

ARTIFICIALLY INTELLIGENT MARKETS

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ABSTRACT

A remarkable transformation is taking place in our financial markets. The rise of machine learning algorithms and other artificial intelligence models has rapidly overtaken older methods of financial decisionmaking, and the consequences of the revolution are beginning to be felt across the capital markets ecosystem, from stock exchanges to derivatives markets to currency trading. These new technologies offer great promise, including more accurate prices, faster transactions, and more efficient trading. But they also create risks. From flash crashes to insider trading algorithms to adversarial attacks, artificial intelligence presents a range of unique vulnerabilities that could lead to significant and wide-ranging harm to our financial system. Legal frameworks devised to structure and constrain financial institutions, in turn, are ill-equipped to deal with these harms because they were designed based on outdated assumptions about the structure of markets, as well as the nature of its primary actors. This Article offers the first comprehensive account of the economic, political, and legal consequences of the rise of artificially intelligent markets. It demonstrates how the major driver of this shift has been the hedge fund industry, an opaque and lightly regulated sector of the financial ecosystem that has long been an early adopter of financial technology. It concludes by proposing a series of escalating regulatory reforms that might better fit financial regulation to our new artificially intelligent markets.

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INTRODUCTION

In February 2025, the governor of the Bank of England, Andrew Bailey, delivered a remarkable speech. In it, he warned that the structure of financial markets was changing at an unprecedented scale and scope, and in ways that raised red flags both for financial stability and for regulators' ability to properly police markets. At the center of these changes was the rise of hedge funds. The increase in their "footprint" in financial markets represented a "fundamental change[] in the dynamics of markets," he remarked, not just because their tendency to "de-risk[] aggressively" in shocks could place strains on market integrity, but also because they increasingly based their trading strategies on "complex statistical models and rules and market signals." These structural changes—opaque markets, concentrated risks, and algorithmic trading—were a recipe for contagion. It is time, he concluded, to have a "fully informed debate about the role of regulation."¹

While the Bank of England's warning was especially dire, it is in no way an outlier. In recent years, global regulatory bodies have increasingly raised concerns about the use of artificial intelligence models in financial markets. In 2024, the U.S. Senate Committee on Homeland Security and Governmental Affairs published a report on "Hedge Funds' Use of Artificial Intelligence in Trading" that identified "increased risks to investors and for financial markets" from the shift.² In the same year, the Commodity Futures Trading Commission issued a report concluding that vulnerabilities associated with machine learning strategies presented "heightened risk of market instability, and, especially when combined with high-frequency trading, potential institutional and wider market instability."³ In 2025, the International Organization of Securities Commissions issued a report concluding that artificial intelligence created dangers for investor protection, market integrity, and financial stability.⁴ Then-chairman of the Securities and Exchange Commission (SEC),

¹ Andrew Bailey, *Are We Underestimating Changes in Financial Markets?*, Speech at the University of Chicago Booth School of Business (Feb. 11, 2025), <https://www.bankofengland.co.uk/speech/2025/february/andrew-bailey-keynote-speech-university-of-chicago-booth-school-of-business> [https://perma.cc/9TGS-U2T9].

² S. COMM. ON HOMELAND SEC. & GOV'T AFFAIRS, 118TH CONG., *AI IN THE REAL WORLD: HEDGE FUNDS' USE OF ARTIFICIAL INTELLIGENCE IN TRADING 2* (Comm. Staff Report, June 2024).

³ U.S. COMMODITY FUTURES TRADING COMM'N, TECH. ADVISORY COMM., SUBCOMM. ON EMERGING AND EVOLVING TECHNOLOGIES, *RESPONSIBLE ARTIFICIAL INTELLIGENCE IN FINANCIAL MARKETS: OPPORTUNITIES, RISKS & RECOMMENDATIONS 47* (May 2, 2024) [hereinafter CFTC Report].

⁴ INTERNATIONAL ORGANIZATION OF SECURITIES COMMISSIONS [IOSCO], *ARTIFICIAL INTELLIGENCE IN CAPITAL MARKETS: USE CASES, RISKS, AND CHALLENGES* (Mar. 2025), <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD788.pdf> [https://perma.cc/GF9K-8V4Q] [hereinafter IOSCO Report].

Gary Gensler, stated that it is “nearly unavoidable” that, without intervention, artificial intelligence will trigger a financial crisis.⁵

Despite the hue and cry of regulators, there has been a surprising dearth of information about the unique risks raised by machine learning in our financial markets. Regulators have repeatedly emphasized that their lack of knowledge about precisely how artificial intelligence is being used by financial actors, particularly hedge funds, has hampered their ability to develop regulatory strategies.⁶ To date, most analyses have offered generic warnings about the risks of technology without articulating what makes machine learning unique from other computerized trading techniques. Why, in other words, is a deep learning hedge fund different from any other hedge fund?

This Article attempts to answer that question. It argues that the rise of artificially intelligent markets does indeed represent a fundamental shift in the nature of financial markets. This shift has been driven by hedge funds. Hedge funds are essential actors in an array of financial markets, from stocks to bonds to complex derivatives, with monthly transaction values reaching into the tens of trillions of dollars.⁷ Hedge funds tend to have flexible investment strategies, large amounts of leverage, and the capacity (and resources) to be leading-edge adopters of financial technology.⁸ They are also notoriously subject to minimal regulation.⁹ As private pools of capital, they are generally not subject to the extensive disclosure regimes of the principal securities

⁵ See Stefania Palma & Patrick Jenkins, *Gary Gensler Urges Regulators to Tame AI Risks to Financial Stability*, FIN. TIMES (Oct. 14, 2023), <https://www.ft.com/content/8227636f-e819-443a-aeba-c8237f0ec1ac> [https://perma.cc/SUS7-F9UE].

⁶ See CFTC Report, *supra* note 3, at 10 (“Part of the challenge in crafting this report was the lack of direct knowledge about the CFTC-registered entities currently leveraging AI, and the level of transparency and explainability among these firms for regulators and customers about AI’s use, particularly as it pertains to trading strategies and risk management, [and] even where firms disclose their use of such technologies, it is not always clear the type of AI that they are using (e.g., predictive, algorithmic, generative, or other frontier models), and for what use cases.”); IOSCO Report, *supra* note 4, at 33 (“[I]t should be noted that for a number of survey questions concerning data, model, and broader risks of the use of AI systems in financial products and services, approximately half of IOSCO Member/SRO Survey respondents collectively provided no response. This could indicate data and knowledge gaps concerning the use of AI technologies in financial markets.”).

⁷ See SEC DIVISION OF INV. MGMT., PRIVATE FUNDS STATISTICS REPORT: THIRD CALENDAR QUARTER 2024 31 (2024), <https://www.sec.gov/files/investment/private-funds-statistics-2024-q3.pdf> [https://perma.cc/G9BJ-EPT9] [hereinafter PRIVATE FUNDS REPORT].

⁸ See Wulf A. Kaal, *Financial Technology and Hedge Funds*, in THE OXFORD HANDBOOK ON HEDGE FUNDS 232 (2021). See also Dan Awrey, *Complexity, Innovation and the Regulation of Modern Financial Markets*, 2 HARV. BUS. L. REV. 235 (2012).

⁹ See Roberta S. Karmel, *Mutual Funds, Pension Funds, Hedge Funds and Stock Market Volatility—What Regulation by the Securities and Exchange Commission is Appropriate?*, 80 NOTRE DAME L. REV. 909, 912 (2005) (“Pension funds are regulated by the Pension Benefit Guaranty Corporation, the Department of Labor and the states; bank collective trust funds are regulated by the Comptroller of the Currency; commodity pools are regulated by the Commodity Futures Trading Commission; and hedge funds are not regulated.”). But see Linda Chatman Thomsen, Daniel M. Hawke & Pauline E. Calande, *Hedge Funds: An Enforcement Perspective*, 39 RUTGERS L.J. 541, 555 (2008) (“Enforcement of the securities laws with respect to hedge funds has been, and will continue to be, among the Enforcement Division’s highest priorities.”). The regulatory structure of hedge funds will be discussed in more depth in Part I.B.

laws and, as a result, have remained fiercely secretive about their practices. Many refuse to divulge even the basics of their strategies, let alone the specifics of how they develop and deploy them.¹⁰ As one investor described their investment in a large hedge fund, “It’s pretty much a black box. People that work there are sworn to secrecy.”¹¹ Indeed, many hedge funds (as that term has generally been understood) have even stopped calling themselves hedge funds at all—their preferred terms are more generic-sounding “alternative asset managers” or “investment holding companies.”¹²

Historically, hedge funds have been at the forefront of quantitative approaches to investing—momentum trading and high-frequency trading are common tactics, and so-called “quant” hedge funds constitute an entire investment category—and so it should come as no surprise that hedge funds are increasingly incorporating artificial intelligence into their investment models.¹³ Large hedge funds like Bridgewater, Two Sigma, and D. E. Shaw have created machine learning departments, hired prominent computer scientists to develop deep learning strategies, and launched AI-driven funds.¹⁴ One hedge fund, Numerai, holds open contests where data scientists compete to create the best machine learning algorithms for investment strategies.¹⁵ Another, Minotaur Capital, has no analysts and instead deploys a large language model

¹⁰ See, e.g., Gregory Zuckerman, *Renaissance’s Man: James Simons Does the Math on Fund*, WALL ST. J. (July 1, 2005), <https://www.wsj.com/articles/SB112018150042875023> [<https://perma.cc/3WPV-NBLY>] (“The firm won’t divulge details of its strategy, even to its own investors.”).

¹¹ *Id.*

¹² See Rob Copeland, *Hedge Funds: Don’t Call Us Hedge Funds*, WALL ST. J. (Mar. 26, 2015), <https://www.wsj.com/articles/some-hedge-funds-just-dont-call-us-a-hedge-fund-1427401282> [<https://perma.cc/72RY-6AAF>].

¹³ See *Hedge Funds Embrace Machine Learning—Up to a Point*, ECONOMIST (Dec. 9, 2017), <https://www.economist.com/finance-and-economics/2017/12/09/hedge-funds-embrace-machine-learning-up-to-a-point> [<https://perma.cc/29JE-5XJS>].

¹⁴ See Sonali Basak, *Bridgewater Launches \$2 Billion Fund Run by Machine Learning*, BLOOMBERG (July 1, 2024), <https://www.bloomberg.com/professional/insights/trading/bridgewater-now-has-2bn-fund-run-by-machine-learning/> [<https://perma.cc/M5D8-C353>]; Justina Lee, *AQR Bets on Machine Learning as Asness Becomes AI Believer*, BLOOMBERG (Apr. 23, 2025), <https://www.bloomberg.com/news/articles/2025-04-23/aqr-bets-on-machine-learning-as-cliff-asness-becomes-ai-believer> [<https://perma.cc/9JYF-4Q5M>]; D. E. Shaw, *D. E. Shaw Group Forms New Machine Learning Research Group*, Aug. 16, 2018, available at <https://www.prnewswire.com/news-releases/d-e-shaw-group-forms-new-machine-learning-research-group-300698027.html> [<https://perma.cc/QA99-GAQL>]; Sheryl Tian Tong Lee, *Two Sigma Taps Nekomouche to Head AI Strategy, Baron Steps Down*, BLOOMBERG (May 22, 2024), <https://www.bloomberg.com/news/articles/2024-05-22/two-sigma-taps-nekomouche-to-head-ai-strategy-baron-steps-down> [<https://perma.cc/6Y39-V7Y7>]; Bradley Saacks, *Milken Conference: How Hedge Funds Citadel, WorldQuant, and Freestone Grove Are Using AI*, BUS. INSIDER (May 7, 2025), <https://www.businessinsider.com/how-citadel-worldquant-freestone-grove-use-ai-2025-5> [<https://perma.cc/4QZB-AHQX>]; Alex Morrell, *He Quietly Made Billions for Two Sigma. Now, The “Godfather” of a Star Research Unit Is Starting His Own Fund*, BUS. INSIDER (July 18, 2025), <https://www.businessinsider.com/how-citadel-worldquant-freestone-grove-use-ai-2025-5> [<https://perma.cc/JT6F-EN5F>].

¹⁵ See Justina Lee, *Paul Tudor Jones-Backed Quant Manager Returns 20% Using Crowdsourced Ideas*, BLOOMBERG (Mar. 6, 2023), <https://www.bloomberg.com/news/articles/2023-02-28/tudor-jones-backed-quant-jumps-20-as-crowdsourced-bets-pay-off> [<https://perma.cc/TDH5-VCVN>]; Nathaniel Popper, *Hedge Fund Driven by Anonymous Ideas Gets*

to research market trends and issue investment reports.¹⁶ Deep learning hedge funds have sprung up in increasing numbers.¹⁷ There is even an index fund designed to track the returns of hedge funds that use machine learning algorithms in their trading portfolios.¹⁸ In a sign of just how intertwined hedge funds and artificial intelligence have become, one of the most innovative AI models of recent years, DeepSeek, was created by a Chinese company that originally started as a hedge fund devoted to deploying AI strategies in the Chinese stock market (it had to abandon the strategy after Chinese regulators began cracking down on risky “speculation”).¹⁹

In many ways, machine learning seems like a natural fit for the financial markets.²⁰ Machine learning was developed as a way for computers to analyze large amounts of data—more than any human could ever review, let alone understand—and identify hard-to-spot patterns in it.²¹ It has proven successful at tackling a wide array of problems, including complex interactions with human beings like games and conversation.²² These are precisely the kinds of difficult problems that financial institutions have been trying to solve in financial markets for decades.²³ Machine learning greatly enhances their capacity to do so, and could lead to faster, more accurate price formation,

New Investments, N.Y. TIMES (Dec. 12, 2016), <https://www.nytimes.com/2016/12/12/business/dealbook/numerai-investment-hedge-fund.html> [<https://perma.cc/UHJ9-Z9MB>].

¹⁶ See Harry Brumpton & Georgina McKay, *Hedge Fund Startup Replacing Analysts with AI Beats the Market*, BLOOMBERG (Feb. 13, 2025), <https://www.bloomberg.com/news/articles/2025-02-13/hedge-fund-startup-replacing-analysts-with-ai-beats-the-market> [<https://perma.cc/8VSG-YTNA>].

¹⁷ See Bradley Hope & Juliet Chung, *The Future Is Bumpy: High-Tech Hedge Fund Hits Limits of Robot Stock Picking*, WALL ST. J. (Dec. 11, 2017), <https://www.wsj.com/articles/the-future-is-bumpy-high-tech-hedge-fund-hits-limits-of-robot-stock-picking> [<https://perma.cc/Z9LQ-PS4G>].

¹⁸ See Mark Hulbert, *Some Hedge Funds Thought AI Would Help Them Beat the Market. Then Things Got Real*, MARKETWATCH (Aug. 17, 2024), <https://www.marketwatch.com/story/some-hedge-funds-thought-ai-would-help-them-beat-the-market-then-things-got-real-e3aae97f> [<https://perma.cc/Q7B9-TJYJ>]; Justina Lee, *Hedge Funds Find It's Really Hard to Beat the Market with AI*, BLOOMBERG LAW (Oct. 6, 2023), <https://news.bloomberglaw.com/artificial-intelligence/hedge-funds-find-its-really-hard-to-beat-the-market-with-ai> [<https://perma.cc/HKL2-LHWN>].

¹⁹ Meaghan Tobin, Paul Mozur, & Alexandra Stevenson, *DeepSeek's Rise: How a Chinese Start-Up Went from Stock Trader to A.I. Star*, N.Y. TIMES (Jan. 28, 2025), <https://www.nytimes.com/2025/01/28/business/deepseek-owner-china-ai.html> [<https://perma.cc/7RME-4ZFN>].

²⁰ For a summary of the key characteristics of hedge funds, see Carl Ackermann, Richard McEnally & David Ravenscraft, *The Performance of Hedge Funds: Risk, Return, and Incentives*, 54 J. FIN. 833, 834 (1999) (arguing that the defining features of hedge funds are their “largely unregulated organizational structure, flexible investment strategies, relatively sophisticated investors, substantial managerial investment, and strong managerial incentives”).

²¹ See KEVIN P. MURPHY, MACHINE LEARNING: A PROBABILISTIC PERSPECTIVE 1 (2012); William Magnuson, *A Unified Theory of Data*, 58 HARV. J. ON LEGIS. 23, 31 (2021).

²² See Bryan Casey & Mark A. Lemley, *You Might Be a Robot*, 105 CORNELL L. REV. 287, 300–309 (2020).

²³ See Ted Caldwell, *Introduction: The Model for Superior Performance*, in JESS LEDERMAN & ROBERT A. KLEIN, HEDGE FUNDS: INVESTMENT AND PORTFOLIO STRATEGIES FOR THE INSTITUTIONAL INVESTOR 5–17 (1995).

greater competition, and more efficient markets.²⁴ As the chief investment officer at Bridgewater has remarked, “You’re going to have intelligence that can read every newspaper in the world. Machines are better at finding patterns across times and across countries.”²⁵

But machine learning is not perfect, and its flaws create potential dangers for the financial system.²⁶ From hallucinations to overfitting to low-prevalence data problems, artificial intelligence models are well known to produce predictions that systematically fail in real-world conditions.²⁷ While the problems are well known, all-purpose solutions remain out of reach.²⁸ The deployment of flawed artificial intelligence models into the complex, highly leveraged markets that hedge funds operate in may well create conditions ripe for market failure.²⁹ Just as importantly, deep learning hedge funds create new sources of risk.³⁰ Not only must regulators continue to monitor the financial institutions that have historically been central to capital markets—investment banks, insurance companies, wealth management firms, and the like—but they will also need to wrestle with the increasingly important role that technology companies are playing in the industry.³¹ Indeed, in July 2025, one of the most popular AI models, Claude, released a new version aimed at financial analysis, lauding that it was “a comprehensive solution for financial analysis that transforms how finance professionals analyze markets, conduct research and make investment decisions.”³² Regulators are ill-equipped to understand these types of actors, who have traditionally been understood to be outside their regulatory ambit and, in any case, fit awkwardly within current doctrine.³³

²⁴ See William Magnuson, *Artificial Financial Intelligence*, 10 HARV. BUS. L. REV. 337, 348–52 (2020).

²⁵ Sonali Basak, *Bridgewater Launches \$2 Billion Fund Run by Machine Learning*, BLOOMBERG (July 1, 2024), <https://www.bloomberg.com/news/articles/2024-07-01/bridgewater-launches-2-billion-fund-powered-by-machine-learning> [<https://perma.cc/3Y2W-UZRX>].

²⁶ See discussion *infra* Part III.

²⁷ *Id.*

²⁸ *Id.*

²⁹ See HEDGE FUNDS’ USE OF ARTIFICIAL INTELLIGENCE IN TRADING, *supra* note 2, at 29–30.

³⁰ See discussion *infra* Part III.

³¹ See Todd Phillips & Adam Conner, *Financial Regulatory Agencies*, in TAKING FURTHER AGENCY ACTION ON AI: HOW AGENCIES CAN DEPLOY EXISTING STATUTORY AUTHORITIES TO REGULATE ARTIFICIAL INTELLIGENCE 20–22 (Ctr. for Am. Progress ed., 2024).

³² See *Claude for Financial Services*, ANTHROPIC (July 15, 2025), <https://www.anthropic.com/news/claude-for-financial-services> [<https://perma.cc/2AL8-8273>].

³³ See Megan Shearer, Gabriel Rauterberg & Michael P. Wellman, *Learning to Manipulate a Financial Benchmark*, 4th ACM Int’l Conf. on AI in Fin. (2024); Michael Wellman, *Written Testimony Before the US Sen. Committee on Banking, Housing, & Urban Affairs, Hearing on “Artificial Intelligence in Financial Services,”* Sept. 20, 2023; Gregory Scopino, *Do Automated Trading Systems Dream of Manipulating the Price of Futures Contracts? Policing Markets for Improper Trading Practices by Algorithmic Robots*, 67 FLA. L. REV. 221 (2015); Gina-Gail S. Fletcher & Michelle M. Le, *The Future of AI Accountability in the Financial Markets*, 24 VAND. J. ENT. & TECH. L. 289 (2022); Gina-Gail S. Fletcher, *Deterring Algorithmic Manipulation*, 74 VAND. L. REV. 259 (2021); Alessio Azzutti, Wolf-Georg Ringe & H. Siegfried Stiehl, *Machine Learning, Market Manipulation, and Collusion on Capital Markets: Why the “Black Box” Matters*, 43 U. PA. J. INT’L L. 79 (2021).

The range of potential financial issues—from insider trading to investor protection to systemic stability—are vast and largely unexplored.³⁴

This Article proceeds in four Parts. Part I offers an overview of the hedge industry, explaining where hedge funds came from, how they are structured, and what role they play in financial markets today. Part II explores the machine learning revolution in financial markets. After briefly detailing the key attributes of artificial intelligence models, it catalogues how hedge funds are using them, and why. With this evidence established, Part III turns to the regulatory issues raised by the rise of artificially intelligent markets. Among other things, it concludes that machine learning-based trading raises serious doctrinal problems for systemic risk regulation, insider trading rules, and investor protection frameworks. Part IV concludes by sketching out a range of potential reforms aimed at better balancing regulation and innovation. Scholarly debate over the proper regulation of hedge funds has been long and vigorous, and this Part will attempt to bridge these divides by articulating the core assumptions that underlie the various regulatory paradigms.³⁵ In short, I offer three models of financial market regulation—what I call the *laissez faire* model, the palace economy model, and the tech-industrial complex model—that provide a sliding scale of regulatory intensity. At the low end of intensity, the *laissez faire* model assumes that financial markets are inherently organic and self-correcting and views intrusive substantive obligations on market actors as generally undesirable and efficiency-destroying. At the high end of intensity, the palace economy model understands financial markets as another forum for political engagement, one where citizens may justly dictate the forms and methods of economic life. In the middle lies the tech-industrial complex model, which asserts that free markets are generally beneficial but must be balanced by closer cooperation between governments and hedge funds to ensure that national interests are protected.

If readers are expecting a doomsday scenario out of this Article, they will not find one. While artificial intelligence has indeed improved in recent years,

³⁴ See generally Howell E. Jackson, *The Nature of the Fintech Firm*, 61 WASH. U. J. L. & POL'Y 9 (2020); Chris Brummer & Yesha Yadav, *Fintech and the Innovation Trilemma*, 107 GEO. L.J. 235 (2019); Rory Van Loo, *Making Innovation More Competitive: The Case of Fintech*, 65 UCLA L. REV. 232 (2018); Dirk A. Zetsche et al., *From FinTech to TechFin: The Regulatory Challenges of Data-Driven Finance*, 14 N.Y.U. J.L. & BUS. 393 (2018).

