basis for governmental intervention to improve asset market performance and investors' welfare.

The reason why GEI typically are constrained Pareto-inefficient is that in a GEI, households "trade assets given spot market prices. In the notion of constrained Pareto-efficiency, the fictive planner can anticipate the changes in spot market prices that are induced by reallocating assets among consumers. This gives him some extra flexibility to redistribute income across states."[134]

In other words, a reallocation of asset portfolio holdings could alter spot commodity market prices that in turn causes a redistribution of real income not attainable by trading assets at their current prices. This is only possible in a GEI because in a complete asset market, any pattern of real income is attainable by trading in assets. The last fact is of course the *raison d'être* for the difference between complete and incomplete asset markets.

The feedback effect of asset portfolio holdings on spot commodity market prices, and hence the distribution of real income, constitutes a pecuniary externality. Even though such an externality is pecuniary, meaning that it is being mediated by the price system, it still raises the possibility that government regulators could improve the risk and allocation of resources by taking into account income effects of asset portfolio holdings on consumption of commodities. The precise scenario that can occur with just a single derivative is demonstrated in the appendix via a simple numerical example of an economy where a regulator increases everybody's utility by redistributing holdings of that one asset and thus moving from one GEI to another.[135] An analogous phenomenon is that of

133. *See* John D. Geanakoplos & Heraklis M. Polemarchakis, *Existence, Regularity, and Constrained Suboptimality of Competitive Portfolio Allocations when the Asset Market Is Incomplete, in* 2 UNCERTAINTY, INFORMATION, AND COMMUNICATION: ESSAYS IN HONOR OF KENNETH J. ARROW 65, 89 (Walter P. Heller, Ross M. Starr & David A. Starrett eds., 1986) (proving that GEI are typically constrained Pareto-inefficient).

134. Thorsten Hens, *Incomplete Markets, in* ELEMENTS OF GENERAL EQUILIBRIUM ANALYSIS 139, 167 (Alan Kirman ed., 1998).

135. This example can be found in tables 1 and 2 of Charles Wilson, *Incomplete Markets, in* 2 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 759, 760 (John Eatwell, Murray Milgate & Peter Newman eds., 1987).

individuals profiting from the pecuniary effects of technological innovation.[136] That phenomenon itself is analogous to many Americans having a large part of their wealth tied up in their homes. Changes in real estate prices can then result in huge windfalls or losses with attendant income effects on real consumption. A similar type of situation is the impact on the competitive market equilibrium price of an underlying stock caused by the introduction of an option for that stock.[137] Such a concern resulted in the prohibition under U.S. laws of trading futures contracts on onions, which continues to this day.[138] Such types of price linkages also underlie the concerns of some asset market observers that portfolio insurance and option replication trading strategies may exacerbate the volatility of the underlying markets and perhaps even cause them to crash.[139] These sorts of price correlations also motivate the concerns of some legal academics that individuals may circumvent insider trading securities laws by trading in assets that do not fall under the legal definition of securities, but whose prices are correlated with the prices of securities.[140] Finally, financial innovators might be motivated by the impact on the prices of existing assets of their innovating assets.[141]

Finally, before moving onto the regulatory implications of the above set of normative results in Parts III.A and III.B, a pair of technical details about both results is worth mentioning. First, both results are demonstrated in what are known as pure exchange models that involve no production. Fortunately, GEI models extend to production economies.[142] Second, the results hold for any derivative whose payoff is a linear function of an underlying price or a combination of prices, as is the case with a derivative that is written on an index. In other words, the proofs of the normative

136. *See generally* Jack Hirshleifer, *The Private and Social Value of Information and the Reward to Inventive Activity*, 61 AM. ECON. REV. 561 (1971) (modeling how there may be incentives for more technological innovation than socially optimal).

137. *See generally* Jerome Detemple & Larry Selden, *A General Equilibrium Analysis of Option and Stock Market Interactions*, 32 INT'L. ECON. REV. 279 (1991) (modeling such feedback interactions between stock and stock option prices).

138. *See* Elul, *supra* note 126, at 44.

139. *See generally* BRUCE I. JACOBS, CAPITAL IDEAS AND MARKET REALITIES: OPTION REPLICATION, INVESTOR BEHAVIOR AND STOCK MARKET CRASHES (1999).

140. *See generally* Ian Ayres & Joseph Bankman, Trading in Stock Substitutes (Mar. 1999) (unpublished manuscript, presented at the University of Pennsylvania Law School Institute for Law and Economics workshop, on file with the author).

141. *See generally* Franklin Allen & Douglas Gale, *Optimal Security Design*, 1 REV. FIN. STUD. 229 (1988) (modeling such a motivation for financial innovators).

142. *See* John D. Geanakoplos, M. Magill, M. Quinzii & J. Dreze, *Generic Inefficiency of Stock Market Equilibrium When Markets Are Incomplete*, 19 J. MATHEMATICAL ECON. 113, 114 (1990) (proving several inefficiency results about incomplete stock market economies).

results only apply to forwards, futures, and derivatives that are based on them, such as swaps. What is unresolved is whether those results extend to any derivative whose payoff is a nonlinear function of an underlying price or a combination of prices because the formal proofs do not apply to European options, American options, and option-based derivatives.[143] The technical reason for this gap is that a European option pays out zero over a broad range of values for the underlying price. In fact, there are numerical examples of GEI involving European options failing to exist. Moreover, such counter-examples to the existence of a GEI for economies with European options are robust with respect to certain perturbations.[144] But, fortunately, GEI typically will exist for European options.[145] GEI also typically exist for derivatives with smooth, nonlinear payoff functions, such as those for American options.[146]

IV. REGULATORY IMPLICATIONS

What are we to make of the above recent normative theoretical results about generic normative indeterminacy of financial innovation and generic constrained inefficiency of GEI? One reaction is that it is not really surprising that derivative innovation is not always Pareto-improving. After all, the introduction of any derivative will involve both winners and losers because derivatives are zero-sum transactions between the counter-parties involved. In addition, there are commissions, the fees of financial advisors, and transaction costs that are involved in derivative trades. But, such a partial equilibrium analysis of the parties directly involved in any particular derivative transaction fails to appreciate the insight provided by a truly GE analysis of derivative innovation. The point of GE analysis in the language of contract law is that there are third-party effects on those not involved in any particular derivative transaction. These pecuniary externalities involve changes in the wealth of others resulting from changes in asset and spot

143. The difference between a European option and an American option is that one can only exercise a European option on the date of its expiration, while one can exercise an American option anytime before and on the date of its expiration.

