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Financial Operating Systems

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FINANCIAL OPERATING SYSTEMS

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ABSTRACT

One of the most consequential and unexamined developments in global finance has been the recent emergence of massive concentrations of financial technology under the control of individual firms. These financial operating systems are, like computing operating systems, relatively inconspicuous yet extraordinarily powerful. They already dominate the world's \$50 trillion investment fund industry, where they play a critical role in asset management for pensions and institutional investors, and their ambitions are far greater.

A harbinger of their growth is a firm with massive size and scope that remains virtually unknown in the United States. China's Ant Financial – an affiliate of Alibaba – is fifty percent more valuable than Goldman Sachs, and its payment system, Alipay, is the world's largest, hosting more than 1 billion clients and executing more than \$16 trillion in annual transactions, equivalent to China's annual GDP. U.S. firms such as BlackRock, Vanguard, and Facebook are working hard to emulate Ant's scale.

Despite intense scholarly focus upon FinTech, we argue that these financial operating systems will ultimately have far greater societal impact. We identify the economic reasons for the dramatic ascendancy of these systems and the legal implications arising from their possible failures and successes, specifically analyzing national security, antitrust, cybersecurity, and related theoretical issues accompanying the rise of these financial leviathans.

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Aladdin is like oxygen. Without it we wouldn't be able to function.

– Anthony Malloy, CEO of New York Life Investors¹

INTRODUCTION

As technological operating systems have grown in size, scope, and influence, the impact from their failures has increased commensurately. Recent years have brought damaging hacks into personal and political data affecting hundreds of millions of consumers, with Facebook often at the center of attention,² and serious, yet widely undetected attacks upon the integrity of the U.S. election system and the very foundation of our democracy.³ These

¹ Antoine Gara, *BlackRock's Edge: Why Technology Is Creating the Amazon of Wall Street*, FORBES, Dec. 26, 2017.

² Following the controversial role of foreign influence in the 2016 presidential election in the United States, U.S. and European officials interrogated Mark Zuckerberg and his lieutenants at Facebook to determine the extent to which the world's leading social network might have influenced or corrupted basic structures and systems of democracy. See Jack M. Balkin, *The First Amendment in the Second Gilded Age*, 66 BUFF. L. REV. 979, 998-1004 (2018) (detailing the threats and consequences of these dynamics).

³ See U.S. SENATE INTELLIGENCE COMMITTEE, REPORT OF THE SELECT COMMITTEE ON INTELLIGENCE, U.S. SENATE, ON RUSSIAN ACTIVE MEASURES, CAMPAIGNS AND

breaches of integrity prompt serious questions about possible vulnerabilities in any computer system that might wield similar influence over the global financial system. Such a scenario is all too easy to imagine when one considers the financial services increasingly offered by Facebook (most notably its much-debated Libra cryptocurrency project⁴ and services such as WhatsApp Pay⁵) and by other big technology firms (“BigTechs”) including Alibaba, Amazon, Apple, Google, and Tencent.⁶ If such vulnerabilities were to exist, the task of addressing their vulnerabilities would require the urgent and immediate attention of regulators and legislators.

No such hypothetical is necessary, however, because as this Article demonstrates such concentrated financial control systems already exist, though they have largely been overlooked by scholars and supervisory authorities. Financial services and technology firms have invested billions of dollars to create dominant information technology systems and platforms, which we refer to as “Financial Operating Systems.” In particular, the leading U.S. financial institutions have built these concentrated Financial Operating Systems (FOS).⁷ BlackRock’s Aladdin and similar platforms by Vanguard, Fidelity, Goldman and J.P. Morgan Chase are striking examples that we will analyze in detail. Thus, the central concern of this Article – whether and how these FOS should be regulated – is a matter of high priority.

In many ways, the rise of FOS reflects the powerful response of massive, established financial institutions to efforts by FinTech start-ups to disrupt the industry. While the focus of commentators and scholars worldwide has been on the rise of innovative and disruptive FinTech *startups*, incumbents and BigTechs have been doing what they do best – working quietly to build the essential infrastructure and scale necessary to counter the start-ups’ strategies, building on their advantages in financial resources and large-scale client access.

The biggest such system in the world, however, is not a U.S. institution.