³⁵ See Karmel, *supra* note 9, at 929–33 (2005); Troy Paredes, *On the Decision to Regulate Hedge Funds: The SEC's Regulatory Philosophy, Style, and Mission*, 2006 U. ILL. L. REV. 975; Marco Bodellini, *From System Risk to Financial Scandals: The Shortcomings of U.S. Hedge Fund Regulation*, 11 BROOK. J. CORP. FIN. & COM. L. 417 (2017) (arguing that U.S. hedge fund regulation insufficiently addresses systemic risk and investor protection issues in the industry); John Kambhu, Til Schuermann & Kevin J. Stiroh, *Hedge Funds, Financial Intermediation, and Systemic Risk*, FRBNY ECON. POL'Y REV. 1 (Dec. 2007) (exploring the systemic risk of hedge funds and concluding that an emphasis on market discipline and counterparty credit risk management is appropriate); Emily Kehoe, *Hedge Fund "Regulation" For Systemic Risk: Largely Impossible*, 14 J. BUS. & SEC. L. 35 (2013) (arguing that the SEC should monitor systemic risk information provided by hedge funds to better protect investors).

and hedge funds have undoubtedly expanded their use of it, neither development is entirely new. The idea of artificial intelligence has existed as long as computers have—indeed, some would say even longer—and while recent iterations of it have new techniques and capabilities, they are far from superhuman. Similarly, hedge funds play a larger role than ever before in our financial system, but this is the result of years of steady growth, not some breakthrough technology. The combination of these two trends represents the culmination of a long process of evolution, not a step change. Deep learning models are best understood as yet another tool in the financial modeling toolbox, one capable of modestly improving some areas of economic prediction, while remaining of limited use in others. The dangers of deep learning hedge funds lie not so much in their turning into “Terminators” bent on humanity’s destruction, as in our placing too much confidence in their predictions.

I. HEDGE FUNDS 101

In order to understand the risks posed by deep learning hedge funds, we must begin by exploring the integral role that hedge funds play in financial markets. From their humble beginnings in the 1950s, hedge funds have grown into an enormous, and enormously profitable, sector of the economy, handling trillions of dollars in capital and generating large returns for the most successful managers.³⁶ Much of this growth has come from their unique governance structure and their ability to take large, leveraged bets on investment theses. And they have used these advantages to expand into an ever-growing array of investment fields. This Part surveys the history of hedge funds, their essential structural features, and the primary strategies they deploy in markets.

A. *Hedge Fund History*

Where did hedge funds come from? It is not as easy a question as one might expect, given the wide attention that hedge funds have received in the financial press. The problem lies in the fundamentally protean nature of hedge funds—they are built to be flexible entities. Even the phrase “hedge fund” is more of a term of art than a precise entity structure. There is no widely accepted definition of a hedge fund, and, just as importantly, not all hedge funds are in fact hedged.

Many economic historians trace the beginnings of the hedge fund industry to 1949, when Alfred Winslow Jones, a sociologist and journalist who had studied technical methods of market analysis, launched a “hedged” fund

³⁶ See SEBASTIAN MALLABY, *MORE MONEY THAN GOD: HEDGE FUNDS AND THE MAKING OF A NEW ELITE* 15 (2010).

using a combination of his own savings and capital raised from outside investors.³⁷ He called his pooled capital a “hedged” fund because of the two-pronged strategy he devised for investing. First, he used leverage to acquire a greater number of shares in companies than would otherwise have been possible given his capital base, and, second, he reduced the risk of his overall portfolio by short-selling the shares of companies that he believed most likely to decline in the near term. The idea was to improve aggregate performance while hedging against broader market risk.³⁸ In crafting this structure, he also hit upon the core compensation structure that would play such an important role in the industry’s future: inspired by Phoenician merchants who kept a fifth of the profits of voyages, Jones charged investors a performance incentive fee of 20% of any profits generated by his strategies.³⁹ Initial returns for his fund were eye-popping. According to a 1966 *Fortune* magazine article, his hedge fund returned 670% over the previous ten years, compared to 358% for the best performing mutual fund over the same period.⁴⁰ In the wake of Jones’ stunning success, a number of other hedge funds emerged seeking to replicate and improve on his basic formula.⁴¹

Over the next several decades, hedge funds saw steady growth, along with an ever-expanding package of strategies.⁴² They began by focusing on hedging interest and currency rate fluctuations, a common source of risk for major companies.⁴³ In 1970, George Soros founded his hedge fund, Soros Fund Management, which famously focused on currency trades, but also invested based on geopolitical trends, such as war, international treaties, and financial deregulation.⁴⁴ In 1975, Ray Dalio founded Bridgewater to advise corporate clients on currency and interest rate risk—it would later become the world’s largest hedge fund.⁴⁵ In 1980, Julian Robertson founded Tiger Fund, and he combined Jones’ long-short equity investing strategy with bets on an assortment of other products, including commodities, currencies, bonds, futures,

³⁷ See Barbara Crutchfield George, Lynn V. Dymally & Maria K. Boss, *The Opaque and Under-Regulated Hedge Fund Industry: Victim or Culprit in the Subprime Mortgage Crisis?*, 5 N.Y.U. J.L. & Bus. 359, 367 (2009); Stephen J. Brown, William N. Goetzmann & Roger G. Ibbotson, *Offshore Hedge Funds: Survival and Performance, 1989-96*, 72 J. Bus. 91, 93 (1999).

³⁸ For a more in-depth discussion of the theory behind Jones’ fund, see MALLABY, *supra* note 36, at 15–39 (2010).

³⁹ He may well have been inspired more by the tax code than the practices of ancient Phoenician merchants—by structuring his compensation as a share of profits, not a set fee, he reduced his tax rate from the 91% applicable to wages to the 25% applicable to capital gains. See MALLABY, *supra* note 36, at 30.

⁴⁰ Carol J. Loomis, *The Jones Nobody Keeps Up With*, FORTUNE, Apr. 1, 1966, at 237.

⁴¹ See Brown, Goetzmann & Ibbotson, *supra* note 37, at 94.

⁴² See Gregory Connor & Mason Woo, *An Introduction to Hedge Funds*, INT’L ASSET MGMT. HEDGE FUND RESEARCH PROGRAMME 12–13, <https://researchonline.lse.ac.uk/id/eprint/24675/1/dp477.pdf> [<https://perma.cc/ZP2H-UWZ4>].

⁴³ See, e.g., Caldwell, *supra* note 23, at 5.

⁴⁴ See MALLABY, *supra* note 36, at 85–86.

⁴⁵ See DAVID SNIDER & CHRIS HOWARD, *MONEY MAKERS: INSIDE THE NEW WORLD OF FINANCE AND BUSINESS* 224 (2010).

and options.⁴⁶ His managers, many of whom went on to found their own hedge funds, became known as “Tiger Cubs.”⁴⁷ In the 1990s, hedge funds specializing in ever more esoteric niches spawned at a furious rate: derivatives, arbitrage, distressed investing, and shareholder activism all became well-known features of the hedge fund world.⁴⁸ By 1998, the number of hedge funds had grown from the 140 or so operating in 1968 to around 3,000.⁴⁹ Together, they controlled approximately \$1 trillion in assets.⁵⁰ Hedge funds had become an entire sector, and a major one, in the international financial system.

In the 2000s and 2010s, hedge funds experienced a dramatic boom followed by a similarly dramatic bust. In the run-up to the global financial crisis of 2008, enormous amounts of capital flowed into hedge funds, reaching an high of \$2.5 trillion in 2007.⁵¹ But after large losses during the crisis, as well as increased evidence of general underperformance paired with high fees, hedge funds experienced a long dry spell in the 2010s, with many hedge funds closing and others experiencing shrinking net assets under management.⁵² For many years, more funds closed down operations than were opened up.⁵³ But hedge funds did not disappear, and the largest grew even larger, continuing to raise funds and deploy capital at scale.⁵⁴

Today, hedge funds have become an enormously important part of the financial ecosystem. By one estimate, the size of the five largest multi-manager hedge funds alone is \$1.6 trillion, measured by the notional value of their positions in markets.⁵⁵ Globally, hedge funds have approximately \$4.9 trillion in assets under management.⁵⁶ They also use large amounts of leverage. According to the Office of Financial Research, total borrowing by hedge funds amounts to around \$5.5 trillion.⁵⁷ They hold derivatives valued at almost \$20 trillion.⁵⁸ Each month, they engage in tens of trillions of dollars

⁴⁶ See MALLABY, *supra* note 36, at 112–13.

⁴⁷ *Id.* at 115–16.

⁴⁸ See Caldwell, *supra* note 23, at 5–17.

⁴⁹ PRES. WORKING GROUP ON FIN. MKTS., HEDGE FUNDS, LEVERAGE, AND THE LESSONS OF LONG-TERM CAPITAL MANAGEMENT 10–14 (1999) [hereinafter LTCM REPORT].

⁵⁰ *Id.*

⁵¹ See FACTBOX: *Figures for the Hedge Fund Industry*, REUTERS (Feb. 28, 2008), [https://www.reuters.com/article/world/factbox-figures-for-the-hedge-fund-industry-idUSL28850044/\[https://perma.cc/B3UR-3UXG\]](https://www.reuters.com/article/world/factbox-figures-for-the-hedge-fund-industry-idUSL28850044/[https://perma.cc/B3UR-3UXG]).

⁵² See, *Investors Are Returning to Hedge Funds. That May Be Unwise*, ECONOMIST (Oct. 26, 2023), <https://www.economist.com/finance-and-economics/2023/10/26/investors-are-returning-to-hedge-funds-that-may-be-unwise> [https://perma.cc/8V7L-9PV9].

⁵³ See Katherine Burton, Melissa Karsh & Sam Dodge, *The Incredible Shrinking Hedge Fund*, BLOOMBERG, (Feb. 4, 2019), <https://www.bloomberg.com/graphics/2018-shrinking-hedge-fund/> [https://perma.cc/87P7-WU3B].

⁵⁴ *Id.*

⁵⁵ See *Can Anything Stop America's Superstar Hedge Funds?*, ECONOMIST (May 23, 2025), <https://www.economist.com/special-report/2025/05/23/can-anything-stop-americas-superstar-hedge-funds> [https://perma.cc/5PP7-E4J5].

⁵⁶ PREQIN, PREQIN 2025 GLOBAL REPORT: HEDGE FUNDS, Dec. 2024, <https://preqin.com/insights/global-reports/2025-hedge-funds> [https://perma.cc/2HDB-U3AW].

⁵⁷ See ECONOMIST, *supra* note 55.

⁵⁸ PRIVATE FUNDS REPORT, *supra* note 7, at 19.

of transactions, in everything from listed equities to futures to corporate and sovereign bonds.⁵⁹

Hedge funds attract some of the brightest minds in finance. The compensation for top performers can be extraordinarily lucrative, and much higher than that found at investment banks. In 2024, Citadel Securities made trading revenue of \$9.7 billion.⁶⁰ The same year, the ten highest-earning hedge fund managers earned an average of \$1.8 billion each, with Millenium's Izzy Englander topping the list at \$3.9 billion.⁶¹ The best-performing portfolio managers can be offered guaranteed pay packages worth \$100 million or more.⁶²

Scholars have identified a range of benefits that hedge funds provide to markets. First and foremost, they are an essential provider of liquidity.⁶³ By investing in a wide range of stocks, bonds, commodities, and other investment classes, they provide a ready source of capital for companies and firms seeking to raise capital.⁶⁴ Second, they provide an essential market-price accuracy role.⁶⁵ By relentlessly tracking and researching price discrepancies between markets and categories, they help provide price accuracy and speed up price formation, making markets more efficiently track fundamental values.⁶⁶ And third, they can serve an essential diversifying and risk-reducing role in the portfolios of large institutional investors such as pension funds and university endowments.⁶⁷

At the same time, critics of the industry have pointed out that hedge funds have played leading roles in some of the worst financial crises of the

⁵⁹ PRIVATE FUNDS REPORT, *supra* note 7, at 31.

⁶⁰ See Carmen Arroyo & Katherine Doherty, *Citadel Securities' \$9.7 Billion Trading Revenue Passes Barclays*, BLOOMBERG (Mar. 6, 2025), <https://www.bloomberg.com/news/articles/2025-03-06/citadel-securities-9-7-billion-trading-revenue-passes-barclays> [https://perma.cc/9TYF-JFGP].

⁶¹ See Tom Maloney & Hema Parmar, *Citrone Joins Top-Paid Hedge Fund Ranks With \$730 Million Payday*, BLOOMBERG (Feb. 19, 2025), <https://www.bloomberg.com/news/articles/2025-02-19/best-paid-hedge-fund-managers-izzy-englander-ken-griffin-top-the-list> [https://perma.cc/M8G7-K8AZ].

⁶² See Peter Rudegeair & Gregory Zuckerman, *The Frenzied Pursuit of Wall Street's Low-Profile All-Stars*, WALL ST. J. (June 13, 2025), <https://www.wsj.com/finance/investing/the-frenzied-pursuit-of-wall-streets-low-profile-all-stars> [https://perma.cc/DKS8-JE4R].

⁶³ See Paredes, *supra* note 35, at 986 (“[H]edge fund trading spins off important systemic benefits by leading to more efficient and more liquid capital markets that are better able to withstand unanticipated shocks to financial markets”).

⁶⁴ See Russell Jame, *Liquidity and the Cross Section of Hedge Fund Returns*, 64 MGMT. SCI. 3288 (2018).

⁶⁵ See Charles Cao, Bing Liang, Andrew W. Lo & Lubomir Petrasek, *Hedge Fund Holdings and Stock Market Efficiency*, 8 REV. ASSET PRICING STUD. 77, 108 (2018) (concluding that “on average, increased hedge fund ownership is significantly related to subsequent improvements in the informational efficiency of prices.”); Richard Sias, H. J. Turtle & Blerine Zykaj, *Hedge Fund Crowds and Mispricing*, 62 MGMT. SCI. 764, 764 (2016).

⁶⁶ See Cao, Liang, Lo & Petrasek, *supra* note 65, at 77–79.

⁶⁷ See Vincent Bouvatier & Sandra Rigot, *Pension Funds' Allocations to Hedge Funds: An Empirical Analysis of US and Canadian Defined Benefit Plans*, 56 APPLIED ECON. 3701 (2013); Greg N. Gregoriou & Fabrice Rouah, *The Role of Hedge Funds in Pension Fund Portfolios: Buying Protection in Bear Markets*, 7 J. PENSIONS MGMT. 237 (2002).

last decades.⁶⁸ In 1992, George Soros' bets against the British pound helped spur a financial crisis in the country that forced a devaluation of the currency and an eventual withdrawal from the European Exchange Rate Mechanism.⁶⁹ In 1998, the collapse of the quant hedge fund Long-Term Capital Management nearly caused the destruction of several banks, and the crisis was only averted after the Federal Reserve organized a bailout.⁷⁰ In the global financial crisis of 2008, several hedge funds made enormous returns from shorting—i.e., betting against—the U.S. housing market and the solvency of large investment banks.⁷¹ Several were immortalized in Michael Lewis' book and subsequent film, *The Big Short*.⁷² In 2010, a “flash crash” in the stock market led indices to suddenly plunge—some stocks fell as much as 60% in a matter of minutes—with little explanation, and a later staff report from the SEC and the CFTC concluded that the decline was caused by an initial large sale, followed by aggressive sales by high-frequency traders.⁷³ The combination of large leverage, complex, poorly understood, and interlinked financial instruments with high-speed computerized trading has raised repeated concerns from market observers.⁷⁴

B. Hedge Fund Structure

Despite the wide variety of hedge funds that exist today, the underlying legal structure of hedge funds has remained remarkably uniform. At their most

⁶⁸ See, e.g., Matt Egan, *Hedge Fund Meltdown: Elizabeth Warren Suggests Regulators Should've Seen It Coming*, CNN (Mar. 30, 2021), <https://edition.cnn.com/2021/03/30/investing/wall-street-hedge-fund-elizabeth-warren/index.html> [<https://perma.cc/89MG-4TUU>]. See generally LLOYD DIXON, NOREEN CLANCY & KRISHNA B. KUMAR, *HEDGE FUNDS AND SYSTEMIC RISK* (2012).

⁶⁹ See MALLABY, *supra* note 36, at 147–71.

⁷⁰ See LTCM REPORT, *supra* note 49, at 10–14. See also Willa E. Gibson, *Is Hedge Fund Regulation Necessary?*, 73 TEMP. L. REV. 681, 681–82 (2000).

⁷¹ For book-length treatments of the subject, see GREGORY ZUCKERMAN, *THE GREATEST TRADE EVER: THE BEHIND-THE-SCENES STORY OF HOW JOHN PAULSON DEFIED WALL STREET AND MADE FINANCIAL HISTORY* (2009); MICHAEL LEWIS, *THE BIG SHORT: INSIDE THE DOOMSDAY MACHINE* (2010). Some have argued that hedge funds did not contribute to the financial crisis but in fact made it less severe. See Houman B. Shadab, *Hedge Funds and the Financial Crisis*, MERCATUS CTR. ON POLICY, Jan. 2009, at 1 (“Hedge funds did not cause or meaningfully exacerbate the financial crisis and in fact have reduced its impact and are helping the economy to recover.”).

⁷² See generally LEWIS, *supra* note 71.

⁷³ See U.S. COMMODITY FUTURES TRADING COMM'N & U.S. SEC. & EXCH. COMM'N, FINDINGS REGARDING THE MARKET EVENTS OF MAY 6, 2010: REPORT OF THE STAFFS OF THE CFTC AND SEC TO THE JOINT ADVISORY COMMITTEE ON EMERGING REGULATORY ISSUES (2010); JOINT CFTC-SEC ADVISORY COMM. ON EMERGING REGULATORY ISSUES, RECOMMENDATIONS REGARDING REGULATORY RESPONSES TO THE MARKET EVENTS OF MAY 6, 2010: SUMMARY REPORT OF THE JOINT CFTC-SEC ADVISORY COMMITTEE ON EMERGING REGULATORY ISSUES (2011).

⁷⁴ See generally Dale A. Oesterle, *Regulating Hedge Funds* (Ohio State Univ. Moritz Coll. of Law, Pub. Law & Legal Theory Working Paper No. 71, 2006), <https://ssrn.com/abstract=913045> [<https://perma.cc/D32H-GPP6>].

basic, hedge funds are pools of capital, raised from institutional investors, and managed by professional traders.⁷⁵ This, of course, makes them sound like many other investment companies, but what makes hedge funds unique, and in fact what many consider to be their defining feature, is their entity structure.⁷⁶ At the center of this structure is the investment fund itself, typically formed as a limited partnership.⁷⁷ The investment fund is run by hedge fund managers—highly specialized traders and analysts who deploy complex trading strategies to generate investment returns—who generally serve (through a separate entity) as the general partner of the fund.⁷⁸ The fund's capital is raised from a combination of the managers' personal savings and the capital of outside investors, typically large institutional entities such as pension funds, university endowments, and sovereign wealth funds.⁷⁹ The investors acquire limited partnership interests in the fund.⁸⁰ Because investors in the fund are large, sophisticated actors, the sale of security interests to them is generally treated as a private placement and thus does not require the expensive and cumbersome registration process that is involved in public sales of securities.⁸¹ The fund then uses the capital it raises to acquire positions and deploy its trading strategies.⁸²

The relationship between hedge fund managers and investors is governed by the limited partnership agreement that forms the fund itself.⁸³ This agreement sets forth the powers and duties of both the general partner and the limited partners, including decision-making authority, fiduciary duties, redemption rights, and compensation arrangements.⁸⁴ While hedge fund fees are highly bespoke and vary from deal to deal, the most common structure is

⁷⁵ See Ackermann, McEnally & Ravenscraft, *supra* note 20, at 834.

⁷⁶ For an in-depth examination of the governing documents and legal restrictions on hedge funds, see GREGORY J. NOWAK, *HEDGE FUND DISCLOSURE DOCUMENTS LINE BY LINE: A USER'S GUIDE TO CONFIDENTIAL PRIVATE PLACEMENT MEMORANDA FOR FUNDS FORMED AS LIMITED LIABILITY COMPANIES* (2004). See also Thierry Olivier Desmet, *Understanding Hedge Fund Adviser Regulation*, 4 HASTINGS BUS. L.J. 1 (2008); Houman B. Shadab, *Hedge Fund Governance*, 19 STAN. J.L. BUS. & FIN. 141 (2013).

⁷⁷ See LEOR LANDA, GREGORY S. ROWLAND & MICHAEL S. HONG, *ADVISING PRIVATE FUNDS: A COMPREHENSIVE GUIDE TO REPRESENTING HEDGE FUNDS, PRIVATE EQUITY FUNDS AND THEIR ADVISERS* § 20:3 (2024).

⁷⁸ See Douglas Cumming, Na Dai & Sofia Johan, *Hedge Fund Organization*, in *HEDGE FUNDS: STRUCTURE, STRATEGIES, AND PERFORMANCE* (H. Kent Baker & Greg Filbeck eds., 2017). In some structures, there is a separate investment manager that provides investment advisory services. See LANDA, ROWLAND & HONG, *supra* note 77, at § 20:3.

⁷⁹ See Cumming, Dai & Johan, *supra* note 78, at 75.

⁸⁰ *Id.*

⁸¹ See Paredes, *supra* note 35, at 982.

⁸² *Id.*

⁸³ And occasionally by side letters individually negotiated with certain investors. See LANDA, ROWLAND & HONG, *supra* note 77, at § 20:7. See also William Magnuson, *The Public Cost of Private Equity*, 102 MINN. L. REV. 1847, 1885-89 (2018); Elisabeth de Fontenay & Yaron Nili, *Side Letter Governance*, 100 WASH. U. L. REV. 907 (2023); William W. Clayton, *The Private Equity Negotiation Myth*, 37 YALE J. REG. 67 (2020).

⁸⁴ See LANDA, ROWLAND & HONG, *supra* note 77, at § 20:7.

a combination of a management fee and a performance fee.⁸⁵ Management fees are paid on a monthly or annual basis by the investors to the hedge fund manager in return for their services.⁸⁶ It is typically calculated as a percentage of the fund's asset value and is often set at around two percent, meaning that, every year, regardless of the firm's performance, the managers earn two percent of the total fund size.⁸⁷ Performance fees, on the other hand, are incentive payments made to the managers based on the success of the fund.⁸⁸ Typically calculated as a percentage of the fund's profits—measured by the increase in net asset value, subject to certain thresholds, hurdles, and waterfall provisions—performance fees are often set at around twenty percent, meaning that the managers will earn twenty percent of any increase in value of the fund's investments over the course of specified periods.⁸⁹ This is a somewhat simplified description of the hedge fund structure, as compensation arrangements vary heavily from deal to deal and are some of the most complex and highly negotiated provisions in limited partnership agreements, but it gives a broad sense of the basic incentive structure of hedge funds.⁹⁰

This combination of management fees and performance fees—the so-called “two-and-twenty” arrangement—creates strong incentives for managers to raise large funds and generate large profits.⁹¹ Consider, for example, a hedge fund that raises a debut fund of \$1 billion, not an uncommon size in the industry.⁹² Regardless of the performance of the fund, the hedge fund managers will earn two percent of the fund's value as a management fee, meaning that, assuming the value stays the same, the firm's managers will earn \$20 million annually. In addition to that sizeable sum, managers will also earn twenty percent of the fund's profits. While returns can fluctuate dramatically from fund to fund, let us posit that the fund earns an investment profit of ten percent or \$100 million in its first year, which was roughly the average return for hedge funds in 2024.⁹³ The hedge fund managers are entitled to twenty

⁸⁵ *Id.* at § 20:14.

⁸⁶ *Id.* at § 20:15.

⁸⁷ The actual percentage can vary substantially from firm to firm. *Id.*

⁸⁸ *Id.* at § 20:16.

⁸⁹ *Id.* at § 20:16.

⁹⁰ *Id.* at § 20:16.

⁹¹ See Ackermann, McEnally & Ravenscraft, *supra* note 20 at 834.