144. *See generally* Heraklis Polemarchakis & Bon-Il Ku, *Options and Equilibrium*, 19 J. MATHEMATICAL ECON. 107 (1990) (providing a counter-example to existence of a GEI involving European options that is robust in exogenous strike prices).

145. *See* Peter H. Huang & Ho-Mou Wu, *Market Equilibrium with Endogenous Price Uncertainty and Options*, *in* MARKETS, INFORMATION, AND UNCERTAINTY: ESSAYS IN ECONOMIC THEORY IN HONOR OF KENNETH J. ARROW 97, 112 (Graciela Chichilnisky ed., 1999) (explaining how and why there is generic existence of GEI when strike prices are not fixed, but instead set endogenously at-the-money).

146. *See* Peter H. Huang & Ho-Mou Wu, *Competitive Equilibrium of Incomplete Markets for Securities with Smooth Payoffs*, 23 J. MATHEMATICAL ECON. 219, 226, 228 (1994).

commodity market prices caused by a new asset and changes in the optimal portfolio asset holdings in response to such price changes in asset and spot commodity markets. It is important to note that after changes in the prices of other assets besides the new derivative transaction, both counter-parties in that derivative transaction might be worse off in terms of their overall utility from their entire portfolio of asset holdings. In other words, everybody, including each party to a new derivative innovation, is affected not only by the wealth effects of that particular derivative transaction, but also by the changes in asset portfolio holdings in response to changes in the prices of other assets besides the new derivative in question. That conclusion is the whole point of the generic normative indeterminacy theoretical results. There is just a priori no guarantee that such feedback and spillover effects will not occur if the counter-parties own at least some other marketed asset. It is highly likely that counter-parties to a new derivative transaction will each own at least another marketed asset, if they are well-diversified.

Asking for Pareto-improvements might be demanding too much. Instead, a regulator might strive to implement Kaldor-Hicks improvements, otherwise known as potential Pareto-improvements in which there are losers and winners, but with the winners being able to theoretically compensate the losers and still remain better off.[147] But, there are well-known problems with Kaldor-Hicks improvements, not the least of which is that the potential compensation payments are not actually required to be made. Consistency of the Kaldor-Hicks improvement test requires constant relative prices or that all consumers be alike in having quite restrictive preferences.[148] It is also likely that government regulators lack the detailed information required to perform timely cost-benefit analysis of asset innovations. Finally, the recent theoretical finance literature on GEI has focused on Pareto-improvements and its variants or the lack thereof, not on Kaldor-Hicks improvements.

Another reaction to the generic normative indeterminacy of derivative innovation is to question whether the precise mathematical characterization of genericity in these results is economically, financially, or legally appropriate. In other words, while asset innovation is normatively

147. For the original definition and formulation of the Kaldor-Hicks welfare criterion, see John R. Hicks, *The Foundations of Welfare Economics*, 49 ECON. J. 696, 711 (1939); Nicholas Kaldor, *Welfare Propositions of Economics and Interpersonal Comparisons of Utility*, 49 ECON. J. 549, 550 (1939).

148. *See* Allan M. Feldman, *Kaldor-Hicks Compensation*, *in* 2 THE NEW PALGRAVE, *supra* note 61, at 417, 420 (discussing how Kaldor-Hieks improvements are fundamentally disappointing from the perspective of an economic theorist).

indeterminate for most economies, how relevant are the notions of typical and/or rare and accidental that are used in these results? An example of the difficulty of interpreting the concept of genericity is provided by the fact that every real-world GE involves a boundary allocation because most consumers neither buy nor sell most commodities. But, the set of boundary allocations is a closed set of measure zero, that is, boundary allocations form a non-generic set. Another way of stating this last observation is that most or typical allocations are not boundary ones. Thus, while generic results hold for almost every theoretical economy, they might not apply to any particular actual economy. Fortunately, these results hold for several different notions of what is typical. But, it is unclear which are the most appropriate notions.

A final reaction to the generic normative indeterminacy of derivative innovation is that "one should not interpret the results of Elul's study as suggesting that some innovations are good and others are bad."[149] Elul explicitly cautioned that his work does not "suggest that it would be easy, or even possible, for a government to introduce the 'right' kinds of assets—the informational burdens in trying to do so would be extreme."[150] He also cautioned that his work does not "suggest that financial innovation is always good or bad—one would be hard-pressed to find a real-world example of either phenomenon, though clearly some innovations seem to confer greater benefit upon society than others."[151] He concluded by stating that his research intended to "suggest that greater sophistication, and perhaps greater oversight, is needed in dealing with this problem, both from a theoretical and from a practical point of view."[152] This part of the Article considers the potential for greater oversight (and greater sophistication) by regulatory agencies towards new derivatives.

A. APPROVAL OF NEW OTC DERIVATIVES

Although the results of Part III.A do not mean that a new derivative market will necessarily reduce societal welfare, they do suggest proceeding carefully in approving new derivatives. Such prudence contrasts with the underlying philosophy of the SEC's regulatory policy of permitting any corporation to issue securities, provided that it complies fully with the mandatory disclosure requirements about its financial health. Such caution is more consistent with the merit review that the CEA authorizes the CFTC

149. MOLYNEUX & SHAMROUKH, *supra* note 10, at 74.
150. *Id.*
151. *Id.*
152. Elul, *supra* note 126, at 73.

to conduct to verify that trading in a new futures contract is not contrary to the public interest.[153] As noted, "[b]ased on the legislative history of the CEA, the CFTC has construed the public interest test as requiring a showing by the exchange seeking designation as a contract market that the contract can be expected to be used by commercial entities for price basing and hedging cash market activities."[154] The Office of Analysis in the Division of Economics and Education at the CFTC has primary responsibility for reviewing new futures contract applications.[155] Since 1975, such reviews are based on CFTC Guideline No. 1, which requires an explanation of how the proposed futures contract would satisfy an economic purpose and an analysis of individual contractual terms and conditions.[156] This guideline was streamlined in 1982 by relaxing the requirement that a petitioning exchange had to affirmatively demonstrate an economic purpose for a proposed contract and justify its terms individually.[157] A newly proposed contract will satisfy the weak economic purpose test of the revised Guideline No. 1 fairly easily.[158] This economic purpose test and the analysis of the individual terms of the proposed contract are the closest real-world inquiry to studying the impact of introducing a futures contract on underlying spot market prices.