INTERFERENCES IN THE 2016 U.S. ELECTION REPORT 116-XX (concluding that election systems in all 50 states were targeted by Russia in 2016, widely undetected by the states and federal officials at the time).

⁴ See Dirk Zetsche, Ross Buckley & Douglas Arner, *Regulating Libra*, 40 OXF. J. LEG. ST. __ (forthcoming 2020).

⁵ WhatsApp Pay has announced its launch in India where WhatsApp already has 400 million users; see Daniel Keyes, *WhatsApp Pay Is on the Verge of Launching in India*, Jul. 2, 2019, <https://www.businessinsider.com/whatsapp-pay-ready-for-india-launch-2019-7?IR=T> (last accessed 12 Nov. 2019).

⁶ See BANK OF INTERNATIONAL SETTLEMENT (“BIS”), BIS ANNUAL ECONOMIC REPORT 55-79, June 23, 2019 (detailing financial services-related activities of big technology firms such as Apple, Amazon, Alibaba, Google and Facebook, and discussing opportunities and risks of BigTech in finance).

⁷ Financial institutions that have launched FOS include: banks such as J.P. Morgan and Goldman Sachs; asset manager giants like BlackRock, Fidelity, and Vanguard; and broker-dealers such as Charles Schwab. Leading internationally, in terms of its system integration and customer base, is the Chinese Alibaba group, with its payment app, Alipay, and its investment arm, Ant Financial. See *infra*, at II.B. to D.

Ant Financial in China boasts a valuation of \$150 billion, making it fifty percent more valuable than Goldman Sachs.⁸ In 2018, the firm raised \$14 billion in venture capital financing, or 36 percent of all VC funding worldwide and more than all U.S. FinTech companies combined.⁹ Its electronic payment system, Alipay, is the world's largest with 1.2 billion active users worldwide (among them over 700 million in China) as of June 30, 2019,¹⁰ making it the hub of a wide ranging ecosystem of financial services that includes one of the world's largest investment funds with a staggering 325 million investors and China's largest fund brokerage platform.

That most people are unaware of these systems compounds the potential risks they pose: consider a world in which a financial services application confirms payment transactions, investment orders, or risk limits, yet no such actions occur if the inner matrix of the financial services universe fails to process the orders. While irritating to individual consumers, these matters would pose systemic risks and societal threats were they to affect the savings and pensions of tens of millions of people.

The consequences of such system failures are potentially dire: the failure to deliver securities after payment, with payments lost; the failure to honor stop loss orders in a falling market, losing clients' investments; the failure to pay bills, triggering enforcement actions including foreclosure. Beyond the impact upon individuals, the broader economy could be seriously damaged if payments and investments fail to be processed over longer periods. Yet these delays need not be long at all, as service interruptions of minutes or even seconds have already triggered adverse market reactions.¹¹

Once participants lose their trust in our financial market infrastructure they might seek to preserve value by withdrawing: client demands for payment could turn into bank or money market runs, ruining financially sound institutions; money market funds could "break the buck," impacting an important cash management tool for millions of Americans and disrupting a key financing mechanism of the U.S. economy; and retirement investments through 401(k) accounts could be frozen. In short, financial intermediation – the process by which the world's capital supply meets capital demand – could cease, prompting a financial and economic crisis similar to, or even more severe

⁸ See Anais Concepcion, *How Ant Financial Became the Largest FinTech in the World*, APPLICO (Mar. 4, 2018), <https://www.applicoinc.com/blog/ant-financial-services-platform-largest-FinTech-in-world/>.

⁹ Reuters, *FinTech companies raised a record \$39.6 billion in 2018*, REUTERS (Jan. 19, 2019), <https://www.reuters.com/article/us-fintech-funding/fintech-companies-raised-a-record-396-billion-in-2018-research-idUSKCN1PNOEL>.

¹⁰ See Xinhua, *Alipay reports 1.2 bln users*, XINHUANET (Oct. 1, 2019), http://www.xinhuanet.com/english/2019-10/01/c_138440413.htm.