⁹² See, e.g., Katherine Burton, *Ex-Viking CIO's Hedge Fund Expected to Top \$1 Billion in Debut*, BLOOMBERG (May 13, 2025), <https://www.bloomberg.com/news/articles/2025-05-13/ex-viking-cio-s-hedge-fund-expected-to-top-1-billion-in-debut> [https://perma.cc/8T5U-X7SN]; Nishant Kumar, *Hedge Fund Titans Breed a \$14 Billion Pack of Startup Cubs*, BLOOMBERG (Sept. 18, 2024), <https://www.bloomberg.com/news/features/2024-09-17/hedge-fund-startups-millennium-citadel-traders-raise-14-billion-for-spinoffs> [https://perma.cc/7KBX-3J2C].

⁹³ See Nell Mackenzie & Carolina Mandl, *Hedge Funds Score Double-Digit Returns in 2024*, REUTERS (Jan. 3, 2025), <https://www.reuters.com/markets/hedge-funds-deliver-double-digit-returns-2024-2025-01-02/> [https://perma.cc/NBG4-CEB7].

percent of that profit, or \$20 million. So if they perform roughly average to the industry, they will make \$40 million annually.⁹⁴

Hedge fund structure has customarily been dictated by regulation, and in particular, by the desire to avoid being subject to the central pillars of financial regulation: the Securities Act of 1933, the Securities Exchange Act of 1934, the Investment Company Act of 1940, and the Investment Advisers Act of 1940.⁹⁵ The Securities Act, among other things, requires companies that sell securities to register with the SEC and provide extensive disclosures to investors in public filings.⁹⁶ The Securities Exchange Act requires companies to make periodic public filings providing information on their performance and business, as well as timely updates upon the occurrence of certain material events.⁹⁷ The Investment Company Act imposes a series of substantive restrictions on “investment companies,” including limiting their ability to engage in short sales and acquire securities on margin.⁹⁸ The Investment Advisers Act requires investment advisers to register with the SEC, provide regular public filings on their business, and refrain from engaging in an array of restricted practices, including the charging of performance-based fees.⁹⁹ Together, these four statutes contain an array of substantive and procedural obligations that would significantly reduce the flexibility of hedge funds to pursue their investment strategies.

As a result, hedge funds have historically tended to structure their operations in ways that qualify them for various exemptions from the principal statutes, largely through limiting the number and type of investors in their funds.¹⁰⁰ Their structure provides them with a variety of advantages. First, it prevents them from having to comply with costly registration and disclosure

⁹⁴ These numbers are simplified, as most hedge funds will have performance thresholds below which the hedge fund does not earn performance fees. This hypothetical also assumes that investors do not demand redemptions of their investments.

⁹⁵ Oesterle, *supra* note 74, at 1 (“Hedge funds owe a substantial degree of their success to their freedom from federal regulations on their formation, organization and trading practices.”).

⁹⁶ See LOUIS LOSS, JOEL SELIGMAN & TROY PAREDES, *FUNDAMENTALS OF SECURITIES REGULATION* 39 (2025).

⁹⁷ *Id.*

⁹⁸ *Id.* at 41–51. Section 12(a) of the Investment Company Act provides that “[i]t shall be unlawful for any registered investment company, in contravention of such rules and regulations or orders as the Commission may prescribe as necessary or appropriate in the public interest or for the protection of investors... (1) to purchase any security on margin, except such short-term credits as are necessary for the clearance of transactions;... or (3) to effect a short sale of any security, except in connection with an underwriting in which such registered company is a participant.” 15 U.S.C. § 80a-12. See also Honghui Chen, Hemang Desai & Srinivasan Krishnamurthy, *A First Look at Mutual Funds That Use Short Sales*, 48 J. FIN. & QUANT. ANAL. 761, 765 (2013) (“At first glance, [Section 12(a)] appears to severely limit the ability of mutual funds to use short sales and has led to a widespread belief among both practitioners and academics that mutual funds virtually never use short sales.”).

⁹⁹ *Id.* at 51–52. See Paul G. Mahoney & Adriana Robertson, *Advisers By Another Name*, 11 HARV. BUS. L. REV. 311, 326–34 (2021).

¹⁰⁰ See Paredes, *supra* note 35, at 982.

requirements of securities and investment regulations.¹⁰¹ Second, it allows them to engage in flexible trading strategies that would be prohibited under other regulatory regimes.¹⁰² Third, they are permitted to charge incentive and performance fees that are restricted or prohibited for other investment companies.¹⁰³ And, finally, they are not subject to the strict capital requirements that limit the amount of leverage that financial institutions may take on.¹⁰⁴

Hedge fund regulation has undergone substantial change over the last two decades.¹⁰⁵ In 2004, the SEC, concerned with the rapid growth of hedge funds and the frequent accusations of fraud being brought against them, enacted a rule requiring hedge funds to register with the regulatory body and comply with general recordkeeping and disclosure rules.¹⁰⁶ But in 2006, after a hedge fund manager challenged the rule in federal court, the Court of Appeals for the District of Columbia overturned the rule as arbitrary and unreasonable.¹⁰⁷ In 2010, in the wake of the global financial crisis and concerns about excessive risk-taking in the hedge fund industry that might have contributed to it, Congress enacted the expansive Dodd-Frank Act eliminating certain exemptions for hedge funds and adding new registration and disclosure obligations.¹⁰⁸ But in 2023, when the SEC promulgated a new rule under the Act aimed at “increasing visibility into certain practices involving compensation schemes, sales practices, and conflicts of interest through disclosure; establishing requirements to address such practices that have the potential to lead to investor harm; and restricting practices that are contrary to the public interest and the protection of investors,” a group of private equity and hedge fund trade groups challenged it as arbitrary and capricious and beyond the SEC’s authority.¹⁰⁹ The Court of Appeals for the Fifth Circuit struck it down in 2024 in *National Association of Private Fund Managers v. Securities and*

¹⁰¹ See Anne Rivière, *The Future of Hedge Fund Regulation: A Comparative Approach United States, United Kingdom, France, Italy, and Germany*, 10 RICH. J. GLOBAL L. & BUS. 263, 265 (2011).

¹⁰² See Paredes, *supra* note 35, at 982.

¹⁰³ See HEDGE FUNDS, LEVERAGE, AND THE LESSONS OF LONG-TERM CAPITAL MANAGEMENT: REPORT OF THE PRESIDENT’S WORKING GROUP ON FINANCIAL MARKETS app. at A-1–A-2 (1999).

¹⁰⁴ See *id.*

¹⁰⁵ See Colleen Honigsberg, *Hedge Fund Regulation and Fund Governance: Evidence on the Effects of Mandatory Disclosure Rules*, 57 J. ACCOUNT RES. 845 (2019).

¹⁰⁶ See Securities and Exchange Comm’n, *Registration Under the Advisers Act of Certain Hedge Fund Advisers*, Advisers Act Release No. IA-2333, 17 C.F.R. §§ 275, 279 (2004).

¹⁰⁷ *Goldstein v. SEC*, 451 F.3d 873, 884 (2006) (“[T]he Hedge Fund Rule only exacerbates whatever problems one might perceive in Congress’s method for determining who to regulate. The Commission’s rule creates a situation in which funds with one hundred or fewer investors are exempt from the more demanding Investment Company Act, but those with fifteen or more investors trigger registration under the Advisers Act. This is an arbitrary rule.”).

¹⁰⁸ See Fernan Restrepo, *The Economic Consequences of Hedge Fund Regulation: An Analysis of the Effect of the Dodd-Frank Act*, 53 J. LEG. STUD. 391 (2024).

¹⁰⁹ Securities and Exchange Comm’n, *Private Fund Advisers; Documentation of Registered Investment Adviser Compliance Reviews*, Advisers Act Release No. IA-6383, 17 C.F.R. § 275 (2023).

Exchange Commission.¹¹⁰ After all this storm of legislation and litigation, we remain largely where we started. Hedge funds are lightly regulated entities with strong performance incentives and flexible governance arrangements.

C. *Hedge Fund Strategies*

Given their flexible regulatory and governance structure, it should come as no surprise that hedge funds engage in a wide range of investment strategies. Many of these have little to do with one another. In fact, when the SEC initially sought to categorize the types of hedge funds for disclosure purposes in 2011, it ended up with no fewer than twenty-two different categories¹¹¹—and, viewing these categories as insufficient, expanded the number to fifty-three in 2024..¹¹² In this Part, I will briefly examine four of the most common strategies, namely, long-short strategies, activist investing, event-driven arbitrage, and high-frequency trading. The point here is not to comprehensively survey every possible activity that a hedge fund can engage in, but rather to get a sense of some of the most important roles that hedge funds play within the financial system.

1. Long-Short Strategies

Long-short strategies are by far the most famous investing strategy of hedge funds. They are also the most common.¹¹³ In 2024, some 40% of single-strategy hedge funds in the U.S. focused on some variety of long-short strategy.¹¹⁴ Alfred Winslow Jones' hedge fund famously adopted a long-short strategy as its founding philosophy.¹¹⁵ As such, long-short strategies have come to define the hedge fund industry in a way that no other trading approach has.¹¹⁶

¹¹⁰ See Nat'l Ass'n of Priv. Fund Managers v. SEC, 103 F.4th 1097, 1114 (5th Cir. 2024).

¹¹¹ See Securities and Exchange Comm'n, *Form PF: Reporting Form for Investment Advisers to Private Funds and Certain Commodity Pool Operators and Commodity Trading Advisors*, OMB No. 3235-0679, 8–9 (2011), <https://www.sec.gov/files/rules/final/2011/ia-3308-formpf.pdf> [<https://perma.cc/TGD4-M7SM>].

¹¹² See Securities and Exchange Comm'n, *Form PF; Reporting Requirements for All Filers and Large Hedge Fund Advisers*, Advisers Act Release No. IA-6546, 17 C.F.R. § 279, at 77 (2025).

¹¹³ See SECURITIES AND EXCHANGE COMM'N, DIVISION OF INVESTMENT MANAGEMENT, PRIVATE FUND STATISTICS: THIRD CALENDAR QUARTER 2024 24 (2024).

¹¹⁴ *Id.*

¹¹⁵ See MALLABY, *supra* note 37, at 15–39.

¹¹⁶ See Paul Kiernan, *Hedge Funds Must Tell SEC Which Companies They Sell Short Under New Rules*, WALL ST. J., (Oct. 13, 2023), <https://www.wsj.com/finance/regulation/hedge-funds-would-have-to-tell-sec-which-companies-they-sell-short-under-new-rules> [<https://perma.cc/AAX4-ZC6B>]; Conrad de Aenlle, *Long-Short Funds: Long on Complexity, Short on Returns*, N.Y. TIMES (June 12, 2019), <https://www.nytimes.com/2019/07/12/business/long-short-bad-returns.html> [<https://perma.cc/3HAM-7JK6>].

The basics of long-short investing are simple.¹¹⁷ Long-short hedge funds make bets in *favor* of some stocks and *against* others.¹¹⁸ Long positions are acquisitions of the stock (or, sometimes, derivatives related to the stock) of a company, and their ownership reflects a belief that the current stock price undervalues the company.¹¹⁹ They are bets in *favor* of a company's stock.¹²⁰ Short positions, on the other hand, are bets against a company's stock, reflecting a belief that the current stock price *overvalues* the company.¹²¹ In order to short a stock, hedge funds can utilize a variety of tactics, but the most common is to borrow shares of a stock, sell them in the market, and then rebuy them at a later date to return them to the original owner.¹²² The hope is that, during this interim period, the price of the stock will fall and, thus, the hedge fund can profit from selling the stock at the initial higher price point and buying it later at a lower price.¹²³

The magic of the long-short strategy lies in how precisely a hedge fund combines its long and short positions.¹²⁴ If a hedge fund only engaged in long positions, it would not perform well when the stock market as a whole declined.¹²⁵ But through a careful balancing of long positions with short positions, a hedge fund can theoretically earn returns *both* in bull markets and in bear markets.¹²⁶ It can also fine-tune its exposure to market segments.¹²⁷ For example, it might acquire a long position in a single tech stock (say, Apple) and a short position in a tech index (say, NASDAQ's technology index).¹²⁸ This would increase its exposure to Apple-specific performance, and reduce its exposure to broader trends in the technology industry.¹²⁹ It is these types of combinations that put the "hedge" in hedge funds: they are hedging their bets.¹³⁰

¹¹⁷ See SCOTT FRUSH, UNDERSTANDING HEDGE FUNDS 95–97 (2007).

¹¹⁸ *Id.*

¹¹⁹ *Id.* at 95–96.

¹²⁰ *Id.*

¹²¹ See *An Introduction to Short Sales*, SECURITIES AND EXCHANGE COMM'N (Oct. 29, 2015), <https://www.investor.gov/introduction-investing/general-resources/news-alerts/alerts-bulletins/investor-bulletins-51> [<https://perma.cc/G6RR-E5BD>].

¹²² See *An Introduction to Short Selling*, MANAGED FUND ASSOCIATION (June, 30, 2021), <https://www.mfaalts.org/research/an-introduction-to-short-selling/> [<https://perma.cc/K4TC-8H65>].

¹²³ *Id.*

¹²⁴ See FRUSH, *supra* note 117, at 95–97.

¹²⁵ *Id.*

¹²⁶ *Id.*

¹²⁷ *Id.*

¹²⁸ *Id.*

¹²⁹ *Id.*

¹³⁰ For a discussion of the benefits of shorting, see Peter Molk & Frank Partnoy, *Institutional Investors as Short Sellers?*, 99 B.U. L. REV. 837 (2019).

2. Activist Investing

Another major strategy of hedge funds that has earned them significant public attention—and scholarly debate—is activist investing.¹³¹ Although estimates for the prevalence of the practice vary, by one count, nine of the fifty largest hedge funds engage in some kind of activist investing.¹³² Activist investing customarily involves a hedge fund acquiring a large stake in a company and then using its rights as a shareholder to pressure the company into making governance and operational changes.¹³³ Shareholder pressure is often paired with a public campaign that aims to disseminate the hedge fund's proposals—sometimes in inflammatory white papers criticizing current management.¹³⁴ In one famous case from 2016, the activist hedge fund Starboard Value released a 294-page report on the mismanagement of Olive Garden's corporate owner, claiming, among other things, that its unlimited breadsticks policy led to high food waste (Starboard ultimately took control of the company's board).¹³⁵ Although the changes proposed vary from deal to deal, they tend to cluster around a standard package of strategic transactions.¹³⁶ These include share buybacks, dividend increases, spinning off of business lines, company sales, board representation, director and management removals, and general operational improvements.¹³⁷

Activist hedge funds profit from their campaigns if the company's stock price increases. This might be caused by expected improvement in the corporation's performance from the management and operational changes, in the expectation of increased dividends or buybacks in the future, or in the announcement of a major transaction or sale.¹³⁸ In any case, the profits must come quickly for the hedge fund to benefit from them. Activist investors

¹³¹ See John C. Coffee Jr. & Darius Palia, *The Wolf at the Door: The Impact of Hedge Fund Activism on Corporate Governance*, 41 J. CORP. L. 546, 546 (2016); Alon Brav, Wei Jang & Rongchen Li, *Governance by Persuasion: Hedge Fund Activism and Market-Based Shareholder Influence* (January 2022) (working paper), available at https://www.ecgi.global/sites/default/files/working_papers/documents/bravjianglifinal_0.pdf [<https://perma.cc/LW2Z-7F7P>].

¹³² See Leo E. Strine Jr., *Who Bleeds When the Wolves Bite?: A Flesh-and-Blood Perspective on Hedge Fund Activism and Our Strange Corporate Governance System*, 126 YALE L.J. 1870, 1886–87 (2017).

¹³³ Anna Christie, *Activist Directors: The Evolution of Hedge Fund Activism in the S&P 500*, 57 CONN. L. REV. 523 (2025).

¹³⁴ *Id.* at 525–26.

¹³⁵ See *Transforming Darden Restaurants*, STARBOARD VALUE (Sept. 11, 2014), https://www.shareholderforum.com/dri/Library/20140911_Starboard-presentation.pdf [<https://perma.cc/LD99-242T>].

¹³⁶ See Alon Brav, Wei Jang, Frank Partnoy & Randall Thomas, *Hedge Fund Activism, Corporate Governance, and Firm Performance*, 63 J. FIN. 1729, 1741–45 (2008).

¹³⁷ See *id.* at 1741–45; Alon Brav, Wei Jang, Frank Partnoy & Randall S. Thomas, *The Returns to Hedge Fund Activism*, 64 FIN. ANALYSTS J. 45 (2008); William Bratton, *Hedge Funds and Governance Targets*, 95 GEO. L.J. 1375 (2007); Christie, *supra* note 133, at 542–43.

¹³⁸ See Strine Jr., *supra* note 132, at 1939.

generally operate on a short time horizon.¹³⁹ They are not long-term investors, and most activist hedge funds exit their investment within one or two years of initially acquiring their position.¹⁴⁰

One of the central debates around activist investing is how hedge fund campaigns affect corporate governance, and in particular, whether hedge fund-initiated changes generate long-term value for a corporation or, instead, are focused on maximizing short-term profits at the expense of long-term value.¹⁴¹ Scholars have come down on both sides of the question.¹⁴² In any case, no one denies that activist hedge funds have become a powerful force in corporate boardrooms around the country.

3. Arbitrage

Another major category of hedge fund activity focuses on an investment technique known as arbitrage.¹⁴³ There are many types of arbitrage, but the fundamental concept is to identify riskless (or low-risk) investments where a security is under- or over-valued because of price inefficiencies in the market.¹⁴⁴ For example, a company's stock might be trading at \$10 a share on a stock exchange, and its convertible bonds (which can be converted to stock at the holder's option) might be trading at \$9 on another exchange.¹⁴⁵ The hedge fund could acquire the bonds for \$9, convert them into shares, and then sell them for \$10—with little to no risk.¹⁴⁶ While arbitrage hedge funds

¹³⁹ See Brav, Jiang, Partnoy & Thomas, *supra* note 136, at 1749.

¹⁴⁰ *Id.* (finding that activist hedge funds hold their investments for a median length of 556 days).

¹⁴¹ See Marcel Kahan & Edward B. Rock, *Hedge Funds in Corporate Governance and Corporate Control*, 155 U. PA. L. REV. 1021, 1022 (2007) (arguing that “the interests of hedge funds sometimes diverge from those of their fellow shareholders, and the intensity of hedge fund activism imposes substantial stress that the regulatory system may not be able to withstand”); John C. Coffee Jr. & Darius Palia, *The Wolf at the Door: The Impact of Hedge Fund Activism on Corporate Governance*, 41 J. CORP. L. 546 (2016).

¹⁴² For example, some scholars have concluded that hedge fund activism generally improves corporate performance. See Lucian A. Bebchuk, Alon Brav & Wei Jiang, *The Long-Term Effects of Hedge Fund Activism*, 115 COLUM. L. REV. 1085, 1153 (2015) (“hedge fund activism is associated with beneficial long-term consequences”). See also Christopher P. Clifford, *Value Creation or Destruction? Hedge Funds as Shareholder Activists*, 14 J. CORP. FIN. 323 (2008); Robin Greenwood & Michael Schor, *Investor Activism and Takeovers*, 92 J. FIN. ECON. 362 (2009). Other scholars have concluded that hedge fund activism tends to boost short-term profits at the cost of long-term value. See Martijn Cremers, Saura Masconale & Simone M. Sepe, *Activist Hedge Funds and the Corporation*, 94 WASH. U. L. REV. 261 (2017); Faith Stevelman & Sarah C. Haan, *Boards in Information Governance*, U. PA. J. BUS. L. 179, 202 (2020) (“In their attempts to alter corporate financial or operating affairs in order to capture a greater, immediate surplus, activist hedge funds represent a trenchant, destabilizing force in contemporary governance”); Kahan & Rock, *supra* note 138, at 1083 (“Short-termism may thus pervade much that hedge funds do, including their corporate governance and control activism.”).

¹⁴³ See FRUSH, *supra* note , at 88.

¹⁴⁴ *Id.*

¹⁴⁵ *Id.*

¹⁴⁶ *Id.*

traditionally focused on closely linked products—such as linked securities or cross-listed stocks—they have expanded into a wide variety of other areas, including merger arbitrage, debt arbitrage, distressed arbitrage, and general event-driven arbitrage.¹⁴⁷

Arbitrage firms are often known for their sophisticated knowledge (and use) of legal structures. In the 2010s, for example, merger arbitrage firms began making increased use of a procedure in Delaware courts known as “merger appraisal.”¹⁴⁸ The statutory procedure permitted shareholders of a company that was being acquired to challenge the price offered and have the “fair value” of their shares instead determined by a court.¹⁴⁹ While the spirit of the law was to allow shareholders who were being forced out of their company involuntarily to be guaranteed a fair price for their shares, hedge funds began buying up the shares of target companies *after* the merger had been announced, and solely for the purpose of pursuing appraisal actions.¹⁵⁰ Driving the trend were two quirks of Delaware law.¹⁵¹ First, it turned out that Delaware courts rarely awarded a dissenting shareholder less than the merger price offered by the acquiror (so it was essentially a riskless investment).¹⁵² Second, the Delaware statute required the buyer to pay interest on the amount owed to the shareholder, and the statute had an unusually high fixed statutory rate, a rate that was significantly higher than the interest firms could achieve in the market at that time.¹⁵³ After years of rising appraisal arbitrage, eventually Delaware amended its statute to address the incentive problems.¹⁵⁴ And while technically appraisal arbitrage was open to all shareholders, it was largely a

¹⁴⁷ See MALLABY, *supra* note 36, at 192.

¹⁴⁸ See generally Charles R. Korsmo & Minor Myers, *Appraisal Arbitrage and the Future of Public Company M&A*, 92 WASH. U. L. REV. 1551 (2015); Wei Jiang, Tao Li & Randall Thomas, *The Long Rise and Quick Fall of Appraisal Arbitrage*, 100 B. U. L. REV. 2133 (2020); Wei Jiang, Tao Li, Danqing Mei & Randall Thomas, *Appraisal: Shareholder Remedy or Litigation Arbitrage?*, 59 J.L. & ECON. 697 (2016) William J. Carney & Keith Sharfman, *The Death of Appraisal Arbitrage: Ending Windfalls for Deal Dissenters*, 43 DEL. J. CORP. L. 61, 96–99 (2018); Jonathan Macey & Joshua Mitts, *Asking the Right Question: The Statutory Right of Appraisal and Efficient Markets*, 74 BUS. LAW. 1015 1026–27 (2019). See also Henry T.C. Hu & Bernard Black, *Hedge Funds, Insiders, and the Decoupling of Economic and Voting Ownership: Empty Voting and Hidden (Morphable) Ownership*, 13 J. CORP. L. 343 (2007) (analyzing how hedge funds decouple voting rights and economic ownership of shares).

¹⁴⁹ See Korsmo & Myers, *supra* note 150, at 1558–59.

¹⁵⁰ *Id.* at 1566–82.

¹⁵¹ See Jiang, Li & Thomas, *supra* note 150, at 2133.

¹⁵² Between 2000 and 2014, the average appraisal action awarded a “fair value” that was 50.6% higher than the deal price. See Jiang, Li, Mei & Thomas, *supra* note 147, at 721.