Recently, however, the CFTC significantly reduced even further its regulatory oversight over new futures contracts by approving final rules that allow a futures exchange to list new contracts for trading without prior approval from the CFTC. An exchange can then amend such contracts pursuant to exchange certification. This new listing procedure is in addition to already existing so-called fast-track procedures.[159] In addition to discontinuing its ex ante new contract approval process, the CFTC is seeking public comments on a proposal to revise CFTC regulation 1.41 to permit a futures exchange to promulgate new exchange rules and amend existing ones without prior CFTC approval.[160] Both of these recent actions suggest that the CFTC is beginning a deregulatory phase at least for the

153. *See* 7 U.S.C. § 5 (2000).

154. GREENE, ET AL., *supra* note 73, at 13-47 n.151.

155. *See, e.g.*, Ronald W. Anderson, *The Regulation of Futures Contract Innovations in the United States*, 4 J. FUTURES MARKETS 297, 299 (1984).

156. *See* Comm. Fut. L. Rep. (CCH) ¶ 20,041 (May 13, 1975), *reprinted in* Anderson, *supra* note 155, at 327-31.

157. Economic and Public Interest Requirements for Contract Market Designation, 57 Fed. Reg. 3518, 3523 (1982) (to be codified at 17 C.F.R. § 5).

158. *See* Anderson, *supra* note 155, at 300-01.

159. *See* CFTC Release #4339-99, *CFTC Approves Actions to Advance Regulatory Reform* (Nov. 17, 1999) <http://www.cftc.gov/opa/press99/4339-99.htm>.

160. *See id.*

foreseeable future. Current CFTC Chairman William Rainer has indicated the above actions are part of an overall plan to move the CFTC from being a frontline to an oversight regulator.[161]

All of the above recent events at the CFTC indicate that it will no longer conduct detailed cost-benefit analysis of new futures contracts, but will rely instead on market forces to impose discipline on exchanges. This means that we may come to live in a world in which the CFTC routinely approves new futures contracts and waits to see if they attract interest. The market system itself could lead to socially-useless futures contracts dying out from a lack of trading volume. In fact, "[n]ew financial instruments continue to proliferate, but most of them fail to trade successfully."[162] An example of a derivative that failed to attract enough interest was a futures contract written on diamonds. This derivative was introduced on the Los Angeles Exchange in the early 1970s. It failed because diamond prices were not sufficiently volatile, diamonds could not be packaged homogeneously, and it had large bid-ask spreads. Another example of a derivative that met with lukewarm interest was a futures contract whose value derived from consumer or wholesale price indices. This derivative may have failed because it was offered in a noninflationary period. But, new derivatives can fail due to design flaws or so-called "political risk" from adverse tax rulings by the Internal Revenue Service, unfavorable judicial decisions, or hostile SEC accounting rulings.[163]

An evolutionary argument reasons that only socially-useful derivatives can and will survive a market test. But this claim is problematic because some of the people who can be harmed by a new derivative may not be among those who trade in that new derivative due to general equilibrium types of spillover effects from interdependencies between markets linked by substitution and income effects of price changes. In other words, the consequences of derivatives are not limited to just those who trade in a particular derivative. Taxpayers in Orange County, California provide a vivid example. Another possible example of the impact that asset innovation can have upon seemingly unrelated markets is provided by high-yield debt or so-called junk bonds. These financial instruments were pioneered by Michael Milken to facilitate corporate takeovers that were

161. *See* William J. Reiner, Chairman Commodities Futures, Trading Commission, Remarks at 22d Annual Chicago-Kent College of Law Derivatives and Commodities Law Institute, Chicago, Illinois (Oct. 28, 1999) <http://www.cftc.gov/opa/speeches/rainer-2.htm>.

162. Jack Clark Francis, *Why Financial Instruments Fail or Succeed, in* THE HANDBOOK OF EQUITY DERIVATIVES, *supra* note 11, at 631.

163. *Id.* at 637-49.

often followed by corporate restructuring that resulted in labor cutbacks in particular sectors in our economy.[164] An economist suggested

> that one effect of trad[ing] in these unusually risky securities might have been to make employment and the price of labor much more volatile, even in industries not directly related to those actually issuing the bonds. Because human capital is a good for which the incompleteness of markets is quite prominent, this increased risk would have been borne by those agents perhaps least able to diversify it.[165]

Of course, that argument is unproven and not a complete GEI analysis because one must determine whether displaced workers acquired new skills and ever found higher paying jobs and whether economically depressed regions ever regained their prosperity. In other words, a bona fide GEI analysis must follow through all the possible multiplier effects of decreased consumption spending as the result of corporate plant closings and ultimately determine if social welfare rose or fell.

A full-scale general equilibrium analysis of the impact of a proposed new derivative may be a daunting and unrealistic prospect for any regulatory agency. But in reality, a regulatory body would only have to study a proposed new derivative's impact on those assets that are substitutes and complements as well as the underlying assets on which the derivative is written. Such an inquiry may require simulations utilizing computational general equilibrium models of a few related asset and commodity markets, not an entire macroeconomic model.[166] A recent model provides a simple algorithm for computing GEI.[167]

Even if the CFTC decides in the future to examine new proposed futures contracts utilizing computational general equilibrium analysis, the CFTC might not have the information required to perform the requisite analysis. More specifically, computational general equilibrium models require inputs of consumers' utility functions and firms' production functions. However, the CFTC or some other government agency can

164. *See, e.g.*, Edmund Faltemayek, *The Deal Decade: Verdict on the 80's*, FORTUNE, Aug. 26, 1991, at 58; Terri Thomson, *Cleaning Up Mike's Mess*, U.S. NEWS & WORLD REP., Oct. 15, 1990, at 85; Pamela Sherrid, Clemens P. Work & Robert F. Black, *Debt on Trial*, U.S. NEWS & WORLD REP., Feb. 15, 1989, at 60 (describing the layoffs resulting from junk-bond financed takeovers).