¹⁵³ The Delaware code provided that prejudgment interest would be awarded at “5% over the Federal Reserve discount rate.” Del. Code Ann. tit. 8, § 262(h) (2015). See Daniel E. Wolf, *Appraisal Rights—The Next Frontier in Deal Litigation?*, HARVARD CORPORATE GOVERNANCE BLOG (May 16, 2013), <https://corpgov.law.harvard.edu/2013/05/16/appraisal-rights-the-next-frontier-in-deal-litigation/> [https://perma.cc/8MH3-HD97] (“In today’s ultra-low interest rate setting, the accumulating interest payments represent, if not an intriguing stand-alone investment opportunity, at least a meaningful offset to the extended period of illiquidity and litigation costs imposed on the dissenting shareholders for the duration of the proceedings.”).

¹⁵⁴ See Jiang, Li & Thomas, *supra* note 150, at 2144–47.

hedge-fund driven phenomenon.¹⁵⁵ Hedge funds represented some 74% of the total dollar volume of appraisal actions between 2000 and 2014.¹⁵⁶

A similar litigation-heavy approach has been taken by arbitrage hedge funds focusing on sovereign debt, particularly distressed sovereign debt.¹⁵⁷ One of the most controversial cases of recent years involved Argentinian sovereign bonds that had gone into default in 2001. The hedge fund Elliott Capital acquired the bonds at a steep discount after Argentina's default.¹⁵⁸ When Argentina restructured the debt, offering bondholders around a quarter of the original face value of the bonds, Elliott Capital and other hedge funds rejected the offer and instead launched a series of lawsuits seeking full repayment.¹⁵⁹ The decade-long dispute involved a global legal battle with multiple lawsuits and proceedings brought in several countries.¹⁶⁰ Elliott Capital even managed to convince a Ghanaian court to seize an Argentinian naval vessel that had sailed into Ghana's Tema port in 2012.¹⁶¹ In the same year, a New York court held that, due to an obscure provision in the sovereign bonds known as a *pari passu* clause, Argentina was prohibited from paying any other bondholders until it had first paid Elliott Capital and the other hedge funds, ratcheting up the pressure on Argentina to settle with the holdout "vulture funds."¹⁶² Finally, in 2016, Argentina agreed to a settlement with Elliott Capital and other hedge funds in which it would pay them a discounted amount in return for their ending the dispute.¹⁶³ According to some reports, the total return for Elliott Capital's investment was 1,180%.¹⁶⁴ Although the Elliott Capital case

¹⁵⁵ See Jiang, Li, Mei & Thomas, *supra* note 150, at 706.

¹⁵⁶ *Id.*

¹⁵⁷ See Tim R. Samples, *Rogue Trends in Sovereign Debt: Argentina, Vulture Funds, and Pari Passu Under New York Law*, 35 NW. J. INT'L L. & BUS. 49 (2014); Daniel J. Brutti, *Sovereign Debt Crises and Vulture Hedge Funds: Issues and Policy Solutions*, 61 B.C. L. REV. 1819 (2020).

¹⁵⁸ See generally Gregory Makoff & W. Mark C. Weidemaier, *Mass Sovereign Debt Litigation: A Computer-Assisted Analysis of the Argentina Bond Litigation in the U.S. Federal Courts 2002-2016*, 56 U.C. DAVIS L. REV. 1233 (2023); Gregory R. Day, *Market Failure, Pari Passu, and the Law and Economics Approach to the Sovereign Debt Crisis*, 22 TULANE J. INT'L & COMP. L. 225 (2014); Jill E. Fisch & Caroline M. Gentile, *Vultures or Vanguard?: The Role of Litigation in Sovereign Debt Restructuring*, 53 EMORY L.J. 1043 (2014); Jonathan I. Blackman & Rahul Mukhi, *The Evolution of Modern Sovereign Debt Litigation: Vultures, Alter Egos, and Other Legal Fauna*, 73 L. & CONTEMP. PROBS. 47 (2010); Juan J. Cruces & Tim R. Samples, *Settling Sovereign Debt's "Trial of the Century"*, 31 EMORY INT'L L. REV. 5 (2016).

¹⁵⁹ See Renae Merle, *How One Hedge Fund Made \$2 Billion from Argentina's Economic Collapse*, WASH. POST (Mar. 29, 2016), <https://www.washingtonpost.com/news/business/wp/2016/03/29/how-one-hedge-fund-made-2-billion-from-argentinias-economic-collapse/> [<https://perma.cc/V8RG-RZPD>].

¹⁶⁰ *Id.*

¹⁶¹ *Id.*

¹⁶² See Day, *supra* note 160, at 242–45.

¹⁶³ See Makoff & Weidemaier, *supra* note 160, at 1235.

¹⁶⁴ See Martin Guzman & Joseph E. Stiglitz, *How Hedge Funds Held Argentina for Ransom*, N.Y. TIMES (Apr. 1, 2016), <https://www.nytimes.com/2016/04/01/opinion/how-hedge-funds-held-argentina-for-ransom.html> [<https://perma.cc/G39U-CB3K>].

was unique in its high-publicity maneuvers, hedge funds have followed a similar playbook in a number of other sovereign defaults of recent years.¹⁶⁵

4. High-Frequency Trading

A final group of hedge funds focuses on a strategy known as high-frequency trading. High-frequency trading is often known as “quant” trading because the speed-based strategy requires the analytical and decision-making speed that only computers can offer. Hedge funds are not the only financial institutions that engage in high-frequency trading—investment banks and proprietary investment firms do as well—but it is nonetheless a significant sector of the hedge fund industry. It is estimated that high-frequency trading accounts for some 50% of trading volume in U.S. equity markets, and hedge funds account for some 6% of this.¹⁶⁶ The SEC has stated that high-frequency trading is a “dominant component of the current market structure and likely to affect nearly all aspects of its performance.”¹⁶⁷

High-frequency trading refers to a collection of investment strategies based around the idea of generating profit through rapid, high-volume, computerized placements of orders.¹⁶⁸ Instead of having human investment managers make individualized decisions on which securities to buy and at what price, high-frequency traders write algorithms or codes that execute orders automatically based on a set of rules.¹⁶⁹ While such algorithmic trading has long been a feature of stock markets, high-frequency traders have developed an entire investment thesis around their ability to generate and execute trades

¹⁶⁵ See Makoff & Weidemaier, *supra* note 160, at 1239–40.

¹⁶⁶ See Johannes Breckenfelder, *How Does Competition Among High-Frequency Traders Affect Market Liquidity?*, 78 EUROPEAN CENTRAL BANK RESEARCH BULLETIN, Dec. 15, 2020, <https://www.ecb.europa.eu/press/research-publications/resbull/2020/html/ecb.rb201215~210477c6b0.en.html> [<https://perma.cc/A9A8-2Z5M>]; Stuart Baden Powell, *High Frequency Trading*, 70 THE HEDGE FUND JOURNAL (2011), <https://thehedgefundjournal.com/high-frequency-trading/> [<https://perma.cc/G4QH-UNY6>].

¹⁶⁷ Securities and Exchange Comm’n, *Concept Release on Equity Market Structure*, Exchange Act Release No. 34-61358, 75 C.F.R. § 3594, 3606 (Jan. 21, 2010) [hereinafter SEC CONCEPT RELEASE].

¹⁶⁸ See Charles R. Korsmo, *High-Frequency Trading: A Regulatory Strategy*, 48 U. RICH. L. REV. 523, 527–28 (2019) (“[High-frequency] traders use high-speed computers to execute rapid-fire trades, usually without real-time human involvement, and have, in a matter of only a few years, gone from non-existent to conducting perhaps a majority of all trades on public securities markets.”); Kristin N. Johnson, *Regulating Innovation: High Frequency Trading in Dark Pools*, 42 J. CORP. L. 833, 855 (2017) (“While various types of market participants have adopted computer-based algorithmic programs, traders who couple algorithmic trading practices with strategies that entail rapidly submitting and canceling significant volumes of small trades—high-frequency trading (HFT)—have captured significant profits and popularity.”); Yesha Yadav, *Insider Trading and Market Structure*, 63 UCLA L. REV. 968 (2016); COMMITTEE ON CAPITAL MARKETS REGULATION, THE U.S. EQUITY MARKETS: A PLAN FOR REGULATORY REFORM (2016), vi–vii.

¹⁶⁹ See Korsmo, *supra* note 170, at 527.

faster than others.¹⁷⁰ In some cases, high frequency traders can enter and exit a position within milliseconds.¹⁷¹ High frequency traders achieve this speed through an obsessive focus on time and network structure. They sometimes utilize co-location services to locate their servers as close as possible to trading centers.¹⁷² In other cases, they subscribe to direct data feeds from stock exchanges to speed up their access to information.¹⁷³

The precise models of high-frequency trading vary considerably.¹⁷⁴ In some cases, they focus on market-making, the process of creating liquidity for under-traded securities by, for example, submitting offers to sell securities at slightly above the market price as well as offers to buy securities at slightly less than the market price.¹⁷⁵ In other cases, they focus on classic arbitrage, tracking brief discrepancies in prices between exchanges or asset classes and profiting off the difference.¹⁷⁶ In still other cases, they focus on directional strategies such as momentum trading.¹⁷⁷ Directional strategies have received significant criticism because of the concern that high frequency traders may be learning of the existence of buyers and sellers and then trading ahead of them (a practice known as front-running), thereby exploiting flaws in securities trading to profit at other investors' expense.¹⁷⁸ In any case, high-frequency trading has proved a profitable strategy for the most successful hedge funds. One of the most famous high-frequency trading firms, Citadel, made a profit of \$3.4 billion in the first three months of 2025.¹⁷⁹

* * *

As this brief survey of hedge funds demonstrates, hedge funds play an essential role in a vast array of financial markets. They invest in stocks, bonds, derivatives, commodities, and much more. Their size—both in assets under management and net asset values—has grown tremendously in recent years.

¹⁷⁰ See HOWELL E. JACKSON & MARGARET E. TAHYAR, *FINTECH LAW: THE CASE STUDIES* 105–06 (2020).

¹⁷¹ See Alain Chaboud et al., *Rise of the Machines: Algorithmic Trading in the Foreign Exchange Market* 69 J. FIN. 2045, 2045 (2014).

¹⁷² See PWC, *An Objective Look at High-Frequency Trading and Dark Pools*, PRICEWATERHOUSECOOPERS LLP 4 (May 6, 2015), <http://www.pwc.com/us/en/pwc-investor-resource-institute/publications/assets/pwc-high-frequency-trading-dark-pools.pdf> [https://perma.cc/878D-DDZ5].

¹⁷³ See SEC CONCEPT RELEASE, *supra* note 169, at 3611.

¹⁷⁴ See Securities and Exchange Comm'n, Division of Trading and Markets, *Equity Market Structure Literature Review, Part II: High Frequency Trading* 7–9, Mar. 18, 2014.

¹⁷⁵ *Id.* at 7.

¹⁷⁶ *Id.* at 8.

¹⁷⁷ *Id.*

¹⁷⁸ See Jerry Markham, *Front-Running—Insider Trading Under the Commodities Exchange Act*, 38 CATH. U. L. REV. 69, 69–71 (1988).

¹⁷⁹ See Eric Platt, *Citadel Securities Profits Jump 70% On Surge in Trading Revenues*, FIN. TIMES (May 28, 2025), <https://www.ft.com/content/d0f4e991-3f19-4ccd-9064-eaf7bfd5c474> [https://perma.cc/777K-7N3Y].

And their investment models—based on high performance incentives, high leverage, and low regulation—prioritize flexibility and the ability to analyze trends in markets. As we will see, this makes them ideal first movers when it comes to artificial intelligence.

II. ARTIFICIALLY INTELLIGENT MARKETS

Now that we have set forth the basic history, structure, and strategies of hedge funds, we can turn to the role that artificial intelligence plays in the hedge fund universe. Artificial intelligence has shown a remarkable increase in analytical capabilities in the last decade and in areas that hedge funds value: the ability to spot trends in large, seemingly chaotic data. This Part will survey advancements in artificial intelligence and how hedge funds are beginning to use it.

A. *The Artificial Intelligence Revolution*

Artificial intelligence has long been a dream of computer science. The idea of thinking machines—computers that can spontaneously have thoughts and act in the world—has drawn the attention and curiosity of programmers and science fiction authors for generations. Indeed, in 1836, Edgar Allan Poe wrote an essay on a chess-playing machine nicknamed “The Turk” that was purportedly better than any human player.¹⁸⁰ In 1950, Alan Turing developed his famous “Turing test,” originally known as an “imitation game,” for determining whether machines could think.¹⁸¹ His test, set forth in the article, *Computing Machinery and Intelligence*, asked whether a machine could formulate written responses to questions in such a way that it would be functionally indistinguishable from a human, and it became tremendously influential in both computer science and philosophy.¹⁸² By the 1970s, artificial intelligence was a developed field in computer science, with university departments, scholars, and private companies focused on researching it as a field.¹⁸³ It would experience rapid growth in future decades.

In the last decade, artificial intelligence has experienced a boom in investment and innovation as a result of advancements in a particular sub-field

¹⁸⁰ Edgar Allan Poe, *Maelzel's Chess-Player*, in EDGAR ALLAN POE, *COMPLETE TALES AND POEMS* 373 (2003).

¹⁸¹ In his article, *Computing Machinery and Intelligence*, he concluded that the very question of whether machines could think was “absurd” and “too meaningless to deserve discussion” and that thus had to be reframed. See A. M. Turing, *Computing Machinery and Intelligence*, 49 *MIND* 433, 433 (1950).

¹⁸² *Id.* at 434–36.

¹⁸³ See NILS NILSON, *THE QUEST FOR ARTIFICIAL INTELLIGENCE: A HISTORY OF IDEAS AND ACHIEVEMENTS* 33–41 (2020).

of computer science known as machine learning and, even more particularly, a sub-field of machine learning known as deep learning.¹⁸⁴ Whereas previous iterations of artificial intelligence had focused on developing ever more intricate rules for artificial intelligence models, machine learning focused on creating programs that could generate its own rules from patterns in data.¹⁸⁵ By feeding these machine learning algorithms large data sets, the models can identify key trends or underlying structures in the data and then make predictions about the world.¹⁸⁶ They typically involve a training set (the data that the machine learning algorithm analyzes for patterns) and a testing set (the outside data that the machine learning algorithm uses for checking whether the rules it develops are accurate).¹⁸⁷ Deep reinforcement learning is a version of machine learning that involves multiple layers of pattern recognition.¹⁸⁸ With deep learning algorithms, neural networks identify patterns in data and pass along those patterns to other layers of neural networks, which in turn identify patterns within the patterns and then pass along those patterns of patterns to other layers.¹⁸⁹

Deep reinforcement learning models have proved stunningly capable. In the last decade, the rapid progress of machine learning models has surprised even long-time researchers in the field.¹⁹⁰ Image recognition models have been able to outperform humans in identifying the contents of digital images.¹⁹¹ AI models have beaten world-experts in a wide range of popular games, from chess to Go to video games.¹⁹² Self-driving cars with no human drivers at the wheel have been deployed at scale in cities across the country.¹⁹³ But perhaps the most popular and widely known AI models have been the large language models that analyze written texts and then use knowledge (or pattern-based

¹⁸⁴ See Ryan Calo, *Artificial Intelligence Policy: A Primer and Roadmap*, 51 U.C. DAVIS L. REV. 399, 402 (2017); Jack M. Balkin, *The Three Laws of Robotics*, 78 OHIO ST. L. J. 1217, 1219–20 (2016); Emily Berman, *A Government of Laws and Not of Machines*, 98 B.U. L. REV. 1277, 1284–90 (2018).

¹⁸⁵ See KEVIN P. MURPHY, *MACHINE LEARNING: A PROBABILISTIC PERSPECTIVE* 1 (2012).

¹⁸⁶ *Id.*

¹⁸⁷ David Lehr & Paul Ohm, *Playing with the Data: What Legal Scholars Should Learn About Machine Learning*, 51 U.C. DAVIS L. REV. 653, 684–88 (2017).

¹⁸⁸ *Id.* at 669.

¹⁸⁹ See DAVID FOSTER, *GENERATIVE DEEP LEARNING: TEACHING MACHINES TO PAINT, WRITE, COMPOSE, AND PLAY* 25–27 (2023).

¹⁹⁰ See Noam Hassenfeld, *Even the Scientists Who Build AI Can't Tell You How It Works*, Vox (July 15, 2023), <https://www.vox.com/unexplainable/2023/7/15/23793840/chat-gpt-ai-science-mystery-unexplainable-podcast> [https://perma.cc/M8PT-R2AE].

¹⁹¹ See *Large Scale Visual Recognition Challenge*, IMAGENET [http://image-net.org/challenges/LSVRC/2017/\[https://perma.cc/2V7L-QKEL\]](http://image-net.org/challenges/LSVRC/2017/[https://perma.cc/2V7L-QKEL]) (last visited May 23, 2026).

¹⁹² See Dan Garisto, *Google AI Beats Top Human Players at Strategy Game Starcraft II*, NATURE (Oct. 30, 2019), <https://www.nature.com/articles/d41586-019-03298-6> [https://perma.cc/PAM6-3G23].

¹⁹³ See Ben Cohen, *It's Waymo's World. We're All Just Riding in It*, WALL ST. J., (May 30, 2025), <https://www.wsj.com/tech/waymo-cars-self-driving-robotaxi-tesla-uber-0777f570> [https://perma.cc/GUP2-LX64].

rules) derived from those texts to respond to written questions.¹⁹⁴ In 2022, the AI company OpenAI released its first model of ChatGPT, a large language model based on massive amounts of scraped data, and it proved capable of engaging in sophisticated conversations with users on a wide array of topics.¹⁹⁵ It has performed well on everything from translation to essay writing to bar exams.¹⁹⁶ Other AI companies have launched competing models that have their own attributes, such as Google's Gemini and Microsoft's Bing (generative chatbots), Anthropic's Claude (especially capable at coding) and DeepSeek (requiring less data and processing power than other AI models).¹⁹⁷ New models with new capabilities are being released at a rapid rate, and the AI boom has spurred a flood of investment in the technology.¹⁹⁸

The deep-learning revolution in AI has three core characteristics. First, it requires large amounts of computing power.¹⁹⁹ AI models are trained using special-purpose processors specifically designed to work with machine learning algorithms and capable of running models with hundreds of billions of parameters.²⁰⁰ Second, machine learning algorithms require large amounts of data.²⁰¹ The third version of ChatGPT, known as GPT-3, was trained on forty-five terabytes of text data, which is equivalent to around ninety million novels.²⁰² And finally, deep-learning algorithms tend to perform best in areas with well-established and well-researched public knowledge.²⁰³ Although AI companies have been secretive about precisely what data they

¹⁹⁴ See Kevin Roose, *A.I.'s Black Boxes Just Got a Little Less Mysterious*, N.Y. TIMES (May 21, 2024), <https://www.nytimes.com/2024/05/21/technology/ai-language-models-anthropic.html> [<https://perma.cc/22DE-QBR4>].

¹⁹⁵ See Kevin Roose, *The Brilliance and Weirdness of ChatGPT*, N.Y. TIMES (Dec. 5, 2022), <https://www.nytimes.com/2022/12/05/technology/chatgpt-ai-twitter.html> [<https://perma.cc/QU95-HT8H>].

¹⁹⁶ See Daniel Martin Katz, Michael James Bommarito, Shang Gao & Pablo Arredondo, *GPT-4 Passes the Bar Exam*, 382 PHIL. TRANS. ROYAL SOC'Y 1 (Apr. 2024).

¹⁹⁷ See Will Knight, *AI Agents Are Getting Better at Writing Code—And Hacking It as Well*, WIRED (June 25, 2025), <https://www.wired.com/story/ai-agents-are-getting-better-at-writing-code-and-hacking-it-as-well/> [<https://perma.cc/7HBZ-LURL>].

¹⁹⁸ See Cade Metz, *OpenAI Completes Deal That Values Company at \$300 Billion*, N.Y. TIMES (Mar. 31, 2025), <https://www.nytimes.com/2025/03/31/technology/openai-valuation-300-billion.html> [<https://perma.cc/3UU8-Y4E9>]; William Magnuson, *Regulating Fintech*, 71 VAND. L. REV. 1167 (2018).

¹⁹⁹ See David Gelles, *A.I.'s Insatiable Appetite for Energy*, N.Y. TIMES (July 11, 2024), <https://www.nytimes.com/2024/07/11/climate/artificial-intelligence-energy-usage.html> [<https://perma.cc/2ZU6-CWQU>].

²⁰⁰ See Peter Slattery, Tal Roded, Emanuele Del Sozzo & Haoran Lyu, *What Drives Progress in AI? Trends in Compute*, MIT FUTURE TECH (Jan. 3, 2025), <https://futuretech.mit.edu/news/what-drives-progress-in-ai-trends-in-compute> [<https://perma.cc/G9Z7-3XE5>]; Will Knight, *Nvidia's \$3,000 "Personal AI Supercomputer" Will Let You Ditch the Data Center*, WIRED (Jan. 6, 2025), <https://www.wired.com/story/nvidia-personal-supercomputer-ces/> [<https://perma.cc/7M7D-YN6V>].

²⁰¹ See Sue Halpern, *What We Still Don't Know About How A.I. Is Trained*, NEW YORKER (Mar. 28, 2023), <https://www.newyorker.com/news/daily-comment/what-we-still-dont-know-about-how-ai-is-trained> [<https://perma.cc/835C-RHPY>].

²⁰² *Id.*

²⁰³ See Lehr & Ohm, *supra* note 191, at 678–79.

use for training their models, it is widely suspected that one of the reasons ChatGPT is so capable at generating human-like text and conversation was that its training data included enormous databases of books, newspapers, and discussion websites like Reddit.²⁰⁴ Other AI models that specialize in coding have been trained using large databases of code depositories, including GitHub, one of the most widely used repositories.²⁰⁵ Where those deep knowledge bases break down or are not sufficiently unified, machine learning algorithms can make elementary mistakes, such as hallucinating sources or suggesting that the best coffee shop in Austin is located in New York.²⁰⁶

B. Artificial Intelligence in Hedge Funds

Given the explosion in the capabilities of artificial intelligence and machine-learning models, it should come as no surprise that hedge funds have shown an interest in the technology. One survey found that 90% of the top fifty hedge fund traders expected to use artificial intelligence in the next year to “achieve portfolio returns.”²⁰⁷ In recent years, many of the largest hedge funds in the world have touted their expertise in AI, forming AI-focused departments and hiring AI specialists. While a comprehensive understanding of the field has been hindered by a lack of public disclosure, there is mounting evidence that machine-learning is widely used in hedge fund trading systems. This Part aggregates the various publicly available reports, statements, and disclosures about hedge fund use of AI to give a sense of how precisely various hedge funds have incorporated deep learning strategies into their models.

1. Research

One of the primary uses that hedge funds make of machine learning is research.²⁰⁸ The time-consuming process of gathering financial data, analyzing it, and then identifying profitable trading strategies from it has long been

²⁰⁴ See Bobby Allyn, *The New York Times Takes OpenAI to Court. ChatGPT's Future Could Be on the Line*, NAT'L PUB. RADIO (Jan. 14, 2025), <https://www.npr.org/2025/01/14/nx-s1-5258952/new-york-times-openai-microsoft> [https://perma.cc/3GBG-JDHF].