165. Elul, *supra* note 126, at 44-45.

166. *See generally* HERBERT E. SCARF, COMPUTATION OF ECONOMIC EQUILIBRIA (1973) (for an exposition of computable GE models).

167. *See* Donald J. Brown, Peter M. DeMarzo & B. Curtis Eaves, *Computing Equilibria when Asset Markets Are Incomplete*, 64 ECONOMETRICA 1, 19-25 (1996) (discusing computational implementation of GEI models).

obtain such information by collecting statistical data regarding the relevant tastes and technology.

B. RETAIL CONSUMER DERIVATIVE PRODUCTS

Part III concluded that when asset markets are incomplete, market forces do not assure that new OTC derivatives will always be socially desirable. This conclusion holds despite the fact that OTC derivatives markets involve corporate or institutional investors who are wealthy, if not sophisticated, because those who might be harmed by new OTC derivatives include people who do not trade them. In fact, the extent to which even corporate or institutional investors understand OTC derivatives is debatable.[168] This Section asks whether the above conclusion that new OTC derivatives may not always be socially desirable also holds for derivative product markets involving retail consumers that might be neither wealthy nor sophisticated. Not surprisingly, the answer is yes.

The demographics of the baby-boomer generation approaching retirement age strains many current public retirement income programs all over the world, especially the pay-as-you-go Social Security program in the United States. Countries such as Argentina, Australia, Chile, and Mexico are or have replaced their national retirement programs with what are known as self-directed Personal Retirement Accounts (PRAs). Even employers in the U.S. and the U.K. are shifting away from defined-benefit plans, where the sponsor of the pension plan guarantees a certain level of retirement income benefits, to PRAs, where the employees are free to make their own choices from a menu of investments.[169] But with such freedom comes the price of bearing all the investment risk of the level of returns upon retirement. Employees could manage that risk with the help of a new proposed class of financially engineered products called Guaranteed Retirement Income Contracts (GRICs) that protect against inflation and stock market risk.[170]

---

168. *See* PARTNOY, *supra* note 67, at 57, 60 (describing how many buyers of Principal Exchange Rate Linked Security (PERLS) "had no idea" what they were doing and "obviously did not understand" them). *But see* Macey, *supra* note 67, at 1490-92 (arguing that corporate and institutional clients could not be so clueless).

169. *See* Zvi Bodie, *Investment Management and Technology: Past, Present, and Future*, *in* THE EFFECT OF TECHNOLOGY ON THE FINANCIAL SECTOR (forthcoming 1999).

170. *See* Zvi Bodie & Dwight B. Crane, *The Design and Production of New Retirement Savings Products*, J. PORTFOLIO MGMT., Winter 1999, at 77, 78 (discussing such products in detail and explaining how financial engineering techniques can price and synthesize them).

Even outside the particular context of insuring against retirement income risks, we may soon live in a world offering many retail consumer derivative products.[171] The menu of possible choices includes mortgage rate swaps at your ATM or via the Internet,[172] S&P Indexed Certificates of Deposit,[173] principal-protected S&P 500 funds,[174] and supershares in superfunds.[175] The current low level of retail swap activity probably results from a combination of legal and regulatory uncertainty as well as consumer unfamiliarity with swaps.[176] All three factors are changing in the direction of supporting a dramatic growth in retail swaps. In its report on OTC derivatives and the CEA, The President's Working Group on Financial Markets stated that specific recommendations concerning the regulation of exchange-traded futures went beyond the scope of that report.[177] But it did state that any regulation of exchange-traded futures must serve valid public policy goals.[178] If the public policy goal of promoting efficiency includes allocational efficiency of risk, then some form of active monitoring of new retail consumer derivative products is in order. If the public policy goal of promoting efficiency means informational efficiency rather than risk-allocational efficiency, there is no guarantee that market or government regulatory forces would keep off the market those retail consumer derivative products that lower societal welfare. In either case, the concerns that arise in the context of OTC derivatives carry over to the setting of retail consumer derivative products.

V. OTHER REGULATORY PROPOSALS

Part IV ouly considered implications of the normative results in Part III for government regulators as gatekeepers determining if new derivatives should be permitted on "wholesale" OTC markets or retail consumer markets. But many other possible forms of regulation exist. For example, the Commodities Futures Trading Commission Act of 1974[179] amended the CEA to create a pervasive regulatory framework applying to commodity

171. *See* Carolyn H. Jackson, Note, *Have You Hedged Today? The Inevitable Advent of Consumer Derivatives*, 67 FORDHAM. L. REV. 3205, 3207 (1999) (arguing that such a world is right around the corner).

172. *See id.* at 3205, 3232.

173. *See id.* at 3222.

174. *See id.* at 3233.

175. *See* Mark Rubinstein, *Supershares*, *in* THE HANDBOOK OF EQUITY DERIVATIVES, *supra* note 11, at 404, 412-13.

176. *See* Jackson, *supra* note 171, at 3206.

177. *See* THE PRESIDENT'S WORKING GROUP ON FINANCIAL MARKETS, *supra* note 62, at 21-23.

178. *See id.* at 22.

179. *See* 7 U.S.C. § 4 (a) (1994).

trading advisors (CTAs)[180] and commodity pool operators (CPOs)[181] involving antifraud prohibitions,[182] bookkeeping and other record-keeping requirements,[183] registration,[184] registration procedure,[185] and reporting requirements.[186] The CFTC has also promulgated regulations under the authority of the CEA that heavily regulate trading practices on futures exchanges.[187] Finally, the Securities Exchange Act of 1934 requires that all brokers[188] and dealers[189] that want to trade on the OTC market be members of the National Association of Securities Dealers, Inc. (NASD).[190] In turn, the NASD requires that broker-dealers recommend only "suitable" investments[191] and must have an adequate basis for making a recommendation.[192] This part of the Article considers two novel regulatory proposals for governmental intervention to improve the allocation of risk in a society.