²⁰⁵ See Janus Rose, *GitHub Users Want to Sue Microsoft For Training an AI Tool With Their Code*, VICE (Oct. 18, 2022), <https://www.vice.com/en/article/github-users-want-to-sue-microsoft-for-training-an-ai-tool-with-their-code/> [https://perma.cc/5C5W-9E92].

²⁰⁶ See Cade Metz & Karen Weise, *A.I. Is Getting More Powerful, But Its Hallucinations Are Getting Worse*, N.Y. TIMES (May 5, 2025), <https://www.nytimes.com/2025/05/05/technology/ai-hallucinations-chatgpt-google.html>, [https://perma.cc/T9BB-EWSR].

²⁰⁷ Market Makers, *9 Out Of 10 Hedge Fund Stars Will Use Ai In 2023. (New Market Makers Survey Revealed)*, PR Newswire (Jan. 17, 2023), <https://www.prnewswire.com/news-releases/9-out-of-10-hedge-fund-stars-will-use-ai-in-2023-new-market-makers-survey-revealed-301722699.html>, [https://perma.cc/YBW6-J2JL].

²⁰⁸ See MAJORITY STAFF OF S. COMM. ON HOMELAND SEC. AND GOV'T AFF., 118TH CONG., *AI IN THE REAL WORLD: HEDGE FUNDS' USE OF ARTIFICIAL INTELLIGENCE IN TRADING* 37 (Comm. Staff Report, June 2024).

one of the core costs of hedge funds. From arbitrage strategies to quant trading, many hedge funds rely heavily on financial research as the foundation of their business models.²⁰⁹ Machine-learning models thrive on data-intensive analysis, and so hedge funds have turned to them for this critical function to reduce the cost of obtaining and processing information. In a report of the Senate Committee on Homeland Security and Governmental Affairs, every hedge fund interviewed by the committee stated that they used machine learning in their data analysis and research.²¹⁰ One hedge fund stated that it intentionally hired employees with machine expertise to develop algorithms to “extract information from large data sets and then use that information to trade in markets.”²¹¹

Hedge fund research begins with data.²¹² In order to train their machine-learning algorithms, hedge funds need to acquire large amounts of data to understand financial patterns and inefficiencies.²¹³ This includes everything from price data to corporate filings to industry reports and social media activity.²¹⁴ The more data, the better. One hedge fund has disclosed that it processes some ten terabytes of data every day.²¹⁵ Once gathered, the data can be added to the firm’s repository and used for machine-learning simulations.²¹⁶ One of the problems that hedge funds have dealt with in deploying machine learning in their research is that financial data tends to be more limited than other forms of data. Images and words, after all, can be created at little to no cost, whereas there is a finite amount of data points for stock prices. As one hedge fund has stated, “financial data cannot be indefinitely generated as the market is path-dependent and we only have one path which is historical data. Overfitting the historical data is almost unavoidable and detrimental in the task, since trading decisions are continuous and every decision can be mission critical to the overall goal, either to achieve absolute return or beating certain benchmarks.”²¹⁷

One firm that uses machine learning heavily in its research is D.E. Shaw, long known as a leading quant hedge fund. The firm was founded by a computer scientist, David Shaw, in 1988, and has relied heavily on computerized

²⁰⁹ See COMM. ON CAPITAL MARKETS REGULATION, THE ROLE OF HEDGE FUNDS IN FINANCIAL MARKETS 3 (Feb. 2025).

²¹⁰ S. COMM. ON HOMELAND SEC. AND GOV’T AFF. Report, *supra* note 209.

²¹¹ *Id.*

²¹² *Id.* at 11.

²¹³ *Id.*

²¹⁴ S. COMM. ON HOMELAND SEC. AND GOV’T AFF. Report, *supra* note 209, at 38.

²¹⁵ *Id.*

²¹⁶ *Id.*

²¹⁷ *Id.* at 39.

financial trading strategies throughout its existence. In 2018, the firm created a new “Machine Learning Research Group” that was headed by a computer science professor who specialized in machine learning.²¹⁸ In a press release connected with the launch, the firm stated that the group would “operate in parallel to the firm’s longstanding machine learning efforts.”²¹⁹ As one career listing put it, “machine learning developers at the D. E. Shaw group work closely with researchers to creatively apply their knowledge of machine learning and software engineering to design, build, and maintain systems for high-performance, large-scale knowledge discovery in financial data.” The firm describes the specific responsibilities of machine learning developers as including “designing, implementing, testing, and documenting modules for all stages of the pipeline from data to predictions, assembling these modules into end-to-end systems, and interacting with researchers to achieve highly productive experimentation, model construction, and validation.”²²⁰ The firm has stated that computerized analysis has assisted its human traders in countering cognitive biases and flawed heuristics.²²¹

2. Portfolio Construction

Another major area in which hedge funds have deployed deep learning strategies is in portfolio construction. While research focuses on identifying patterns in financial data, portfolio constructions involve the process of structuring investments to earn reliable returns.²²² Research might, for example, discover that certain commodities perform well after unusually hot summers.²²³ Portfolio construction would involve the selection of how and when to execute trades in those commodities, as well as how to hedge risks of unexpected events occurring.²²⁴ Given that hedge funds are generally marketed

²¹⁸ *Técnico Alumnus Leads the New D. E. Shaw Machine Learning Group*, UNIVERSIDADE DE LISBOA (Oct. 22, 2018), <https://tecnico.ulisboa.pt/en/news/campus-community/tecnico-alumnus-leads-the-new-d-e-shaw-machine-learning-group/> [<https://perma.cc/6Z2G-2BVF>].

²¹⁹ D. E. Shaw Group, *D. E. Shaw Group Forms New Machine Learning Research Group*, PR NEWswire (Aug. 16, 2018), <https://www.prnewswire.com/news-releases/d-e-shaw-group-forms-new-machine-learning-research-group-300698027.html> [<https://perma.cc/2RLC-DAVQ>].

²²⁰ D. E. Shaw Careers, *Machine Learning Developer*, listed at <https://www.deshaw.com/careers/machine-learning-developer-4954> [<https://perma.cc/X5QQ-VY2F>].

²²¹ See *Machine Teaching: What I Learned from My Optimizer*, D.E. SHAW & Co. 6 (Dec. 2023), <https://www.deshaw.com/library/machine-teaching> [<https://perma.cc/2VYX-63P7>].

²²² See Laurent Favre, *The Evolving Role of Portfolio Management*, HEDGE FUND J., Nov. 2014.

²²³ See *Machine Learning*, *supra* note 222.

²²⁴ *Id.*

as uncorrelated with broad market trends, portfolio construction plays an essential role in their ability to succeed in the markets.²²⁵

Hedge funds have used machine learning in their portfolio construction in a variety of ways. Citadel, for example, has stated that it uses machine learning to create “signals” that are incorporated into the firm’s quantitative and discretionary strategies.²²⁶ WorldQuant has stated that it has used some version of artificial intelligence for years. Its employees use machine learning tools for research, code editing, and to identify combinations of trading signals to support their portfolio strategy.²²⁷ Portfolio managers may use artificial intelligence in their strategy construction, and they “review investment strategies after deep learning processes are completed.”²²⁸

Perhaps no firm has been as active in incorporating artificial intelligence strategies into their models as British hedge fund Man Group, the world’s largest publicly listed hedge fund. Man Group discloses that it has been using machine learning systems in its investments since 2014.²²⁹ In 2023, it created a new data and machine learning team aimed at improving investment tools and building new ones. It created its own proprietary AI model, called ManGPT, that employees can use for research and idea generation.²³⁰ The figure below shows the usage rates of ManGPT at the firm. Man Group’s software engineers have used AI to write code.²³¹ The fund’s chief investment officer has stated that “it is clear that AI – in its various guises – has the potential to disrupt traditional asset management as it will other industries. The high adoption rate of AI across our business – be it for data analysis, strategy development or execution – really speaks to its functionality, as well as its potential.”²³² When Man Group began using Microsoft’s Copilot, usage numbers similarly increased dramatically, as shown in the chart below:

²²⁵ See Collin Bell et al., *Mapping the Evolution: Hedge Funds in A New Market Regime*, GOLDMAN SACHS PERSPECTIVES 2, Mar. 7, 2025.

²²⁶ U.S. Senate Committee on Homeland Security and Governmental Affairs, *AI in the Real World: Hedge Funds’ Use of Artificial Intelligence in Trading* 37-38 (June 2024).

²²⁷ *Id.* at 37.

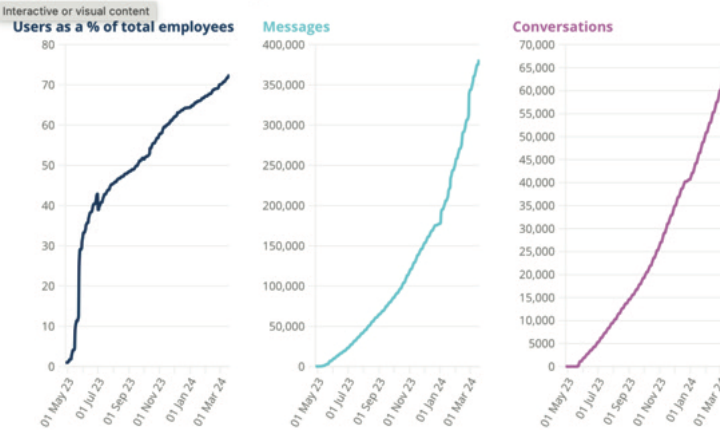
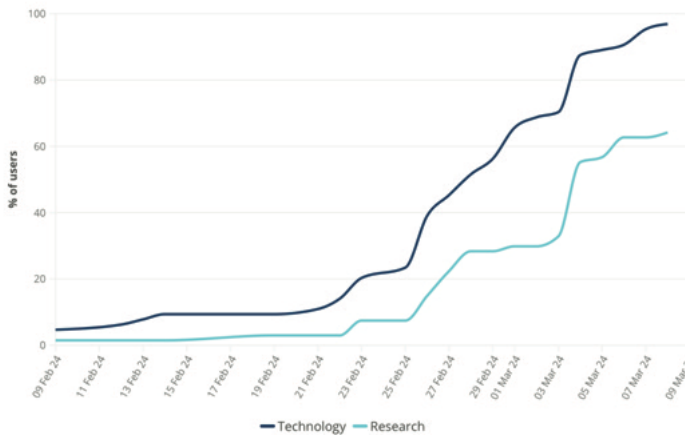
²²⁸ *Id.* at 40–41.

²²⁹ *The Rise of Machine Learning at Man AHL*, MAN GROUP (Nov. 17, 2016), <https://www.man.com/insights/the-rise-of-machine-learning> [<https://perma.cc/2JTB-H6YF>].

²³⁰ Bianca Chan, *The New AI Head at Man Group, the Largest Publicly Listed Hedge Fund, Breaks Down His Plans to Change How Investors Work*, BUS. INSIDER (Nov. 13, 2023), <https://www.businessinsider.com/man-group-new-ai-team-plans-alpha-assistant-2023-11> [<https://perma.cc/T47E-P55H>].

²³¹ Russell Korgaonkar, *The Big Picture: AI Diary of a Quant*, MAN GROUP (Mar. 21, 2024), <https://www.man.com/insights/the-big-picture-ai> [<https://perma.cc/42HG-6WNN>].

²³² *Id.*

Figure 1. Cumulative usage of ManGPT**Figure 2. Copilot adoption at Man AHL**

Finally, AQR Capital Management, another large quant hedge fund, initially began investing in machine learning technology in 2018, and its use of the technology has steadily increased over time. By 2025, the firm was stating that it used machine learning to, among other things, identify market patterns and determine the weightings given to individual factors in a portfolio.²³³

²³³ See Costas Moursela & Amelia Pollard, *We Have “Surrendered More to the Machines,” Says Quant Fund Titan Cliff Asness*, *FIN. TIMES* (June 4, 2025), <https://www.ft.com/content/e62c85cb-e3c8-4df3-b115-e3e11eeaa266?syn-25a6b1a6=1> [<https://perma.cc/F62R-ZBNB>]. See also *Can Machines Build Better Stock Portfolios?*, AQR (Nov. 7, 2024), <https://www.aqr.com/Insights/Research/Alternative-Thinking/Can-Machines-Build-Better-Stock-Portfolios> [<https://perma.cc/BUZ9-5SFE>].

As founder Cliff Asness has stated, the firm has “surrendered more to the machines” and that “[w]hen you turn yourself over to the machine, you obviously let data speak more.”²³⁴

3. Trading

Perhaps the most sensitive of all uses of machine learning in the hedge fund world is the idea of creating machine-learning algorithms capable of trading independently.²³⁵ Of course, hedge funds have been using computerized trading for decades, and the entire industry of high frequency trading is premised on the structure. But as machine learning has grown in power, its potential to act in markets has grown, and hedge funds have explored using it directly in their trading processes to draw rules from financial data. The precise amount of human intervention varies from firm to firm.²³⁶

Bridgewater, the world’s largest hedge fund, has stated that it is “dedicated to developing and applying state-of-the-art AI & ML tools to generate alpha in markets,” and has launched an AI-focused venture called the “Artificial Investment Associate Labs,” also known as AIA.²³⁷ AIA Labs consists of 20 investors and machine learning specialists whose aim is “to do everything that we do via machine-learning techniques.”²³⁸ That includes idea generation, testing, and modeling.²³⁹ In 2024, the firm launched a fund with nearly \$2 billion in capital that used machine learning as the primary basis for its investment decisions.²⁴⁰ It has hired numerous AI researchers for its team, including David Ferrucci, a lead engineer at IBM’s Watson system, and Yale professor Jasjeet Sekhon, a specialist in statistics and machine learning.²⁴¹

²³⁴ *Id.*

²³⁵ See Hilary Allen, *Driverless Finance*, 10 HARV. BUS. L. REV. 158, 170 (2020).

²³⁶ See Gregory Zuckerman, *AI Can Write a Song, But It Can’t Beat the Market*, WALL ST. J. (Apr. 12, 2023), <https://www.wsj.com/articles/ai-can-write-a-song-but-it-cant-beat-the-market-6df50efd> [<https://perma.cc/RZ2J-XBZ8>].

²³⁷ Bridgewater, *Bloomberg on Bridgewater’s Latest Innovations in AI & ML*, (July 1, 2024) <https://www.bridgewater.com/in-the-news/bloomberg-on-bridgewaters-latest-innovations-in-ai-ml> [<https://perma.cc/QHX6-Q4XY>]. Bridgewater describes its AIA labs as “an in-house venture at Bridgewater Associates that is focused on using AI (Artificial Intelligence) to generate returns in markets. Its goal is to develop capabilities that enhance Bridgewater’s existing strategies as well as to manage a dedicated AI strategy for clients. Bridgewater’s AIA Labs is combining a broad set of AI tools (de-optimized tabular data models, reasoning tools, and LLMs) using proprietary techniques developed in-house to build an AI-based Reasoning Engine capable of performing fundamental, systematic investment research.” Bridgewater, *Senior Full Stack Software Engineer (AI), AIA Labs*, available at <https://www.builtinnyc.com/job/sr-full-stack-software-engineer-ai/4458674> [<https://perma.cc/5URV-5JYF>].

²³⁸ See Bianca Chen, *One of Bridgewater’s Top Investors Explains Why the World’s Largest Hedge Fund is Handing the Investment Process Over to AI in a New Fund*, BUS. INSIDER (Nov. 20, 2023), <https://www.businessinsider.com/bridgewater-building-ai-fund-machine-learning-greg-jensen-2023-11> [<https://perma.cc/B7RQ-RH6B>].

²³⁹ *Id.*

²⁴⁰ See Basak, *supra* note 25.

²⁴¹ *Id.*

It has reported that its AI fund has earned returns that are “comparable” to the firm’s human-led investments.²⁴²

Voleon, a California-based hedge fund with \$16 billion in assets under management, is the rare firm that states that its investment strategy is exclusively generated by machine learning.²⁴³ Founded in 2007 by two former traders from D. E. Shaw with Ph.D.s in computer science and statistics, the firm’s funds focus on statistical arbitrage, identifying short-term discrepancies in prices based on massive databases of historical stock price ticks.²⁴⁴ It boasts that some seventy of its employees have Ph.D.s, primarily in areas such as computer science or statistics.²⁴⁵ Its primary fund reported a profit of 13% in 2024.²⁴⁶ As one founder described his firm’s trading strategy: “The kind of trading strategies our system uses are not the kind of strategies that humans use. We’re not competing with humans, because when you’re trading thousands of stocks simultaneously, trying to capture very, very small changes, the human brain is just not good at that. We’re playing on a different field, trying to exploit effects that are too complex for the human brain. They require you to look at hundreds of thousands of things simultaneously and to be trading a little bit of each stock. Humans just can’t do that.”²⁴⁷ Other machine-learning-based hedge funds include Quantitative Investment Management and Teza Capital Management.²⁴⁸

The most in-depth report of how hedge funds incorporate machine learning into trading comes from an SEC investigation of the hedge fund Two Sigma in 2025.²⁴⁹ The SEC charged Two Sigma with breach of fiduciary duties for

²⁴² See Georgia Hall, *AI-Run Funds, Four-Day Work Weeks: Investors Say Hype Is Real*, BLOOMBERG (Mar. 5, 2025), <https://www.bloomberg.com/news/articles/2025-03-05/ai-run-funds-four-day-work-weeks-investors-say-hype-is-real> [<https://perma.cc/372T-Y67Z>]. Another major hedge fund, Citadel, has stated that it does not use machine learning for fully automated trading, but rather incorporates machine learning into its quantitative strategies. See U.S. Senate Committee on Homeland Security and Governmental Affairs, *AI in the Real World: Hedge Funds’ Use of Artificial Intelligence in Trading* 37–38, (June 2024).

²⁴³ See Erin Arvedlund, *Machine-Learning Quant Firm Voleon Posts Double-Digit Gains. Pension Funds Are Taking Notice.*, PENSIONS & INV. (May 28, 2025), <https://www.pionline.com/alternatives/machine-learning-quant-firm-voleon-posts-double-digit-gains-pension-funds-are-taking/> [<https://perma.cc/BE33-QEKM>]; Melissa Karsh, *Michael Haritonov and Jon McAuliffe, the Killer Quants*, BLOOMBERG (Dec. 4, 2019), <https://www.bloomberg.com/news/articles/2019-12-04/voleon-s-kharitonov-and-mcauliffe-are-the-killer-quants> [<https://perma.cc/KNA8-REWU>].

²⁴⁴ See Laurence Fletcher, *AI Hedge Fund Voleon Suffers in Choppy Markets*, FIN. TIMES (Sept. 6, 2020), <https://www.ft.com/content/87725d8e-870b-42a4-8f1b-e07ab58c354b?syn-25a6b1a6=1> [<https://perma.cc/WUA5-JAHK>].

²⁴⁵ See Arvedlund, *supra* note 247.

²⁴⁶ *Id.*

²⁴⁷ See Felix Salmon & Jon Stokes, *Algorithms Take Control of Wall Street*, WIRED (Dec. 27, 2010), <https://www.wired.com/2010/12/ff-ai-flashtesting/> [<https://perma.cc/F4M4-YG3T>].

²⁴⁸ See Bradley Hope & Juliet Chung, *The Future Is Bumpy: High-Tech Hedge Fund Hits Limits of Robot Stock Picking*, WALL ST. J. (Dec. 11, 2017), <https://www.wsj.com/articles/the-future-is-bumpy-high-tech-hedge-fund-hits-limits-of-robot-stock-picking-1513007557> [<https://perma.cc/U8MR-PKD9>].

²⁴⁹ Two Sigma Invs. LP and Two Sigma Advis. LP, Exchange Act Release No. 102207, Advisers Act Release No. 6824 (Jan. 16, 2025).

failing to reasonably address known vulnerabilities in its investment models, and in the order settling the charges, the SEC set forth in detail how the hedge fund's models worked.²⁵⁰ Two Sigma used hundreds of different algorithmic investment models developed by researchers for various investment strategies.²⁵¹ The firm used these models "when making investment decisions."²⁵² The firm's live trading system used model code stored in a file known as the "Jar."²⁵³ When the firm began to use machine-learning-based models, the data needed to run the models grew to such an extent that it quickly exceeded the size limits of the Jar and, as a result, modelers created a separate database known as "celFS" to store model parameters.²⁵⁴ Modelers could code their own individual models to run by linking the code in the Jar with the parameters in celFS.²⁵⁵ The firm also created a manual (known as the "Productionize a Model" manual) setting forth its policies on how models should be created and used, and the manual generally required modelers to receive approval before launching new models or changing existing ones.²⁵⁶ But a variety of problems arose with the system. In 2019, Two Sigma employees raised concerns that the model parameters in celFS lacked access controls, such as "read" and "write" permissions, that could protect the models from inadvertent or intentional changes.²⁵⁷ In 2022, an employee accidentally overwrote an entire volume in celFS that contained model parameters just moments before markets opened for trading, and the changes prevented the models from generating predictions.²⁵⁸ Two Sigma recovered the data before market trading opened, but it raised red flags about the machine learning model's cybersecurity procedures.²⁵⁹ The SEC's order focused on a single modeler who, between 2021 and 2023, made dozens of unauthorized changes to model parameters stored in celFS that Two Sigma used in live trading.²⁶⁰ These changes caused certain funds to overperform and others to underperform by hundreds of millions of dollars.²⁶¹ In the end, the firm paid a fine of \$90 million to settle the SEC's charges of breach of fiduciary duty and related oversight violations.²⁶²

It should be noted that not all hedge funds have been equally optimistic about artificial intelligence or its use in the industry. One major skeptic has been Elliott Management, which, in a letter to investors in 2024, wrote

²⁵⁰ *Id.* at 2.

²⁵¹ *Id.* at 3.

²⁵² *Id.* at 3–4.

²⁵³ *Id.* at 4.

²⁵⁴ *Id.*

²⁵⁵ *Id.*

²⁵⁶ *Id.* at 4–5.

²⁵⁷ *Id.* at 5.

²⁵⁸ *Id.* at 6.

²⁵⁹ *Id.*

²⁶⁰ *Id.* at 6–7.

²⁶¹ *Id.* at 7.

²⁶² *Id.* at 12.

that AI was “overhyped with many applications not ready for prime time.”²⁶³ “There are few real uses [other than] summarizing notes of meetings, generating reports and helping with computer coding.”²⁶⁴ In 2024, the hedge fund bet against Nvidia, a chip maker for AI, acquiring put options on Nvidia shares.²⁶⁵ The hedge fund Citadel has similarly stated that it does not “understand [AI trading] to be generally used in the industry.”²⁶⁶ So while some hedge funds have incorporated machine learning into their trading strategies, others have remained more hesitant.

C. Regulatory Structure

Despite the increased use of artificial intelligence by hedge funds, the regulatory structure surrounding the industry remains rudimentary. There are few guardrails governing how hedge funds may use artificial intelligence, what obligations they have to disclose such uses, and what consequences they may face from misuse. Given that artificial intelligence’s latest iteration is relatively new, this should perhaps come as no surprise. But it is striking nonetheless, particularly given the rising importance of hedge funds to our financial markets.²⁶⁷

Hedge funds have historically been exempt from the primary securities regulations governing companies and financial institutions, but in the last two decades, some limited reforms have imposed greater obligations on the industry. In 2004, the SEC enacted a short-lived rule requiring hedge funds to register under the Investment Advisers Act of 1940, and while the rule was overturned in 2004 in the D.C. Circuit’s *Goldstein v. SEC* decision, many hedge funds continued to remain registered afterwards.²⁶⁸ As a result, most of the largest hedge funds make periodic Form ADV filings disclosing summary information on such issues as their assets under management, their holdings of public stock, and their company headquarters.²⁶⁹

²⁶³ See Laurence Fletcher & Costas Mourselas, Elliott Says Nvidia is in a “Bubble” and AI is “Overhyped,” *FIN. TIMES* (Aug. 2, 2024), <https://www.ft.com/content/24a12be1-a973-4efe-ab4f-b981aee0cd0b?syn-25a6b1a6=1> [<https://perma.cc/K7EH-ULYN>].