A. REALLOCATING EXISTING ASSETS

The specific numerical example in the Appendix makes it clear that attaining Pareto-improvements requires that regulators have information about individuals' preferences that most regulators are unlikely to have or attain from market demand information. As the authors of the result that GEI are typically constrained Pareto-inefficient conclude:

> Whether it is generically possible to effect a Pareto-improving portfolio reallocation when knowledge of investors' preferences is limited to market demand functions is an open question.
>
> To be sure, in order to effect a Pareto-improving reallocation of assets, the government must be able to forecast all the resulting adjustments in spot market prices and their effects on individual's utilities. This is an enormous information burden, which it may be argued the government cannot carry. But such an argument against market intervention, based on the presumed ignorance of the government, is radically different from

180. *See* Commodity Exchange Act § 2(a)(1)(A), 7 U.S.C. § 1a(5)(A) (1994) (defining CTA).
181. *See* Commodity Exchange Act § 2(a)(1)(A), 7 U.S.C. § 1a(4)) (1994) (defining CPO).
182. *See* Commodity Exchange Act § 4o, 7 U.S.C. § 6*o* (1994).
183. *See* Commodity Exchange Act § 4n(3), 7 U.S.C. § 6n(3) (1994).
184. *See* Commodity Exchange Act § 4m, 7 U.S.C. § 6m (1994).
185. *See* Commodity Exchange Act § 4n(1), 7 U.S.C. §§ 6n(1), (2) (1994).
186. *See* Commodity Exchange Act § 4n(4), 7 U.S.C. § 6n(4) (1994).
187. *See* CFTC Reg 1.38, 17 C.F.R. § 1.38 (2000) (requiring open and competitive outcry).
188. *See* Commodity Exchange Act § 3a(4), 15 U.S.C. § 78c (a)(4) (2000) (defining a broker).
189. Dealers are defined by Exchange Act § 3a(5), 15 U.S.C. § 78c (a)(5) (2000).
190. *See* Exchange Act § 15(b)(8), 15 U.S.C. § 78*o* (b)(8) (2000).
191. NASD Rules of Fair Practice, Art. III, § 2.
192. *See* Hanly v. SEC, 415 F.2d 589, 597 (2d Cir. 1969).

> the standard argument for Pareto optimality that does not rely on any lack of information.[193]

Although the numerical example in the Appendix only holds for a particular set of preferences and initial endowments, other work suggests that constrained Pareto-inefficiency is more widespread.[194] The important contribution of GEI models is to provide an analytical apparatus and formal techniques for proving the prevalence of the phenomena of constrained Pareto-inefficiency. The intuition for this general result that GEI are constrained Pareto-inefficient is aptly summarized by its authors:

> An asset reallocation in any economy has two effects on an individual's utility—a direct effect from the income transfer and an indirect effect due to the relative price change in commodity spot markets. When markets are complete, the income reallocation caused by the price change can be decomposed into a combination of assets that have already been priced by the market. When the asset market is incomplete, it is generically the case that the price changes will cause an income redistribution that market itself could not directly implement. In essence, the central planner has access to a wider class of assets than those directly traded.[195]

A later paper by the same authors demonstrated that a benevolent regulator might not be able to deduce individuals' tastes and initial endowments from their observable market behavior so as to implement a Pareto-improving reallocation of investors' asset portfolios.[196]

But a less restrictive informational scenario, other than being able to deduce or observe the individual characteristics of tastes and initial endowments, is that a benevolent regulator can obtain statistical information about such individual characteristics. In this more plausible case, a benevolent regulator is unable to discern an investor's type, defined to be his particular utility function and initial endowment. Thus, any proposed reallocation of asset portfolios has to be a rule specifying a particular asset portfolio for a reported investor's type. In other words, any

---

193. Geanakoplos & Polemarchakis, *supra* note 133, at 94.

194. *See generally* Joseph E. Stiglitz, *The Inefficiency of the Stock Market Equilibrium*, 49 REV. ECON. STUD. 241 (1982); David M. Newbery & Joseph E. Stiglitz, *The Choice of Technique and the Optimality of Equilibrium with Rational Expectations*, 90 J. POL. ECON. 223 (1982) (providing examples of constrained Pareto-inefficiency for competitive market equilibrium allocations in particular models).

195. Geanakoplos & Polemarchakis, *supra* note 133, at 69.

196. *See* John D. Geanakoplos & Heraklis M. Polemarchakis, *Observability and Optimality*, 19 J. MATHEMATICAL ECON. 153, 154, 162, 165 (1990) (formally proving that even a benevolent central planner may be unable to determine Pareto-improving portfolio reallocations from the observed market behavior of individuals).

reallocation by a benevolent regulator who is unable to verify an individual's type must be designed so that each individual finds it in his best interest to truthfully report his type. A particular reallocation of asset portfolios is defined to be anonymous if each individual prefers to receive the asset portfolio assigned to his type over that assigned to any other type.[197] A GEI is defined to be anonymous constrained optimal if there is no anonymous reallocation of asset portfolios resulting in a Pareto-improvement.

A natural question is whether a GEI can be anonymous constrained optimal. The answer depends on when a benevolent regulator intervenes and whether investors anticipate perfectly that intervention. If a benevolent regulator intervenes before asset markets open and is able to prevent any asset trading after intervening, then for generic utility functions and initial endowments, a GEI is not anonymous constrained optimal.[198] But if a benevolent regulator intervenes before asset markets open and investors can trade assets after that intervention, then for generic initial endowments, a GEI is anonymous constrained optimal.[199] Finally, if a benevolent regulator intervenes after investors finish trading assets and investors can anticipate perfectly that intervention, then any GEI that is not Pareto-dominated by another GEI is anonymous constrained optimal.[200]

B. REGULATING UNDERLYING SPOT MARKET PRICES

A final policy reaction to ambiguous normative results about new assets or government reallocating asset portfolios is to consider government regulation of underlying spot commodity market prices. Familiar examples of price regulation are fixed or pegged currency exchange rates, interest rate ceilings for credit cards or consumer loans, minimum wage legislation, price supports for agricultural products, and rent controls. The first type of price regulation was made in the name of stability while the other forms of price regulation are usually proposed and implemented on the basis of improving equity. Of course, regulating spot commodity market prices to take on values that are different from their market equilibrium values means there will have to be rationing to clear markets that otherwise will not balance demand and supply.

197. *See* Atsushi Kajii, *Anonymity and Optimality of Competitive Equilibria when Markets Are Incomplete*, 64 J. ECON. THEORY 115, 116 (1994) (defining the requirement of anonymity and explaining its importance when investors are heterogeneous).

198. *See id.* at 124.

199. *See id.*

200. *See id.* at 125.

A theoretical concept known as fix-price equilibrium describes the allocation of resources when prices can take on arbitrary (that is, nonmarket clearing) values.[201] This notion extends to an economy with incomplete asset markets.[202] Price regulation is said to Pareto-improve upon a competitive equilibrium if there is a set of spot commodity market prices such that a new fix-price equilibrium commodity allocation at the new spot commodity market prices and the original competitive equilibrium's asset prices Pareto-dominates the competitive equilibrium's commodity allocation.[203] If there are sufficiently many states of the world or commodities, then Pareto-improving price regulation is generically possible.[204] If there are sufficiently many commodities, the deviation of prices from their competitive market equilibrium values can be selected before knowing the state of the world.[205]

Such price regulation has several advantages over asset portfolio reallocation. First, it involves only aggregate market variables, namely spot commodity market prices. Second, it is an anonymous intervention so there is no household specific information required for achieving it. In both asset markets and spot commodity markets, the volume of trade is determined endogenously. But such price regulation still places severe informational demands on a regulator to know the marginal utilities of income and excess demands for spot commodities across states to determine and compute the necessary spot commodity market prices and rationing scheme.[206]

VI. CONCLUSIONS

This Article considered the normative implications of derivative innovations by drawing on the recent literature about general equilibrium models of incomplete asset markets. In particular, there are several perhaps unexpected regulatory policy implications when competitive asset markets are incomplete. First, if, as is likely true, asset markets are sufficiently incomplete, the normative consequences of introducing nonredundant

201. *See generally* Jacques H. Dreze, *Existence of an Exchange Equilibrium Under Price Rigidities*, 16 INT'L ECON. REV. 301 (1975) (defining and proving existence of fix-price equilibria).

202. *See* P. J. J. HERINGS & HERAKLIS POLEMARCHAKIS, PARETO IMPROVING PRICE REGULATION WHEN THE ASSET MARKET IS INCOMPLETE 1, 6-7 (Tilburg Univ. Center for Econ. Res. Discussion Paper No. 9930, Mar. 1999) (extending fix-price equilibrium definition to economies with incomplete asset markets).

203. *See id.* at 28.

204. *See id.* at 31.

205. *See id.* at 35.

206. *See id.* at 41.

derivatives are typically ambiguous. In other words, there is a sharp discontinuity between economies with more than one asset missing and those with just one asset missing because in the former introducing a derivative has ambiguous normative consequences while in the latter, introducing a derivative that completes asset markets unambiguously increases all consumers' utilities. Second, whether even a fictitious benevolent government regulator can improve upon the allocation of risk that corresponds to a competitive general equilibrium of incomplete asset markets depends on three factors. These factors are the level of information that regulators have about consumers, the timing of regulation, and the anticipation by investors of regulation. Both of these normative results contrast sharply with a world in which asset markets are complete. In a complete asset markets world, the resulting equilibrium allocation is ensured to be Pareto-efficient so that there is no scope for derivative innovation or government regulation to improve the well-being of households.

Of course, the above results also assumed symmetric information among participants in asset markets. Many of the recent well-publicized problems involving derivatives were the result of breaches of fiduciary duties, outright fraud, or asymmetric information[207]—hence, the proposals for improving disclosure about derivatives and greater transparency regarding positions of derivatives that are not traded on exchanges (where disclosure and transparency are less problematic). But some commentators believe that such proposals may do more damage than good.[208] Even in the absence of deception or manipulation, the mere fact that asset markets are incomplete could lead to investors overreacting to news or events (because they are unable to hedge all conceivable risks) and thus a breakdown of the informationally efficient capital markets hypothesis (ECMH). The ECMH is the foundation of much corporate and securities law.[209] Legal academics, judges, lawyers, and law students may come to realize, as most current financial academics and professionals do, that it is high time to

207. *See* Franklin R. Edwards, *Hedge Funds and the Collapse of Long-Term Capital Management*, 13 J. ECON. PERSP. 189, 204, 205 (1999) (discussing the lack of information on the part of Long-Term Capital Management's creditors and counter-parties about Long-Term Capital Management's borrowings, derivatives positions, and trading strategies).

208. *See, e.g.*, DON M. CHANCE, *Accounting for Derivatives*, *in* ESSAYS IN DERIVATIVES 289, 289-93 (1998); DON M. CHANCE, *Derivatives Disclosure*, *in* ESSAYS IN DERIVATIVES 294, 294-97 (1998) (arguing that a perfect accounting or disclosure regime is an impossibility); MCLAUGHLIN, *supra* note 8, at 494-99.

209. *See generally* FRANK H. EASTERBROOK & DANIEL R. FISCHEL, THE ECONOMIC STRUCTURE OF CORPORATE LAW (1991).

move past the finance of the 1960s that assumed ECMH.[210] One impetus for such a move is a set of experimental findings from behavioral and cognitive psychology.[211] But the meaning and interpretation of some of these findings is disputed.[212] Additionally, there are difficulties in developing theoretical underpinnings for and policy implications of such findings.[213] This Article illustrates how the recent GEI literature about incomplete asset markets provides a coherent theoretical catalyst for a rethinking of regulatory policy regarding asset markets.