²⁶⁴ *Id.*

²⁶⁵ See Theron Mohamed, Paul Singer’s Elliott Management Bets Against Nvidia After Calling it a “Bubble” and Saying AI is “Overhyped,” *YAHOO FINANCE* (Feb. 18, 2025), <https://finance.yahoo.com/news/paul-singers-elliott-management-bets-002313242.html>.

²⁶⁶ See STAFF OF S. COMM. ON HOMELAND SEC. & GOV’T AFFS., 118TH CONG., *AI in the Real World: Hedge Funds’ Use of Artificial Intelligence in Trading* 35 (Comm. Print 2024).

²⁶⁷ See generally Gabriel V. Rauterberg & Jeffery Y. Zhang, *Shadow Banking and Securities Law*, 77 *STAN. L. REV.* 563 (2025) (arguing that securities law both can and should play a larger role in regulating financial institutions).

²⁶⁸ See Wulf A. Kaal & Dale Oesterle, *The History of Hedge Fund Regulation in the United States*, in *HANDBOOK ON HEDGE FUNDS* (Oxford Univ. Press 2016).

²⁶⁹ See Honigsberg, *supra* note 105, at 8.

The Dodd-Frank Act of 2010 went slightly further.²⁷⁰ Title IV of the Dodd-Frank Act amended the Investment Advisers Act of 1940 to require hedge funds with over \$150 million in assets under management to register with the SEC and report “systemic risk data” such as trading practices, leverage and counterparty credit risk exposures in a new Form PF.²⁷¹ While these disclosures are significantly more detailed than the Form ADV information, Form PF filings are not made public—they can only be accessed by the SEC.²⁷²

In addition to these disclosure-oriented obligations, hedge funds are also subject to the securities laws’ broad prohibitions against fraud. Section 10(b) of the Securities Exchange Act prohibits “manipulative or deceptive device[s] or contrivance[s]” in connection with sales of securities.²⁷³ Rule 206(4)-8, promulgated under Section 206 of the Investment Advisers Act, prohibits investment advisers from engaging in “any act, practice or course of business that is fraudulent, deceptive, or manipulative.”²⁷⁴ Both provisions have been used to target hedge funds that have made misleading statements about their use of artificial intelligence.²⁷⁵

Aside from these limited disclosure obligations and the general prohibitions on fraud, there are few substantive restrictions on hedge funds’ use of machine learning.²⁷⁶ Neither the SEC—tasked with regulating capital markets—nor the CFTC—tasked with regulating derivatives—has enacted binding rules on the subject. Their inaction does not come from a lack of concern. In fact, both regulators have expressed deep concerns with wider use of machine learning in markets. In 2024, the CFTC’s Technology Advisory Committee released a report that concluded that “[w]ithout appropriate industry engagement and relevant guardrails...potential vulnerabilities from using AI applications and tools within and outside the CFTC could erode public trust in financial markets, services, and products.”²⁷⁷ The report called on the CFTC to adopt a risk management framework for artificial intelligence.²⁷⁸ In 2023, the SEC issued a proposed rule governing how investment advisers use “technologies, such as AI, machine learning, or deep learning algorithms,

²⁷⁰ See Kaal & Oesterle, *supra* note 272.

²⁷¹ See QUINN EMANUEL URQUHART & SULLIVAN LLP, *US Outlook: Legal Limits on Hedge Fund Redemption Gates and Suspensions* 2 (Mar. 26, 2020).

²⁷² See Kaal & Oesterle, *supra* note 272, at 4.

²⁷³ 15 U.S.C. § 78j(b).

²⁷⁴ 17 C.F.R. § 275.206(4)-8.

²⁷⁵ See *SEC Charges Two Investment Advisers with Making False and Misleading Statements About Their Use of Artificial Intelligence*, SEC. & EXCH. COMM’N (Mar. 18, 2024).

²⁷⁶ The SEC does, however, have broad examination powers over private funds, powers that have allowed them to uncover compliance failures in a number of instances. See HOWELL E. JACKSON & MARGARET E. TAHYAR, *FINANCIAL REGULATION: LAW AND POLICY* 1261 (4th ed. 2025).

²⁷⁷ TECH. ADVISORY COMM., SUBCOMM. ON EMERGING & EVOLVING TECHS., U.S. COMMODITY FUTURES TRADING COMM’N, *RESPONSIBLE ARTIFICIAL INTELLIGENCE IN FINANCIAL MARKETS: OPPORTUNITIES, RISKS & RECOMMENDATIONS* 19 (2024).

²⁷⁸ *Id.* at 12.

neural networks, NLP, or large language models.”²⁷⁹ The SEC concluded that existing rules were insufficient to protect investors in light of “the rate of investor interactions, the size of the datasets, the complexity of the algorithms on which the PDA-like technology is based, and the ability of the technology to learn investor preferences or behavior, which could entail providing disclosure that is lengthy, highly technical, and variable, which could cause investors difficulty in understanding the disclosure.”²⁸⁰ The SEC withdrew the proposed rule in June 2025, along with a rule governing cybersecurity practices at investment advisers, providing no explanation for the change of heart.²⁸¹

In a way, the most consequential regulation of hedge funds comes not from legislation or government bodies but from private market participants, particularly the investors that fund the hedge funds. The relationship between hedge funds and investors is governed by operating agreements that set forth the duties of hedge funds. These might include fiduciary duties and redemption rights, but they might also go further and specify cybersecurity procedures or disclosure of unusual trading methods. Investors that are concerned with the machine-learning applications of hedge funds could demand that their contracts include guarantees that the hedge funds are using best practices in the industry or refuse to invest in the first place.

But at least to date, and in practice, the pushback from investors in the private market is weak. Most hedge fund operating agreements give managers wide discretion to operate the fund in the way they see fit without intrusive obligations.²⁸² Many hedge fund operating agreements grant managers absolute discretion to decide their investments in the ways they see fit, with little to no recourse if they act wrongly.²⁸³ One common clause, known as a “hedge clause,” limits the fiduciary duties that hedge funds owe their investors and

²⁷⁹ See Conflicts of Interest Associated with the Use of Predictive Data Analytics by Broker-Dealers and Investment Advisers, 88 Fed. Reg. 53,960, 53,975 (proposed Aug. 9, 2023) (to be codified at 17 C.F.R. pt. 275).

²⁸⁰ *Id.* at 53,968. See also Henry T. C. Hu, *Too Complex to Depict? Innovation, “Pure Information,” and the SEC Disclosure Paradigm*, 90 TEX. L. REV. 1601, 1601–02 (2012) (arguing that “modern financial innovation has resulted in objective realities that are far more complex than in the past, often beyond the capacity of the English language, accounting terminology, visual display, risk measurement, and other tools on which all depictions must primarily rely”).

²⁸¹ See Bill Alpert, SEC Officially Withdraws 14 Biden-Era Proposals, BARRON’S (June 14, 2025), <https://www.barrons.com/articles/sec-proposals-gary-gensler-b054569c> [<https://perma.cc/SBU5-RNL8>].

²⁸² See *Hedge Funds Structure and Organization*, LEXISNEXIS (Apr. 20, 2025), <https://advance.lexis.com/open/document/openwebdocview/Hedge-Funds-Structure-and-Organization/?pdmfid=1000522&pddocfullpath=%2Fshared%2Fdocument%2Fanalytical-materials%2Furn%3AcontentItem%3A5SD8-TTJ1-FH4C-X2P8-00000-00&pdcomponentid=500749> [<https://perma.cc/4EBC-9W8D>].

²⁸³ See Edward L. Pittman, *Quantitative Investment Models, Errors, and the Federal Securities Laws*, 13 N.Y.U. J. L. & Bus. 633, 688–89 (2017).

only allows for liability for managers in certain restricted cases, such as a non-appealable judicial finding of fraud or intentional misconduct.²⁸⁴

Consider, for example, the case of Amaranth Partners LLC. Although ordinarily hedge fund operating agreements are highly secretive, Amaranth's operating agreement was disclosed in connection with a lawsuit over its collapse in 2007.²⁸⁵ The agreement provides broad discretion to the manager to act as it sees fit. Section 2.1 provides that the manager "shall have full and complete charge of all affairs of the company."²⁸⁶ Section 1.2 provides that the company "may engage, directly and indirectly, in all aspects of investing and trading."²⁸⁷ It adds that "for the avoidance of doubt but not by way of limitation, no limitation is imposed by this Agreement on the investment or trading activities that the company may employ."²⁸⁸ It then lists a long list of activities that the company may engage in, including "all other business and activities as may be desirable, necessary, advisable or incidental to the Company's business of investing and trading, as the Manager may determine."²⁸⁹ In addition, Section 2.2 provides that "whenever the Manager is to determine or decide any matter relating to this Agreement or the Company, such determination or decision shall be in the sole and absolute discretion of the Manager."²⁹⁰ And in Section 2.8, the agreement limits the fiduciary obligations of the manager, providing that no manager party will have any liability—to the company or its investors—for "any act performed, or the omission to perform any act, within the scope of the power and authority conferred on the manager by this Agreement and/or by the Act, except by reasons of acts or omissions of a Manager Party Finally Determined to constitute fraud, bad faith, gross negligence or reckless or intentional misconduct."²⁹¹ In Section 2.9, the company agrees to indemnify the manager parties "from and against any loss, cost, expense, liability, fees or damages suffered" as a result of the manager's acts, so long as the acts were not determined, in a final non-appealable judgment of a court, to constitute breaches of the limited fiduciary duties that the manager owed.²⁹² In short, and to summarize, Amaranth's manager was authorized to invest the fund's capital in any way it wanted, with complete power over its investment

²⁸⁴ See DIV. OF EXAMS., U.S. SEC. & EXCH. COMM'N, *Risk Alert: Observations from Examinations of Private Fund Advisors*, 5 (Jan. 27, 2022).

²⁸⁵ See Dane Hamilton, San Diego Pension Fund Sues Amaranth, REUTERS (Mar. 30, 2007, 5:10 PM), <https://www.reuters.com/article/legal/government/san-diego-pension-fund-sues-amaranth-idUSN30441455/>.

²⁸⁶ See *Fourth Amended and Restated Limited Liability Company Agreement of Amaranth Partners L.L.C.* § 1.2 (Mar. 1, 2003) https://legaldatalab.law.virginia.edu/hedge_funds/pdf/oa/Amaranth_2003.pdf [<https://perma.cc/M6MW-SG6U>].

²⁸⁷ *Id.* at § 1.2.

²⁸⁸ *Id.*

²⁸⁹ *Id.*

²⁹⁰ *Id.* at § 2.2.

²⁹¹ *Id.* at § 2.8.

²⁹² *Id.* at § 2.9.

decisions, and if it acted badly, it could only be held accountable if it could be proved in a court of law that its actions constituted wrongdoing tantamount to fraud. Otherwise, it was to be indemnified for any and all losses. The discretion is breathtaking and it is in no way unusual. In 2022, the SEC issued a risk alert highlighting how common fiduciary duty limitations had become in hedge fund agreements.²⁹³

III. REGULATORY RISKS

The previous Parts set forth a survey of the increasingly integral role that hedge funds play in our financial system and their rush to incorporate machine learning technology into their businesses. They focused, in particular, on how hedge funds invest in stocks, bonds, futures, commodities, currencies and complex derivatives. In each of these areas, they have outsized influence due to the flexibility of their strategies, their leverage, their sophisticated use of the legal system and the sometimes highly public campaigns they launch alongside their investments. Given their strong performance incentives, it is natural that hedge funds have taken the lead in exploring artificial intelligence. Dramatic leaps in the power and accuracy of artificial intelligence in recent years have demonstrated just how transformative the technology can be in areas as diverse as medicine to image generation to test taking. The ability of deep learning algorithms to spot nonlinear patterns in data and make predictions about future data has stunned the world, and it has obvious applications for the investment world. Hedge funds have used it to improve their research, their investment portfolio and their trading strategies.

This Part will turn to the implications of the rise of deep learning hedge funds. In particular, it will make three arguments. First, it will argue that deep learning hedge funds, either by incorporating flawed technology or failing to understand its limits, create significant risks for the *efficiency* of financial markets. Second, it will argue that the wider use of machine learning by large hedge funds may reduce the *stability* of financial markets through increased volatility, model correlation, and herding effects. And finally, it will argue that, even if machine learning technologies evolve to address these problems, the shifting of financial activity to machine learning hedge funds raises fundamental questions of *fairness*. In sum, it concludes that, without sufficient legal guardrails, deep learning hedge funds may usher in a new mode of financial governance, one that is less efficient, less stable, and less fair.

²⁹³ See SEC DIV. OF EXAMS., *Risk Alert: Observations from Examinations of Private Fund Advisors*, *supra* note 288, at 5.

A. Efficiency

One of the core functions of financial markets is to ensure the efficient allocation of society's resources.²⁹⁴ By connecting providers of capital with users of it, financial markets direct resources towards their most productive uses and allow for the efficient discovery of prices.²⁹⁵ There is perhaps no more influential theory of financial efficiency than the efficient capital markets theory, which asserts that capital markets incorporate all available information into prices.²⁹⁶ The theory comes in different forms—some believe that prices incorporate all information, others believe they only incorporate all public information, some believe that only large, liquid markets incorporate prices, and so on and so forth—but the essential insight is that prices generally reflect the true value (however defined) of the asset.²⁹⁷ When you buy a stock of Tesla on the New York Stock Exchange, you know it is a fair price because thousands of traders around the world have scoured research forums, stockholder meetings, and newspapers to find information on Tesla and trade on it. This crowd of investors pushes stocks and other securities inevitably towards fair valuations.²⁹⁸

How might deep learning hedge funds affect this ecosystem? On the one hand, one might expect that the widescale deployment of machine learning algorithms into capital markets would *improve* efficiency. Whereas human traders must attend stockholder meetings and read *Wall Street Journal* articles to gather information, artificial intelligence models can simply tap directly into the source code, feed the data into their models, and generate new predictions in real time. ChatGPT and Claude and other widely available machine learning algorithms have demonstrated an astonishing ability to process large amounts of information quickly. You can upload an entire book and have it analyzed and dissected within a matter of seconds. This might lead one to conclude that deep learning hedge funds will be tools for enhancing efficiency in markets. They will push prices to their fundamental values quicker than ever before.

²⁹⁴ See EUGENE F. FAMA & MERTON H. MILLER, *THE THEORY OF FINANCE* 3–15 (1972); Joseph E. Stiglitz, *The Allocation Role of the Stock Market: Pareto Optimality and Competition*, 36 J. FIN. 235, 235 (1981); Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. FIN. 383, 383 (1970); JOHN ARMOUR, DAN AWREY, PAUL DAVIES, LUCA ENRIQUES, JEFFREY N. GORDON, COLIN MAYER & JENNIFER PAYNE, *PRINCIPLES OF FINANCIAL REGULATION* 22–51 (2016); Robert B. Ahdieh, *Making Markets: Network Effects and the Role of Law in the Creation of Strong Securities Markets*, 76 S. CAL. L. REV. 277, 284–85 (2003).

²⁹⁵ See Ronald J. Gilson & Reinier H. Kraakman, *The Mechanisms of Market Efficiency*, 70 VA. L. REV. 549, 554 (1984).

²⁹⁶ *Id.* at 554–65; Burton G. Malkiel, *The Efficient Market Hypothesis and Its Critics*, 17 J. ECON. PERSPS. 59, 59 (2003).

²⁹⁷ See Lynn A. Stout, *How Efficient Markets Undervalue Stocks: CAPM and ECMH under Conditions of Uncertainty and Disagreement*, 19 CARDOZO L. REV. 475, 478 (1997).

²⁹⁸ *Id.*

The problem with this conclusion is that artificial intelligence, despite its many virtues, suffers from several well-known flaws. Foremost among them is their tendency to “hallucinate.” Asked seemingly basic questions, such as simply adding two numbers or identifying articles written by a journalist, artificial intelligence models will often respond with patently incorrect answers.²⁹⁹ Even a small amount of research would prove them wrong, but they are incapable of reliably doing it. This could lead to significant problems if airdropped into financial markets. Imagine, for example, a long-short hedge fund that concluded that the true value of a company was not \$100 a share, but \$1, based on a hallucination. It might acquire short positions on the company aimed at driving the price down one hundred fold. In the best case, this might simply lead to the hedge fund losing money, but it might also create substantial havoc in the market, pushing down the stock price, forcing executives to respond, and generating rumors about impending catastrophe. Or imagine an activist hedge fund that publishes an investment presentation written by a machine learning algorithm and that mistakenly contains false quotes from the targeted chief executive officer or negative information about his past behavior. Or imagine an arbitrage firm that uses an algorithm that hallucinates a correlation between two securities and places large bets on their converging. While one would hope that these biases would be corrected by better-informed traders, it has been shown over and over again that even small distortions in prices can lead to long-term effects through the self-reinforcing mechanisms of market actors.³⁰⁰ All of these scenarios are imminently plausible and could create significant inefficiencies in markets.

Another major flaw in machine learning algorithms is their struggles in handling non-stationary data, that is, areas where patterns change over time.³⁰¹ Artificial intelligence techniques excel at spotting complicated patterns in data, but they are by definition forced to rely on historical data. Their predictions are based on a deep analysis of previous periods. But when something fundamental changes in the area, its predictions can break down.³⁰² Language, of course, changes quite slowly, and so large language models can reliably generate text that sounds like a human. But not all phenomena are so slow to evolve. Consider, for example, the invention of the train. Prior to

²⁹⁹ See Kyle Wiggers, *Why Is ChatGPT So Bad at Math?*, TECHCRUNCH (Oct. 2, 2024), <https://techcrunch.com/2024/10/02/why-is-chatgpt-so-bad-at-math/> [https://perma.cc/Y2HN-AM7D]. Another related problem is that of “over-fitting,” where a machine-learning model generates rules that work well with training data but fail to generalize to the real-world. Overfitting is a particularly pernicious problem where data sets are insufficiently large. See *Data-sets, Generalization, and Overfitting*, GOOGLE DEVELOPERS, <https://developers.google.com/machine-learning/data-prep/construct/collect/data-size-quality> [https://perma.cc/WF2A-5B6D] (last visited Mar. 29, 2026).

³⁰⁰ See Stout, *supra* note 301, at 478.

³⁰¹ See MASASHI SUGIYAMA & MOTOAKI KAWANABE, MACHINE LEARNING IN NON-STATIONARY ENVIRONMENTS: INTRODUCTION TO COVARIATE SHIFT ADAPTATION (2012).

³⁰² *Id.* at 1.

the widespread adoption of the train in the United States in the mid-1850s, methods of transportation had remained remarkably stable for centuries. The average Ancient Roman traveled about the same speed as an American in the early 1800s. But then in the mid-1800s, everything changed as railroads were constructed across the country. Suddenly, goods and people could move farther and faster than ever before. A machine learning algorithm trained on prelocomotive data might vastly underestimate transportation speeds. The same problem could apply in financial markets. Deep learning hedge funds trained on outdated information (say, the meme stock craze of 2021 or the inversion transaction boom of the early 2010s) might overestimate the performance of some companies or bonds or derivatives, and underestimate others. This could lead to distortions in prices. With any luck, the distortions would be temporary. But they might also be more permanent if investments lead to governance changes or significant shifts in capital formation.

Of course, one might reply that these concerns are all failures that a human could make as well. Human can also hallucinate. They also are forced to rely on history. They also cannot see the future. Why, in other words, are deep learning hedge funds any different from an ordinary hedge fund that relies on humans?

There is a short answer to this question, and there is a long one. The short answer is that they are not. Artificial intelligence is not a magic box that will solve all hedge funds' problems. Nor is it a Pandora's box that will destroy them. It is simply a tool with advantages and flaws, and hedge funds that use it will not suddenly stop being hedge funds. But the longer answer is that while machine learning does not create new problems, it does exacerbate old ones and create tensions in new sectors. Of course, hedge funds (the old ones, run by humans) can get prices wrong or underestimate the forces of change. But humans have an innate capacity to adapt and to reason. They can think through problems, generate ideas, and create innovative solutions. They can self-correct when things go wrong. Artificial intelligence, on the other hand, can be surprisingly bad at simple tasks that no human would ever struggle with. And as this technology is built into the internal structure of our markets, the capacity of machine learning to cause real financial harm rises.

Scholars and regulators do not have reliable mechanisms for determining whether artificial intelligence is making markets less efficient. There is no widely accepted method for valuing financial assets. Some of the most common methods (fair market value, comparable companies, and comparable transactions) depend on market prices themselves as the most reliable measure of value.³⁰³ If it turns out that machine learning algorithms are distorting financial markets in some way, those distortions themselves could become the

³⁰³ See generally William A. Groll & David Leinwand, *Judge and Banker—Valuation Analyses in the Delaware Courts*, 116 PENN. ST. L. REV. 957 (2012).

new normal, deemed the best and most efficient value according to prevailing valuation practices. Imagine, for example, that hedge fund artificial intelligence leads to some deep change in the underlying dynamics of the stock market. It might believe that stock markets systematically overvalue stocks and trade to push down the Dow Jones Industrial Average or the S&P 500. It might believe that technology company stocks are systematically undervalued and cause hedge funds to pile into the sector, or launch activist campaigns against their managers. Given the size and influence of hedge funds, they might well transform the structure of our markets. And there would be no way to determine if this was inefficient because a sizeable portion of market watchers—including the deep learning hedge funds themselves—could point to the prices as the product of a free and fair market. What is more, given that modern artificial intelligence algorithms are so complex that we are unable to explain the bases for their decisions—the proverbial “black box” problem—we could not even know *why* hedge funds were pushing markets in a particular direction. The hedge funds themselves might not know.

B. Stability

The rise of deep learning hedge funds also raises risks for the systemic stability of financial markets. Together, the five largest multi-manager hedge funds today control around \$1.6 trillion in assets.³⁰⁴ In all, hedge funds have over \$12 trillion in gross asset value.³⁰⁵ They are extraordinarily active in trading stocks, bonds, derivatives, commodities, and other complex financial instruments. And they are highly leveraged. In 2024, large hedge funds had borrowings that amounted to 56.3% of their aggregate gross asset value, compared to just 4.7% for private equity funds.³⁰⁶ Given this combination of size and structure, regulators have long worried about the tendency of hedge fund bets to create contagion.³⁰⁷

In recent years, numerous regulators have pointed out that the computerized trading strategies of hedge funds raise systemic risk concerns.³⁰⁸ Andrew Bailey, the governor of the Bank of England, stated in his 2025 speech that the

³⁰⁴ *How The Next Financial Crisis Might Happen*, ECONOMIST (May 23, 2025), <https://www.economist.com/special-report/2025/05/23/how-the-next-financial-crisis-might-happen> [https://perma.cc/6TZK-62JW].

³⁰⁵ See DIVISION OF INVESTMENT MANAGEMENT: ANALYTICS OFFICE, *Private Funds Statistics Report: Third Calendar Quarter 4* (2024), <https://www.sec.gov/files/investment/private-funds-statistics-2024-q3.pdf> [https://perma.cc/7WJL-VS3H].

³⁰⁶ *Id.* at 7.

³⁰⁷ See, e.g. PRES. WORKING GROUP ON FIN. MARKETS, HEDGE FUNDS, LEVERAGE, AND THE LESSONS OF LONG-TERM CAPITAL MANAGEMENT (1999).

³⁰⁸ Andrew Bailey, *Are We Underestimating Changes in Financial Markets?*, Speech Delivered at the University of Chicago Booth School of Business (Feb. 11, 2025), <https://www.bankofengland.co.uk/speech/2025/february/andrew-bailey-keynote-speech-university-of-chicago-booth-school-of-business> [https://perma.cc/RN3W-GJLN].

substantial growth in the “footprint” of hedge funds represented a “fundamental change[] in the dynamics of markets.” He pointed to several potential dangers from this change. First, where groups of hedge fund managers attempt to “de-risk[] aggressively in a shock,” it could lead to the funds “amplifying market moves” and creating “risks to the system.” Second, he pointed out that “systematic strategies which trade based on complex statistical models and rules and market signals, rather than fundamentals, are becoming more popular.” As a result, markets have begun reacting more quickly to news, and sometimes in ways divorced from fundamental market structures. And finally, he noted that high-frequency trading firms had grown substantially in scale and scope globally and that they were creating strains on financial systems.³⁰⁹ Similarly, then-chairman of the Securities Exchange Commission, Gary Gensler, warned about the systemic risks of artificial intelligence in capital markets. In 2023, he stated that it was “nearly unavoidable” that AI would cause a financial crisis in the next decade.³¹⁰

Where do the risks to systemic stability lie? First, the artificial intelligence models that different hedge funds develop for their trading strategies may well have unexpected correlations with one another.³¹¹ We have seen in the real world that machine learning algorithms create images with distinctive looks and text with distinctive characteristics. A similar phenomenon in the financial world could create contagion and herd behavior if the largest hedge funds race in and out of particular trades all together and all at once.³¹² One study has even found that AI-powered trading algorithms begin to collude with one another even absent agreement or communication among themselves.³¹³ The speed of machine trading means that such moves could generate greater volatility in our markets.³¹⁴

Second, machine learning hedge funds could make financial bubbles last longer and grow bigger, leading to even greater losses when they finally collapse. Artificial intelligence models are based on historical data, and they make predictions based on past trends. So if they are trained on data in a past period that shows that certain subsectors outperform, they may all rush into that sector and extend its overpricing. Unless there is some countervailing force in the marketplace, their positions could well cause mid-to long-term price

³⁰⁹ *Id.*

³¹⁰ Stefania Palm & Patrick Jenkins, *Gary Gensler Urges Regulators to Tame AI Risks to Financial Stability*, FIN. TIMES (Oct. 14, 2023), <https://www.ft.com/content/8227636f-e819-443a-aeba-c8237f0ec1ac?syn-25a6b1a6=1> [<https://perma.cc/87MU-RGPM>].

³¹¹ See William Magnuson, *Financial Regulation in the Bitcoin Era*, 23 STAN. J. L. BUS. & FIN. 159, 184–88 (2018).

³¹² See Magnuson, *supra* note 24, at 362–63.

³¹³ See Winston Wei Dou, Itay Goldstein & Yan Ji, *AI-Powered Trading, Algorithmic Collusion, and Price Efficiency 1* (Nat’l Bureau of Econ. Rsch., Working Paper No. w34054, 2025), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4452704 [<https://perma.cc/4MME-U3V9>].

³¹⁴ *Id.*

distortions that are only corrected when some new trend or pattern emerges, leading them to shift their positions once again. The resulting collapse could cause a series of unintended consequences, particularly if it sets off broader contagion among correlated funds.

Third, there is also a risk that artificial intelligence might be exploited by malicious actors. One particularly fruitful field of machine learning scholarship examines so-called “adversarial artificial intelligence.”³¹⁵ The idea of adversarial artificial intelligence is to intentionally manipulate input data in a way to “trick” machine learning algorithms into generating faulty or predictable outcomes.³¹⁶ Adversaries feed poisoned data to a machine learning algorithm, either through internal or external methods, to take advantage of it in some way.³¹⁷ One infamous example came from self-driving cars where, in one study, researchers found that by placing a few black and white stickers in the right places on a red stop sign, they could trick the machine learning algorithms in the self-driving cars to fail to recognize the sign 100% of the time.³¹⁸ Adversaries might use similar strategies to trick hedge fund algorithms into malfunctioning. The tactics could be used for private gain—by, say, convincing the algorithms to purchase a particular stock or bond—or by nation-states to cause havoc in the marketplace. Both raise serious systemic risk concerns.

Finally, another unique risk raised by deep learning hedge funds is that they may also inadvertently introduce new systemically important financial institutions into financial markets: artificial intelligence companies themselves. Historically, financial regulators such as the Financial Stability Oversight Council and the Financial Stability Board have focused their attention on traditional financial companies like multinational banks (JPMorgan Chase, Citigroup, Goldman Sachs, etc...) and large insurers (AIG, MetLife, Prudential, etc...).³¹⁹ But many artificial intelligence models used by private sector actors today are not in fact generated in-house but rather plug into the largest models, such as ChatGPT and Claude, either through application programming interfaces or through siloed containers in cloud platforms.³²⁰ If these models become essential to the operations of hedge funds and other financial actors, they may well raise systemic risk concerns that would be overlooked by regulators focused on the traditional actors. What are the methods used by

³¹⁵ See Calo, *supra* note 188, at 419–20; see generally Tom C. W. Lin, *Financial Weapons of War*, 100 MINN. L. REV. 1377 (2016).

³¹⁶ See Calo, *supra* note 188, at 419.

³¹⁷ *Id.*

³¹⁸ See Kevin Eykholt et al., *Robust Physical-World Attacks on Deep Learning Visual Classification*, arXiv 1707.08945 (Apr. 2018), <https://arxiv.org/abs/1707.08945> [<https://perma.cc/PF8H-62XQ>].

³¹⁹ See Christina Parajon Skinner, *Financial Stability and Bank Agency Discretion*, 92 U. CHI. L. REV. 503, 508 (2025).

³²⁰ See Justina Lee, *Hedge Funds Battle to Turn ChatGPT From Intern to Analyst*, BLOOMBERG (Aug. 24, 2024), <https://www.bloomberg.com/news/articles/2024-08-14/hedge-funds-battle-to-turn-chatgpt-from-intern-to-analyst> [<https://perma.cc/TY9K-XT9W>].

OpenAI to study securities? How does its model generate predictions? What would happen if a hacker destroyed the source code or altered it in some malicious way? Are its cybersecurity procedures sufficiently robust? Artificial intelligence companies do not look like financial actors and they aren't regulated by financial regulators, but they increasingly play significant roles in shaping the behavior of financial markets.

C. Fairness

The rise of deep learning hedge funds also exacerbates concerns about the fundamental fairness of financial markets. Setting aside questions about the efficiency of stock prices or the stability of markets, we also have reasons to care about the moral consequences of our financial system. We don't just want to have perfect prices or stable companies. We also want a financial system that works for all of us, one that protects investors from deceitful or manipulative practices and that can generate long-term prosperity for all citizens. The increasing computerization of the financial system raises a series of concerns on this front.

One problem is insider trading. It has long been the law in the United States that corporate insiders—CEOs, board members, financial advisors, and others—may not trade on material non-public information.³²¹ The policy behind the law is that, whether or not such trading might produce more efficient prices, it is simply unethical for executives to take advantage of their special position to trade with unwitting ordinary investors.³²² But insider trading doctrine, as incorporated in Rule 10b-5, is notoriously convoluted, and courts have held in a series of decisions that it does not cover a range of behaviors that ordinary observers might deem classic instances of insider trading.³²³ Hedge fund artificial intelligence raises even trickier dimensions.³²⁴ Among other things, the structure of the machine learning industry create new avenues for inside information to leak out. Sending information and queries to AI companies reduces the security of valuable, confidential data. The queries may not stay secret, employees at the AI company may be able to see the information, other counterparties may be able to access the data, or the information may leak into future model responses. What do the terms and conditions

³²¹ See Michael A. Perino, *The Lost History of Insider Trading*, 2019 U. ILL. L. REV. 951, 952, 1000 (2019).

³²² *Id.* at 953–54.

³²³ See Cindy A. Schipani & H. Nejat Seyhun, *Defining “Material, Nonpublic”: What Should Constitute Illegal Insider Information?*, 21 FORDHAM J. CORP. & FIN. L. 327, 329 (2016); Sureyya Burcu Avcı, Cindy A. Schipani, H. Nejat Seyhun, & Andrew Verstein, *Insider Trading By Other Means*, 14 HARV. BUS. L. REV. (forthcoming 2025).

³²⁴ Insider trading rules in the European Union also struggle to capture artificial intelligence-based abuses. See Dörte Poelzig & Paul Dittich, *Artificial Intelligence and EU Insider Regulation*, (Eur. Corp. Gov. Inst., Working Paper No. 866, 2025).

of the models say about confidentiality of searches and whether they can be used to train new models? Would insider trading rules governing tippers and tippees reach the various individuals who might access training data, queries, and responses? And if artificial intelligence models are trained on confidential information, a cascade of new problems emerges. It is far from clear that a court would hold that a hedge fund that used an artificial intelligence model trained on non-public information was engaged in prohibited insider trading.

Consider, for example, the following hypothetical example. A manager of a large activist hedge fund named Eisenhower Square is considering taking a significant stake in a small public company named Applet Corp. to press for a sale of the company. In advance of the acquisition, the manager uses his account with ChatLLM, a large AI company, to research Applet, asking a series of questions about Applet's management, financial performance, and potential acquirors. ChatLLM, which was trained in part on private data bought from third party vendors, responds with answers that are not generally available to the public. An employee at ChatLLM who has access to the model's chat logs sees the interchange, recognizes the user's location as being at Eisenhower Square's headquarters, and acquires shares in Applet. The next day, the ChatLLM employee meets a friend at a venture capital firm for lunch and tells him about his discovery; the venture capitalist acquires a position in Applet as well. Meanwhile, a high-frequency trading hedge fund that subscribes to ChatLLM's enterprise mode, which incorporates real-time information about user searches, receives an alert that Applet is experiencing unusual interest. The high-frequency trading fund buys shares in Applet. Which, if anything, of these actors could be prosecuted for violating Rule 10(b)(5), the core insider trading law? Depending on the web of contracts at each company, the answer may well be none. The activist hedge fund has acquired material non-public information but it likely has no duty to Applet or ChatLLM not to trade on the information under the classical theory of insider trading.³²⁵ The ChatLLM employee also owes no duty to Applet shareholders under the classical theory, and while he may have a duty not to misappropriate model information, this would depend on the precise terms of his employment contract.³²⁶ The venture capitalist friend's trades likely do not satisfy the personal benefit test established by the Supreme Court in *Dirks v. SEC* because, among other things, it is unclear that the information was exchanged for the *purpose* of trading—it may well have been about exploring interesting developments in AI technology.³²⁷ And finally, the high-frequency trading firm could plausibly

³²⁵ See *United States v. O'Hagan*, 521 U.S. 642 (1997).

³²⁶ See *Carpenter v. United States*, 484 U.S. 19 (1987).

³²⁷ See *Salman v. United States*, 580 U.S. 39 (2016); *Dirks v. SEC*, 463 U.S. 646 (1983).

argue that it breached no duty to any of the parties because its terms of service explicitly provided for it to have the right to access such information.³²⁸

This hypothetical is not as far-fetched as it might seem. The terms of service of some of the most popular artificial intelligence models today are strikingly broad. In ChatGPT's terms of service, OpenAI grants itself a remarkable amount of freedom in what it may do with user data.³²⁹ OpenAI asserts in its privacy policy that it has the right to collect personal data about its users, including names, dates of birth, any inputs (files, images, and audio) and queries, content interacted with, log data, user IP addresses, browser types, location information, cookies, and "information from other sources, like information that is publicly available on the internet."³³⁰ It claims that it has the right to use this information to "provide, analyze, and maintain" its services and to "improve and develop [its] [s]ervices and conduct research, for example to develop new product features."³³¹ It claims that it may disclose personal data (including name, location and queries) to vendors "to perform certain services and functions."³³² It also claims that it may disclose personal data in the course of due diligence connected with strategic transactions, and that it may be transferred to "industry peers or other third parties" to "protect against legal liability."³³³ Needless to say, this is a truly stunning amount of power over what many users believe to be private interactions.

More broadly, though, the rise of algorithmic finance raises questions about the mounting divide between sophisticated and unsophisticated investors.³³⁴ There has long been a concern that unsophisticated, ordinary investors do not have access to the same investment—and thus profits—that sophisticated ones do.³³⁵ Deep learning hedge funds could exacerbate this divide. If machine learning algorithms really do generate better returns than human investors, then deep learning hedge funds will earn outsized returns compared to ordinary traders just using pen and paper. Their investments will not be open to ordinary citizens, who are restricted from investing in private funds. And if high frequency traders can use artificial intelligence to predict when and where ordinary investors will be executing their transactions, they could front-turn them and drive prices up or down in advance. If markets become

³²⁸ See O'Hagan, 521 U.S. at 651–52.

³²⁹ *Privacy Policy of June 27, 2024*, OPENAI (Feb. 6, 2026), <https://openai.com/policies/row-privacy-policy/> [<https://perma.cc/QJ54-JTWK>].

³³⁰ *Id.* at § 1.

³³¹ *Id.* at § 2.

³³² *Id.* at § 3.

³³³ *Id.*

³³⁴ See Cary M. Shelby, *Privileged Access to Financial Innovation*, 47 LOY. U. CHI. L. J. 315 (2015); Cary Martin Shelby, *How Did We Get Here? Dissecting the Hedge Fund Conundrum Through an Institutional Theory Lens*, 74 BUS. LAW. 735 (2019).

³³⁵ See Christina Parajon Skinner, *Private Equity for the People*, 171 U. PENN. L. REV. 2059, 2064 (2023).

increasingly one-sided forms for profit extraction from regular individuals, it will be a sad testament to the dark sides of technology and finance.

IV. REGULATORY REFORMS

The previous Part set forth a range of financial risks raised by the advent of deep learning hedge funds. These risks include the possibility of price distortions, market instability, and investor abuse. While the general categories of risk should be familiar to financial regulators, the sources and actors are different. The question for regulators, then, is whether and how to address algorithmic finance. Some have called for new laws. Others have called for more information. Still others have called for measures to promote artificial intelligence deployment. This final Part of the article will identify and assess three different models for regulating machine learning in hedge funds.³³⁶ The first, what the article refers to as the “*laissez faire*” model, focuses on allowing markets to correct inefficiencies and address excessive risk. The second, the “palace economy” model, calls for more intrusive governmental regulation, including both disclosure rules and substantive behavioral restrictions. The third, the “tech-industrial complex” model, calls for governments to play an instrumental role in promoting and deploying artificial intelligence among private sector actors. This Part will conclude with some initial thoughts on the benefits and costs of each model.³³⁷

A. *The Laissez Faire Model*

The *laissez faire* model of regulation asserts that the most efficient way to regulate markets is to let market forces determine the allocation of resources.³³⁸ A *laissez faire* regulator might look at deep learning hedge funds and conclude that there is nothing to worry about. Hedge funds are highly incentivized, both through compensation and reputational effects, to generate reliable profits. Their investors—pensions funds, sovereign wealth funds

³³⁶ For a discussion of the different models that the European Union and the United States have developed towards regulating financial technology, see Howell E. Jackson & Katja Langenbucher, *The Regulation of Technological Innovation in Financial Services: A Comparative Approach with Respect to Digital Assets and Artificial Intelligence*, White Paper (2025).

³³⁷ For a magisterial comparative survey of how the United States and the European Union have attempted to regulate technological innovation in financial services, see Howell E. Jackson & Katja Langenbucher, *The Regulation of Technological Innovation in Financial Services: A Comparative Approach With Respect to Digital Assets and Artificial Intelligence*, 88 L. & CONTEMP. PROB. 77 (2026).

³³⁸ See Jacob Viner, *The Intellectual History of Laissez Faire*, 3 J.L. & ECON. 45 (1960); Richard A. Epstein, *The Assault That Failed: The Progressive Critique of Laissez Faire*, 97 MICH. L. REV. 1697 (1999); Kevin Dowd, *The Case for Financial Laissez-Faire*, 106 ECON. J. 679 (1996).

and university endowments—are some of the wealthiest and most sophisticated actors in finance. Long-short funds often trade in highly liquid markets. Activist investors present their claims in widely publicized campaigns. Hedge funds regularly contract with large, multinational investment banks. Surely, if there is one sector of the financial world that is safe from abuse and deceit, it is the hedge fund world. If hedge funds find that artificial intelligence is a useful tool for generating profits, they will use it and succeed with it. If they do not, they will either stop using it or fail. It is a highly competitive field that rewards winners and punishes losers.

What is more, a *laissez faire* theorist might add, it is not just that regulation is unnecessary—it is also costly.³³⁹ Additional disclosure rules or behavioral restrictions will create burdensome new obligations for hedge funds that will limit their ability to serve useful roles in the financial world. New costs reduce their capacity to provide liquidity to markets, to reduce price inefficiencies, and expose corporate mismanagement. Additional regulation also affects the public institutions, like pension funds and retirement accounts, that rely on hedge funds to invest their money. Several scholars have worried that overregulation of hedge funds could impose unnecessary costs on the industry.³⁴⁰ A *laissez faire* theorist would prefer that the risks of hedge funds be controlled through private sector monitoring, not direct government control.³⁴¹

Finally, a *laissez faire* theorist would assert that even if deep learning hedge funds create risks that are inadequately addressed by private sector mechanisms, government regulators do not have the capacity to draft reasonable restraints.³⁴² Artificial intelligence is a dynamic technology that has changed dramatically in a matter of months.³⁴³ Agency regulation is a cumbersome process, taking months or years to draft, revise, and finally enact new rules.³⁴⁴ Congressional legislation is beset by partisan politics and interest

³³⁹ See Roberta Romano, *The Sarbanes-Oxley Act and the Making of Quack Corporate Governance*, 114 YALE L. J. 1521 (2005); Adam J. Levitin, *The Politics of Financial Regulation and the Regulation of Financial Politics*, 127 HARV. L. REV. 1991 (2014).

³⁴⁰ Troy A. Paredes, *On the Decision to Regulate Hedge Funds: The SEC's Regulatory Philosophy, Style, and Mission*, 2006 U. ILL. L. REV. 975.

³⁴¹ See Hossein Nabilou & Alessio M. Paces, *The Hedge Fund Regulation Dilemma: Direct vs. Indirect Regulation*, 6 WM. & MARY BUS. L. REV. 183, 183 (2015) (arguing that “indirect regulation of hedge funds through their counterparties and creditors is not only less costly but also can better address regulatory arbitrage by hedge funds and their potential contribution to systemic risk”).

³⁴² See John C. Coffee, *Political Economy of Dodd-Frank: Why Financial Reform Tends to Be Frustrated and Systemic Risk Perpetuated*, 97 CORNELL L. REV. 1019 (2012).

³⁴³ See Will Knight, *The AI Race Has Gotten Crowded—And China Is Closing In On Us*, WIRED (Apr. 7, 2025), <https://www.wired.com/story/stanford-study-global-artificial-intelligence-index/> [<https://perma.cc/J2XF-WHL5>].

³⁴⁴ See generally Sharon B. Jacobs, *The Administrative State's Passive Virtues*, 66 ADMIN. L. REV. 564 (2014).

group manipulation.³⁴⁵ It is hard to imagine that these processes would lead to an ideal regulation for such a highly technical, varied, and constantly changing industry. Even if such an ideal regulation were passed, regulators would struggle to develop the necessary expertise to properly apply it.

In place of intrusive new rules, a *laissez faire* theorist would conclude, we should instead rely on the well-established rules we already have.³⁴⁶ Securities regulation already broadly prohibits fraud. Contract law already provides ample remedies for parties that have been harmed by a counterparty's breach. Corporate law already contains numerous doctrines governing the obligations of managers to investors. All together, these interlocking doctrines create a robust framework for injured parties to find redress. If deep learning hedge funds act improperly, they will face consequences through private sector mechanisms.

But there are reasons to think that the *laissez faire* model of regulation might struggle to rein in the risks of machine learning. For one, hedge funds have structured their businesses in such a way as to be exempt from the primary securities regulations. They do not face the most cumbersome disclosure rules and substantive restrictions of the Securities Act, the Securities Exchange Act, the Investment Company Act and the Investment Advisers Act.³⁴⁷ And while regulators have repeatedly expressed concern about the lack of oversight over hedge funds, regulations have either been struck down in court or stymied by lobbying.³⁴⁸ For another, hedge funds have crafted operating agreements—their primary contracts with investors—to protect themselves from liability for misbehavior.³⁴⁹ Fiduciary limitations and blanket indemnifications are prevalent in the industry and act to shut down a range of contractual and corporate law claims that would otherwise be viable.³⁵⁰

Another problem with the *laissez faire* approach is that the structure of hedge funds themselves impedes the proper functioning of market forces. Hedge funds do not bear the full cost of all the risks they impose on the markets. When they generate systemic risks, they create harms for a wide range of market actors—retail investors, banks, and counterparties—that they are not properly incentivized to account for.³⁵¹ As a result, they are more likely to engage in activities that create these types of externalities. Similarly, the compensation structure of hedge funds actively incentivizes them to engage

³⁴⁵ See Alex Acs & Cary Coglianese, *Influence by Intimidation: Business Lobbying in the Regulatory Process*, 39 J. L. ECON. & ORG. 747 (2023).

³⁴⁶ See Frank H. Easterbrook, *Cyberspace and the Law of the Horse*, 1996 U. CHI. L. FOR. 207 (1996).

³⁴⁷ See *supra* Part I.B.

³⁴⁸ See *supra* Part I.B.

³⁴⁹ See *supra* Part II.C.

³⁵⁰ See *supra* Part II.C.

³⁵¹ See Kathryn Judge, *Fragmentation Nodes: A Study in Financial Innovation, Complexity, and Systemic Risk*, 64 STAN. L. REV. 657 (2012).

in excessive risk-taking. Their performance-based compensation—often referred to as “carried interest”—grants them a percentage (typically around 20%) of any profits they generate. But carried interest cannot go negative. In other words, if hedge funds gain money, they earn their carried interest. If they lose money, they simply don’t earn their carried interest. They do not have to pay investors 20% of any losses they generate for them.³⁵² As a result, even high-risk, low-probability bets can make financial sense for a hedge fund. If the bet pays off, they profit substantially. If it loses, they simply earn no extra compensation. This is a classic formulation for excessive risk-taking, and the industry has seen first-hand the consequences of failure.³⁵³ Finally, the most important actors that do have the proper incentives to monitor hedge fund behavior—the pension funds, endowments and other institutional investors that have their capital invested with them—are typically rife with agency conflicts of their own. The managers that make decisions are typically risk-averse and have mandates to invest a certain percentage of their assets to various alternative investment strategies. From a career perspective, these fund managers have strong incentives to follow past practice, investing their sums with the largest, most well-established hedge funds.³⁵⁴ For all these reasons, the *laissez faire* model may be ill-equipped to monitor deep learning hedge funds. And to the extent that the worry is about the *advantage* that machine learning provides hedge funds, relying on private sector pressure might exacerbate the problem. Large, sophisticated investors would actively encourage hedge funds to generate such profits.³⁵⁵

B. The Palace Economy Model

An alternative model for regulating deep learning hedge funds is to grant regulators substantially greater power to intervene directly in their operations. This model, what I term the “palace economy” model, begins with the position that government has a legitimate interest in governing the economy.³⁵⁶ Democratic institutions represent the will of the people, and their powers are

³⁵² Operating agreements do sometimes include “clawback” provisions forcing hedge funds to forfeit previously earned performance-based payments, but these provisions do not typically apply absent such previous payments. This is why they are termed “clawbacks”: investors can claw back payments that had been made or earned in the past.