Merton H. Miller concluded his 1990 Nobel Memorial Prize in Economics lecture by proclaiming that "the focus in finance has not been on issues of public policy.... Now that [finance] has officially come of age, [it is time] ... to bring ... the public policy insights, to the attention of a wider audience."[214] This Article has taken a step along that journey by tracing through three central regulatory implications of incomplete asset markets analysis. More generally, this Article suggests that recent theoretical research on allocating risk in an efficient manner does not necessarily support a laissez-faire regulatory stance towards derivative innovations. On the other hand, specific numerical examples offer support for the proposition that, empirically, the gains to a particular derivative innovation can be quite significant.[215] Because a government regulator might be less than benevolent or be informationally challenged, it is important not to make "the Nirvana fallacy, under which any discrepancy between the real and the ideal is viewed as proof that the real is

210. *See generally, e.g.*, ROBERT A. HAUGEN, THE NEW FINANCE: THE CASE AGAINST EFFICIENT MARKETS (2d ed. 1999) (asserting that investors and corporations face inefficient and over-reactive capital markets, thus requiring the revision of many long-accepted principles of corporate finance).

211. For a discussion on how heurestic-driven cognitive biases and frame dependence can lead stock prices to deviate from their fundamental values for very long periods, see BELSKY & GILOVICH, *supra* note 79, at 33-42.

212. *See* Gerd Gigerenzer, *How to Make Cognitive Illusions Disappear: Beyond "Heuristics and Biases"*, 2 EUR. REV. SOC. PSYCHOL. 83, 86-101 (1991) (arguing that many so-called cognitive biases do not actually violate probability theory); Gerd Gigerenzer, *On Narrow Norms and Vague Heuristics: A Reply to Kahneman and Tversky*, 103 PSYCHOL. REV. 592, 592-95 (1996) (argning that certain heurestics explain too little and too much).

213. *See* Jennifer Arlen, *Comment: The Future of Behavioral Economic Analysis of Law*, 51 VAND. L. REV. 1765, 1768 (1998) (discussing the lack of a coherent model for behavioral law and economics).

214. Merton H. Miller, *Leverage*, 46 J. FIN. 479, 488 (1991).

215. *See* David M. Newberry, *Missing Markets: Consequences and Remedies*, *in* THE ECONOMICS OF MISSING MARKETS, INFORMATION, AND GAMES 211, 231-38 (Frank Hahn ed., 1989); DAVID M. NEWBERRY & JOSEPH E. STIGLITZ, THE THEORY OF COMMODITY PRICE STABILIZATION 187, 291 (1981).

inefficient."[216] In the real world, regulators may be politically unwilling or myopically motivated not to determine ex ante whether a particular derivative innovation will raise societal welfare.[217] An economic theory of regulation teaches us that regulation often benefits members of the industry being regulated.[218] For example, prohibitions against insider trading can end up benefiting securities market professionals.[219]

A pro-regulatory position that supports the government reallocating portfolios of existing assets via taxation and redistribution policies would require that there are sizeable inefficiencies from existing GEI. This is an empirical question that will involve a very fact-specific inquiry depending upon the precise assets that are missing and the exact values of the parameters describing an economy. For example, farmers adopting an inefficient choice of production technique resulted in an extremely small welfare loss of less than one-sixth of one percent.[220]

A government regulator can also make all households better off by introducing new public or government-backed assets or by standardizing privately-created assets.[221] While reputational bonding devices can mitigate fraud or agent myopia, they cannot guarantee that a new asset or derivative will necessarily improve societal welfare. Organizational norms and institutional cultures affect not only how efficient, but also how equitable market outcomes are. Wall Street norms that accept, if not even reward, certain types of greedy behavior partially explain the continuing and numerous instances of rogue trading.[222] The norms of behavior or institutional cultures of brokers, dealers, exchanges, investment banks, markets, and even regulatory agencies can affect how much material fraud

216. Daniel R. Fischel & Sanford J. Grossman, *Customer Protection in Futures and Securities Markets*, 4 J. FUTURES MARKETS 273, 281 (1984) (defining Nirvana fallacy).

217. *See generally* Christopher Colburn & Peter Locke, Derivatives Regulation: Efficiency versus Public Choice Perspectives (1999) (unpublished manuscript, on file with the author).

218. *See generally* George J. Stigler, *The Theory of Economic Regulation*, 2 BELL J. ECON. & MGMT. SCI. 3 (1971); Samuel Peltzman, *Toward a More General Theory of Regulation*, 19 BELL J. ECON. & MGMT. SCI. 211 (1976).

219. *See* David D. Haddock & Jonathan R. Macey, *Regulation on Demand: A Private Interest Model, with an Application to Insider Trading Regulation*, 30 J.L. & ECON. 311, 313 (1987).

220. *See* Newberry, *supra* note 215, at 230-31. *See generally* David M. Newberry & Joseph E. Stiglitz, *The Choice of Techniques and the Optimality of Market Equilibrium with Rational Expectations*, 90 J. POL. ECON. 223-46 (1982).

221. For a description of each of these regulatory options, see ALLEN & GALE, *supra* note 13, at 271-307, 309-45.

222. *See* Kimberly D. Krawiec, *Accounting for Greed: Norms, Psychology and the "Rogue Trader"*, U. OR. L. REV. (forthcoming 2000) (explaining how individual traders' psychology and or institutional norms account for greed and persistent rogue trades).

occurs and what time horizons asset market participants adopt.[223] Fairness or equity-based norms of behavior and organizational cultures may even prevent the introduction of new derivatives that will lower societal welfare because the design and marketing of derivatives often exploit behavioral aspects of human decisionmaking.[224] But, without strong enough norms or cultures, such behavioral realities provide another impetus for the regulation of derivative innovations and markets.[225]

In conclusion, although new financially-engineered derivatives can shift financial risks, "[t]hey have also often fostered the illusion of a safe haven offering seemingly unlimited investment returns with virtually no risk" and "[g]iven human nature, many investors are probably unable to resist the allure of strategies that promise both increased returns and reduced risk."[226] But, the incompleteness of asset markets implies that market participants can not hedge fully or insure against or speculate upon some financial risks. In other words, there will always be some degree of residual financial risks in an economy. But, as is the case with nonfinancial risks, financial risks might not always be undesirable. It is only human nature to believe in and hope for technological progress to improve social welfare. A principal moral of this Article is that for most economies, financial technological progress in the form of new derivatives created by financial engineering might not improve societal welfare if asset markets are sufficiently incomplete.