³⁵³ See *supra* Part I.A.

³⁵⁴ See Ludovic Phalippou & William Magnuson, *Private Equity, Publica Capital, and Litigation Risk*, 105 N. C. L. REV. (forthcoming 2026).

³⁵⁵ See Robert F. Weber, *The Corporate Finance Case for Deliberation-Oriented Stress Testing Regulation*, 39 J. CORP. L. 833 (2014).

³⁵⁶ See Joseph E. Stiglitz, *The Role of the State in Financial Markets*, 7 WORLD BANK ECON. REV. 19, 20 (1993) (arguing that “there exist forms of government intervention that will not only make [financial] markets function better but will also improve the performance of the economy”); Zephyr Teachout & Lina Khan, *Market Structure and Political Law*, 9 DUKE J. CONST. L. & PUB. POL’Y 37 (2014) (arguing that market structure is fundamentally a political question);

not limited simply to political and social rights. Economic affairs are core to the lives of citizens, and therefore governmental bodies, from legislatures to executives to regulatory agencies, act properly when they extend their powers into these spheres.³⁵⁷ The palace economy theorist asserts that regulatory bodies should not solely concern themselves with market failures—classically defined. They also have the right—and duty—to define what market *success* looks like. Where should society’s resources be directed? How should employees be treated? Which sorts of transactions should be encouraged, and which should be discouraged, or even banned? These are the sorts of questions they must ask, and public enforcement of legislative priorities is essential to the proper functioning of markets.³⁵⁸

A palace economy theorist would assert that deep learning hedge funds present a range of unique risks for financial markets. If high-frequency trading firms are extracting excessive profits from retail investors, then regulators should be empowered to stop them. If machine learning algorithms make financial markets less fair or more prone to volatility, then regulators should step in to rein in their practices. If deep learning hedge funds are distorting markets, then financial overseers should develop measures to mitigate them. More broadly, regulators must begin by understanding *what* deep learning hedge funds are doing before they can formulate *how* to regulate them.

The toolkit of a palace economy theorist, then, would involve greater disclosure, more active policing and potentially closer scrutiny of proprietary algorithms. This might take the form of additional cybersecurity rules, requiring hedge funds to adopt best practices for protecting their trading algorithms from improper behavior. It might involve stress testing of machine learning algorithms, similar to the kinds of testing that the Federal Reserve uses to assess the resilience of large banks.³⁵⁹ It might include pre-clearance processes that hedge funds must submit to before they may deploy new machine learning algorithms in markets. It might also call for the shifting of regulatory powers from less capable agencies to more capable ones, ones that have

Gregory Brazeal, *Markets as Legal Constructions*, 91 U. CIN. L. REV. 595 (2023) (exploring the government’s role in structuring markets).

³⁵⁷ See MICHAEL J. SANDEL, WHAT MONEY CAN’T BUY: THE MORAL LIMITS OF MARKETS (2012).

³⁵⁸ See Howell E. Jackson & Jeffrey Y. Zhang, *Does Public Enforcement Work?*, in THE OXFORD HANDBOOK OF CORPORATE LAW AND GOVERNANCE 2 (Jeffrey N. Gordon & Wolf-Georg Ringe eds., 2d ed. 2025) (arguing that “greater levels of public enforcement are associated with key measures of robust capital markets”).

³⁵⁹ See Rory Van Loo, *Stress Testing Governance*, 75 VAND. L. REV. 553 (2022); Mehra Baradaran, *Regulation by Hypothetical*, 67 VAND. L. REV. 1247 (2014); Kathryn Judge, *Stress Testing During Times of War*, in HANDBOOK OF FINANCIAL STRESS TESTING (J. Dooyne Farmer, Alissa Kleinnijenhuis, Til Schuermann & Thom Wetzer, eds., 2022); Robert Weber, *A Theory for Deliberation-Oriented Stress Testing Regulation*, 98 MINN. L. REV. 2236 (2014); John Crawford, *Wargaming Financial Crises: The Problem of (In)experience and Regulator Expertise*, 34 REV. BANKING & FIN. L. 111 (2015).

both the size and capacity to understand and monitor hedge fund behavior.³⁶⁰ It might include mandatory, non-waivable fiduciary duties for hedge funds.³⁶¹ Finally, a palace economy theorist would argue in favor of strengthening liability regimes, ensuring that hedge funds—and potentially artificial intelligence firms—are held responsible for harms they generate.³⁶² Strict liability regimes, for example, could improve the flawed incentive structure surrounding financial artificial intelligence.³⁶³

The key danger of the palace economy model stems from its reliance on democratic processes. While citizens have numerous reasons to care about the structure of financial markets, the ability of representative government to fashion intrusive substantive rules specifying the internal logic of these markets faces some reasonable doubt.³⁶⁴ Are legislators sufficiently informed to draft reasonable rules governing the wide range of hedge fund strategies? Are cumbersome legislative processes sufficiently flexible to govern the fast-evolving models of artificial intelligence? Are regulatory agencies better equipped than investors to negotiate the terms of transactions? A skeptic might think that governmental regulation of financial markets is largely a source of inefficiency and bureaucratic red tape. Compliance costs are real, and the imposition of heavy regulatory burdens might well reduce the ability of hedge funds to fulfill their beneficial roles in financial markets.

Another major obstacle to successful palace economy regulation is the opposition such rules would face in practice. The hedge fund industry has pushed hard against stricter oversight, including anti-fraud, cybersecurity and machine-learning rules. In 2023, when the SEC issued its “private fund adviser” rule—requiring hedge funds and other private funds to provide investors with periodic information about fund performance, undergo annual audits, and refrain from engaging in certain restricted fee-charging practices—hedge fund and private equity trade groups sued the SEC, arguing that the rules exceeded the SEC’s statutory authority under the Investment Advisers Act. The Fifth Circuit Court of Appeals ruled in favor of the trade groups and struck the rule down.³⁶⁵ “By congressional design,” the Fifth Circuit held, “private funds

³⁶⁰ See Cary Martin Shelby, *Closing the Hedge Fund Loophole: The SEC as the Primary Regulator of Systemic Risk*, 58 B. C. L. REV. 639 (2017).

³⁶¹ See Howell E. Jackson & Talia B. Gillis, *Fiduciary Law in Financial Regulation*, in THE OXFORD HANDBOOK ON FIDUCIARY LAW 852 (Evan J. Criddle, Paul B. Miller & Robert H. Sitkoff eds., 2019) (noting that oversight mechanisms may establish a non-waivable regulatory regime).

³⁶² See Alison Lui & Andrea Miglionico, *AI Generated Deepfake Financial Scams on Digital Platforms: A Missing Liability Regime for Consumer Protection Frameworks*, ASIAN J. COMPAR. L. (forthcoming 2026).

³⁶³ See William J. Magnuson, *The Failure of Market Efficiency*, 48 BYU L. REV. 827, 905 (2023).

³⁶⁴ See Coffee Jr., *supra* note 346.

³⁶⁵ See *Private Fund Advisers; Documentation of Registered Investment Adviser Compliance Reviews*, Advisers Act Release No. 1A-6383 (Aug. 23, 2023); Nat’l Ass’n of Priv. Fund Managers v. SEC 103 F.4th 1097 (5th Cir. 2024).

are exempt from federal regulation of their internal “governance structure.”³⁶⁶ During the same year, the SEC proposed two new technology rules aimed at hedge funds. The first, a cybersecurity rule, required market entities to establish policies “reasonably designed to address their cybersecurity risks.”³⁶⁷ The second, a “predictive data analytics” rule, required hedge funds to “eliminate, or neutralize the effect of” conflicts of interest created by their machine-learning models.³⁶⁸ In response, a group of investment management industry groups issued a letter urging the SEC to withdraw both rules, arguing that they exceeded the regulatory body’s authority.³⁶⁹ As they argued, “by congressional design, private funds are exempt from federal regulation of their internal ‘governance structure,’ including ‘advisers’ oversight’ of vendors and other operational matters.”³⁷⁰ In 2025, the SEC formally withdrew both proposed rules.³⁷¹

This sort of intense industry pressure, combined with judicial decisions limiting the scope of the securities laws, stands as a serious obstacle to any palace economy model of hedge fund regulation. But it does not address the merits of the model itself—it simply suggests that any attempt to adopt such policies will require new legislation and alternative interest group mobilization. In other jurisdictions, similar models have been constructed in related industries and have been met with general approval by outside observers across the political spectrum.³⁷²

C. The Tech-Industrial Complex Model

A final model for regulating deep learning hedge funds involves something of a mixture of both the *laissez faire* and palace economy models. This approach, what I term the “tech-industrial complex” model, pairs closer government scrutiny with active subsidization of research and development.³⁷³

³⁶⁶ *Id.* at 1114.

³⁶⁷ See *Cybersecurity Risk Management for Investment Advisers, Registered Investment Companies, and Business Development Companies*, Release No. 34-97142, at 55 (2023).

³⁶⁸ See *Conflicts of Interest Associated with the Use of Predictive Data Analytics by Broker-Dealers and Investment Advisers*, Release No. 34-97990, at 1 (2023). For a discussion of the rule and the problems of algorithmic financial advice, see James Fallows Tierney, *Reg BI+: Conflicted Sales Practices and Algorithmic Financial Advice*, 2024 MICH. ST. L. REV. 947 (2024).

³⁶⁹ See Letter from Nat’l Ass’n of Priv. Fund Managers et al. to Sec. & Exch. Comm’n, (July 9, 2024) <https://www.sec.gov/comments/s7-25-22/s72522-489303-1405987.pdf> [<https://perma.cc/K48L-2F5N>].

³⁷⁰ *Id.*

³⁷¹ See *Withdrawal of Proposed Regulatory Actions*, 90 Fed. Reg. 25531 (June 17, 2025), <https://www.federalregister.gov/documents/2025/06/17/2025-11110/withdrawal-of-proposed-regulatory-actions> [<https://perma.cc/VS94-LL63>].

³⁷² See, e.g., Lin Lin, *Regulating Fintech: The Case of Singapore*, 35 BANKING & FIN. L. REV. 94 (2019); DOUGLAS W. ARNER ET AL. BUILDING OPEN FINANCE: FROM POLICY TO INFRASTRUCTURE, (Cir. for Fin., Tech. & Entrepreneurship, 2025), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5116657 [<https://perma.cc/MQ4J-B9HZ>].

³⁷³ See, e.g., KAREN I. MATTHEWS, AGILE AI PARTNERSHIPS: A PUBLIC-PRIVATE FLEXIBLE AND SMART FRAMEWORK FOR NATIONAL SECURITY AND COMPETITIVE INNOVATION (Belfer

Government encouragement of nationally-important technology has had a long history and has featured most recently in the so-called “green industrial policies” of many countries.³⁷⁴ One of the core arguments in favor of such economic policies is that, in some markets, it is a matter of national security to maintain and develop domestic capacity above and beyond private market incentives.³⁷⁵ A good example is the semiconductor industry.³⁷⁶ While outsourcing the manufacturing of chips might make sense for any individual firm—indeed, the vast majority of companies have neither the expertise nor the capital to develop them—from a national perspective, it is dangerous for *all* semiconductor companies to be located abroad.³⁷⁷ In times of shock—such as wars or pandemics or financial crises—the supply chains necessary for the free flow of semiconductors might break down, reducing the capacity of domestic economies to provide essential goods.³⁷⁸ In order to incentivize domestic production of essential chips, then, nations have increasingly resorted to taxes, subsidies, and a range of other policy measures to build up domestic industries.³⁷⁹

Many observers, both in political and academic circles, have asserted that artificial intelligence represents just such a nationally important technology.³⁸⁰ They have argued that machine learning will transform industries across the economy, from education to transportation to finance.³⁸¹ And in order to ensure that domestic companies develop the expertise and knowledge necessary to thrive in the era of artificial intelligence, they have argued that

Ctr. for Sci. & Int’l Affs., Harvard Kennedy Sch, 2025); Samar Fatima, Kevin C. Desouza & Gregory S. Dawson, *National Strategic Artificial Intelligence Plans: A Multi-Dimensional Analysis*, 67 ECON. ANAL. & POL’Y 178 (2021).

³⁷⁴ See Dani Rodrik, *Green Industrial Policy*, 30 OXFORD REV. ECON. POL’Y 469 (2014).

³⁷⁵ See Kenneth Flamm & William B. Bonvillian, *Solving America’s Chip Manufacturing Crisis*, 9 AM. AFFS. (May 2025), <https://americanaffairsjournal.org/2025/05/solving-americas-chip-manufacturing-crisis/> [<https://perma.cc/M6C4-5VDK>].

³⁷⁶ *Id.*

³⁷⁷ *Id.*

³⁷⁸ *Id.*

³⁷⁹ *Id.*

³⁸⁰ See Gary Roughead, *When It Comes to Military AI, There Is No Second Place*, MIL. TIMES (Aug. 24, 2024), <https://www.militarytimes.com/opinion/2024/08/24/when-it-comes-to-military-ai-there-is-no-second-place/> [<https://perma.cc/D7E5-2PZE>]; Stephen Haber & Amit Seru, *AI or Bust*, HOOVER INST. (Apr. 25, 2025), <https://www.hoover.org/research/ai-or-bust> [<https://perma.cc/ZU6E-QUXW>]; Radha Iyengar Plumb & Michael C. Horowitz, *What America Gets Wrong About the AI Race*, FOREIGN AFFAIRS (Apr. 18, 2025), <https://www.foreignaffairs.com/united-states/what-america-gets-wrong-about-ai-race> [<https://perma.cc/LVS9-7BB6>]; Matan Chorem & Joel Predd, *America Should Assume the Worst About AI*, FOREIGN AFFAIRS (July 22, 2025), <https://www.foreignaffairs.com/united-states/artificial-intelligence-geopolitics-worst-about-ai> [<https://perma.cc/Z3SK-DZLE>].

³⁸¹ See Anant Agarwal, *How A.I. Can Revive a Love of Learning*, N.Y. TIMES (Dec. 7, 2024), <https://www.nytimes.com/2024/12/07/special-series/artificial-intelligence-schools-education.html> [<https://perma.cc/85T2-YEHV>]; Cohen, *supra* note 197; CARSTEN MAPLE ET AL., *THE AI REVOLUTION: OPPORTUNITIES AND CHALLENGES FOR THE FINANCE SECTOR* (The Alan Turing Inst. 2023).

governments must take a more active hand in promoting research and development in the private sector.³⁸²

What might a tech-industrial complex model look like with respect to hedge funds? It would begin by reducing the risk and subsidizing the cost of developing industry-leading financial technology models. This could take the form of low-interest loans, tax privileges or direct subsidies for hedge funds engaged in artificial intelligence research or other technologies of national interest. State pension plans might allocate a certain percentage of their capital to hedge funds that prioritize machine learning applications. It could also include training programs—either through universities or through specialized institutions—to develop and disseminate knowledge about artificial intelligence and financial technology. These cooperative measures would need to be paired with greater governmental oversight, ensuring that hedge funds' development of technology is responsive to broader public interests.

One of the major objections to a tech-industrial complex model would likely be that hedge funds are rarely seen as a sympathetic group in need of public support. The largest hedge funds are some of the most profitable firms in the world, and the most successful managers can earn hundreds of millions of dollars a year. These are not the kinds of institutions or actors that typically need additional tax subsidies. Any policy that funnels additional capital to hedge funds would likely face substantial criticism. What is more, it is not clear that hedge funds would even be willing to trade their substantial freedom of action for additional governmental support, if such a trade involved substantial new regulatory burdens. They might prefer to continue to operate outside governmental oversight.

A second risk from a tech-industrial complex paradigm is that it might lead to even further distortions in financial markets. Government actors and regulatory bodies are subject to different kinds of pressures and interests than traditional financial institutions, and these new avenues might create perverse incentives for hedge funds, from shifting resources to lobbying to pushing for the exclusion of competitors. Regulatory capture is a major risk for any government agency that oversees a powerful and concentrated industry.³⁸³ Indeed, the very existence of a tech-industrial complex might suggest the presence of regulatory capture. Recent history from government intrusion into the electric vehicle market—a market that some politicians viewed as essential to national security and environmental protection—has not been edifying. A range of federal and state programs aimed at driving adoption of electric vehicles to fight climate change were enacted in the last decade, but they

³⁸² See Plumb & Horowitz, *supra* note 384.

³⁸³ See George J. Stigler, *The Theory of Economic Regulation*, 2 BELL J. ECON. & SCI. MGMT. 3 (1971).

have been plagued with problems.³⁸⁴ Because even heavily subsidized electric vehicles were more expensive than gas-powered vehicles, the overwhelming majority of purchasers were wealthy consumers, thereby redistributing wealth from poor citizens to wealthier ones.³⁸⁵ Because foreign producers could make electric vehicles more cheaply than American ones, the restrictions perversely reduced domestic production and increased imports.³⁸⁶ Because electric vehicles had numerous limitations, involving range and charging time and weather effects, many buyers purchased them as secondary vehicles (or even third vehicles), rather than their primary ones.³⁸⁷ While electric vehicles tend to produce fewer greenhouse gas emissions during their operation, they create new environmental problems, including the environmentally harmful mining of rare earth minerals.³⁸⁸ And because electric vehicles were significantly heavier than ordinary cars, they created a range of new road concerns, including air pollution from tire degradation, more dangerous accidents, and more wear-and-tear on roads.³⁸⁹ All of these raised steep questions about the ability of regulatory bodies to properly intervene in markets to achieve the goals they claim to be pursuing.

One potential middle ground might be the creation of hedge fund sandboxes, formalized centers where hedge funds could test out new computerized trading technologies under the watchful eye of regulators. Fintech sandboxes have been created across the globe as a regulatory tool for incentivizing safe and effective financial technology.³⁹⁰ While the details vary from jurisdiction to jurisdiction, sandboxes generally allow interested actors to research and deploy promising new financial technologies under relaxed regulatory standards.³⁹¹ In return, they agree to close supervision by financial regulators.

³⁸⁴ See Donald Van Der Vaart, *Environmentalists Should Lead the Charge Against Electric Vehicles*, HILL (Feb. 1, 2021) <https://thehill.com/opinion/energy-environment/536296-environmentalists-should-lead-the-charge-against-electric-vehicles/> [<https://perma.cc/AU9L-KBKW>].

³⁸⁵ See Veronique de Rugy, *The Case for Killing the Tax Credit for Electric Vehicles*, L.A. TIMES (Dec. 29, 2024), <https://www.latimes.com/opinion/story/2024-12-29/ineffective-federal-tax-credit-electric-vehicles> [<https://perma.cc/5PAH-5YHK>].

³⁸⁶ See Agnes Chang & Keith Bradsher, *How China Became the World's Largest Car Exporter*, N.Y. TIMES (Nov. 29, 2024), <https://www.nytimes.com/interactive/2024/11/29/business/china-cars-sales-exports.html> [<https://perma.cc/PZV2-LEGV>] (noting that production costs are “much lower” in China).

³⁸⁷ See Niklas Tilly et al., *How Sustainable Is Electric Vehicle Adoption? Insights from a PRISMA Review*, 117 SUSTAINABLE CITIES & SOC’Y 105950 (2024).

³⁸⁸ See de Rugy, *supra* note 389; Jack Ewing, *An Auto Holy Grail: Don’t Rely on Chinese Rare Earths*, N.Y. TIMES (Nov. 24, 2025), <https://www.nytimes.com/2025/11/24/business/automakers-rare-earth-minerals-magnets.html> [<https://perma.cc/DV8W-G7KX>].

³⁸⁹ See Michael Buschbacher & Taylor Myers, *Electric Cars Emit More Particulate Pollution*, WALL ST. J. (Mar. 3, 2024), <https://www.wsj.com/opinion/electric-cars-emit-more-soot-california-ban-gas-powered-vehicles-521b29e3> [<https://perma.cc/B5CX-DKLM>]; NTSB *Head Warns of Risks Posed by Heavy Electric Vehicles Colliding With Lighter Cars*, ASSOCIATED PRESS (Jan. 11, 2023), <https://apnews.com/article/technology-road-safety-national-transportation-board-automotive-accidents-dd5c4260f68e9f5dcb430a02cc939f6b> [<https://perma.cc/Q7XV-J6B3>].

³⁹⁰ See Hilary Allen, *Regulatory Sandboxes*, 87 GEO. WASH. L. REV. 579 (2019).

³⁹¹ *Id.*

Various forms of sandboxes have been used in jurisdictions as diverse as Singapore, Switzerland, Argentina and South Africa.³⁹² For hedge funds seeking to raise public money from large investors, they might provide a useful mechanism for balancing innovation and risk reduction.

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The *laissez faire*, palace economy, and tech-industrial complex models each represents a starkly different regulatory approach for deep learning hedge funds. The *laissez faire* model prioritizes innovation, regulatory freedom, and the discipline of markets. The palace economy model prioritizes democratic determination, systemic stability, and the failures of markets. The tech-industrial complex prioritizes national security and cooperation between governments and the private sector. None has all the answers, and each comes with tradeoffs. The *laissez faire* model requires economies to accept that hedge fund interests will often diverge from public interests. The palace economy model imposes costs in the form of regulatory capture and administrative inefficiency. The tech-industrial complex model risks exacerbating concentrations of wealth and financial power. The optimal regulatory structure will likely depend on a combination of market dynamics, domestic politics, and the evolution of technology, and it will likely differ from jurisdiction to jurisdiction, and from time to time. But if regulators are to fashion thoughtful responses to deep learning hedge funds, they must begin asking these questions.

CONCLUSION

Over the last decade, hedge funds have increasingly incorporated artificial intelligence into their businesses, and they are already transforming the nature of our financial system. Machine learning algorithms offer the alluring promise of greater efficiency and better predictions, but they also raise serious risks. Regulators are only beginning to grapple with the unintended consequences of the deployment at scale of machine learning into our financial markets. This Article articulates a set of principles to govern how regulators should approach machine learning in finance. While the doomsday predictions are overblown, regulators should be mindful of the new avenues for algorithms to generate inefficient, unstable, and unfair markets.

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³⁹² See BAKER MCKENZIE, A GUIDE TO REGULATORY FINTECH SANDBOXES INTERNATIONALLY (2021), https://www.bakermckenzie.com/en-/media/files/insight/publications/2021/03/baker-mckenzie--a-guide-to-regulatory-fintech-sandboxes-internationally_230321.pdf [<https://perma.cc/2LLG-WZD6>].