---

223. *See generally* MITCHEL Y. ABOLAFIA, MAKING MARKETS: OPPORTUNISM AND RESTRAINT ON WALL STREET (1996) (providing a fascinating ethnography of three Wall Street subcultures: the markets for bonds, futures, and stocks).

224. *See, e.g.*, SHEFRIN, *supra* note 79, at 273 (discussing behavioral aspects in option markets) & 289 (discussing behavioral aspects in orange juice concentrate futures markets); Hersh Shefrin & Meir Statman, *Behavioral Aspects of the Design and Marketing of Financial Products*, 22 FIN. MGMT. 123 (1993) (proposing a behaviorally based model of asset design and promotion).

225. *See* Hersh Shefin & Meir Statman, *Ethics, Fairness and Efficiency in Financial Markets*, FIN. ANALYSTS J., Nov.-Dec. 1993, at 21-23 (discussing alternative rationales for prohibiting insider trading).

226. JACOBS, *supra* note 139, at 300.

APPENDIX: AN EXAMPLE OF A REGULATOR IMPROVING RISK ALLOCATION BY REALLOCATING A DERIVATIVE

This appendix provides a specific numerical example of a competitive market economy in which a government regulator implements a Pareto-improvement from a GEI by reallocating an existing derivative without completing asset markets. The results discussed in Part III.B of the Article demonstrate that the phenomenon illustrated by this example holds more generally.

Consider an economy with the following structure. There are three consumers: Alpha, Beta, and Delta; two commodities: gold and oil; and two states of the world: one and two. Denote by g^j_s and o^j_s the respective consumption of gold and oil by consumer j in state of the world s, where j = A (Alpha), B (Beta), or D (Delta) and s = 1 or 2. Alpha's utility function is given by this formula: $g^A_1 + k \min \{g^A_2, o^A_2\}$, where k is a fixed constant; Beta's utility function is given by this formula: $g^B_2 + k \min \{g^B_1, o^B_1\}$, with k again being the same fixed constant; and Delta's utility function is given by this formula: $o^D_1 + o^D_2$.

Alpha's utility function means that Alpha consumes only gold in state one and that Alpha always consumes an equal number of units of gold and oil in state two. The functional form of Alpha's utility means that for each bundle of gold and oil that Alpha consumes in state two, Alpha is willing to forgo k units of gold in state one. Beta's utility function means that in state one Beta always consumes an equal number of units of gold and oil, and in state two Beta consumes only gold. The functional form of Beta's utility means that for each bundle of gold and oil that Beta consumes in state one, Beta is willing to forgo k units of gold in state two. Delta's utility function means that Delta will consume only oil. The functional form of Delta's utility function means that Delta's marginal rate of substitution between consumption of oil in states one and two is unity.

Assume that initially Alpha has no units of gold and two units of oil in state one as well as two units of gold and no units of oil in state two. Furthermore, assume that Beta initially has two units of gold and no units of oil in state one as well as no units of gold and two units of oil in state two. Finally, assume that Delta initially has one unit of gold and one unit of oil in both states of the world. So, in this economy, there is an aggregate

initial endowment of three units of gold and three units of oil in each state of the world.

The asset structure of this economy is extremely simple. There is just one derivative asset, namely a forward contract written on gold, that delivers one unit of gold in each state of the world. The initial commodity endowments of consumers in each state completely determine spot commodity prices in each state and the resulting equilibrium levels of income because the single derivative asset market of this economy is not active.

In a competitive equilibrium, the spot commodity relative price ratio is one in both states of the world. Alpha consumes two units of gold and no units of oil in state one, but just one unit of gold and one unit of oil in state two. Beta consumes two units of gold and no units of oil in state two, but just one unit of gold and one unit of oil in state one. Delta consumes two units of oil in either state one or state two. Both Alpha and Beta enjoy an expected utility level of two plus k, while Delta enjoys an expected utility level of four.

Although the derivative asset market involves no active trading because there is just one derivative asset, a benevolent and knowledgeable regulator could utilize that single derivative asset to redistribute income across the states and hence change spot commodity prices. For example, assume that our benevolent and knowledgeable regulator directs that Alpha and Beta each supply Delta with two units of the one derivative asset. Because the one derivative asset is a forward contract that delivers one unit of gold in each state of the world, such a requirement is equivalent to changing initial commodity endowments as follows.

Alpha initially has negative two units of gold (that is, owes gold to Delta) and two units of oil in state one, but has nothing in state two. Beta initially has nothing in state one, but has negative two units of gold (again, owes gold to Delta) and two units of oil in state two. Delta initially has five units of gold and one unit of oil regardless of the state of the world. For this economy with these modified initial endowments, the new equilibrium price ratio of gold in terms of oil is two and one-half in each state of the world. Alpha consumes all three units of gold and no units of oil in state one, but nothing in state two. Beta consumes nothing in state one, but all three units of gold and no oil in state two. Delta consumes all three units of oil in either state of the world. Both Alpha and Beta enjoy an expected utility level of three, while Delta enjoys an expected utility level of six.

Comparing consumers' expected utilities before and after the regulator mandated reallocation of the one derivative asset reveals that for all values of k satisfying $0 < k < 1$, everybody is better off after than before the regulator reallocated the one derivative asset. In other words, the new equilibrium spot commodity market allocation Pareto-dominates the old equilibrium spot commodity market allocation. The reason for this result is that transferring income to Delta in both states of the world lowered the price of the gold demanded by Alpha and Beta in those states where they valued their increased utility the most.

If this economy had a complete set of asset markets, then consumers could have attained the above Pareto-superior equilibrium spot commodity market allocation themselves by trading on the set of complete asset markets without any government intervention or income transfers. The above Pareto-superior spot commodity market allocation provides the commodity amounts that balance the demands and supplies in those commodity markets if the spot price ratio of gold in terms of oil is one-half in each state of the world. In other words, the above Pareto-superior spot commodity market allocation is the quantity part of a GEI if the relative commodity market price ratio is one across the states of the world.