¹¹ See Patrick Gillespie, Matt Egan & Heather Long, *Trading Resumes on NYSE after Nearly 4-hour Outage*, CNN (July 8, 2015), <https://money.cnn.com/2015/07/08/investing/nyse-suspends-trading/> (reporting that a software update prompted the NYSE to halt trading for four hours, resulting in the Dow losing 1.5% in a single day).

than, the Great Recession of 2008.

This hypothetical scenario could eventuate if financial operating systems – the IT backbone of the world’s financial systems – malfunction or are subjected to attack. Recently, regulators around the globe have begun to recognize the importance of capital market and other systemically important financial infrastructure,¹² of which financial operating systems form the technical core. This Article is the first to conceptualize and devise a framework for understanding the regulatory challenges associated with these systems.

In recent years, financial technology or “FinTech” has received a great deal of attention. Indeed, financial services cannot meaningfully be analyzed today without considering FinTech;¹³ and no such analysis would be complete without understanding the underlying technologies: Big Data¹⁴ and artificial intelligence,¹⁵ distributed ledger technology and blockchain,¹⁶ smart

¹² See IOSCO & BIS – COMMITTEE ON PAYMENT AND SETTLEMENT SYSTEMS, PRINCIPLES FOR FINANCIAL MARKET INFRASTRUCTURES (APR. 2012), <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD350.pdf>.

¹³ See generally Douglas Arner, Janos Barberis & Ross Buckley, *The Evolution of FinTech: A New Post-Crisis Paradigm?*, 47 GEO. J. INT’L L. 1271, 1275 (2017) (describing the disruptive effect of financial technologies); Chris Brummer, *Disruptive Technology and Securities Regulation*, 84 FORDH. L. REV. 977 (2015) (arguing that securities regulation must be adapted to FinTech); Chris Brummer & Yesha Yadav, *FinTech and the Innovation Trilemma*, 107 GEO. L.J. 235, 248-49 (2019) (describing FinTech regulation as a trilemma where regulators must ensure innovation, simple rules and market integrity at the same time); Kathryn Judge, *Investor-Driven Financial Innovation*, 8 HARV. BUS. L. REV. 291 (2018) (arguing that FinTech shall be used to avoid suboptimal regulation-inspired over-demand); Dirk Zetzsche, Ross Buckley, Douglas Arner & Janos Barberis, *From FinTech to TechFin: The Regulatory Challenges of Data-Driven Finance*, 14 N.Y.U. J. L. & BUS. 393, 435-443 (2018) (arguing in favor of data-specific adjustments to financial regulations).

¹⁴ See Solon Barocas & Andrew D. Selbst, *Big Data’s Disparate Impact* 104 CAL. L. REV. 671 (2016) (highlighting data dependency and the risk that algorithms reinforce existing biases); Julie E. Cohen, *What Privacy Is For*, 126 HARV. L. REV. 1904, 1918 (2013) (arguing that Big Data furthers surveillance of individuals and asking to strengthen privacy); Stacy-Ann Elvy, *Paying for Privacy and the Personal Data Economy*, 117 COLUM. L. REV. 1369, 1400-28 (2017) (highlighting tensions between a commercial data market and consumer privacy).

¹⁵ See Anthony J. Casey & Anthony Niblett, *Self-Driving Contracts*, 43 J. CORP. L. 1, 13-26 (2017) (arguing that technology will lead to subject-specific, self-completing contract law); Anthony J. Casey & Anthony Niblett, *A Framework for the New Personalization of Law*, U. CHI. L. REV. 333 (2019) (developing preconditions for AI-based reconfiguration of the law); Mark Lemley & Bryan Casey, *Remedies for Robots*, U. CHI. L. REV. 1311 (2019) (conceptualizing a compensation and sanction systems for artificial intelligence); Bryan Casey & Mark Lemley, *You Might Be a Robot*, 105 CORN. L. REV. 18 (2019) (analyzing definitions of AI for the purpose of regulation); Harry Surden, *Machine Learning and Law*, 89 U. WASH. L. REV. 87, 102-10 (2014) (discussing how AI may affect the practice of the law).

¹⁶ See PRIMAVERA DE FILIPPI & AARON WRIGHT, *BLOCKCHAIN AND THE LAW – THE RULE OF CODE* (2018) (acknowledging the opportunities of blockchain technologies and arguing that the law needs to catch up, because blockchain could undermine the capacity of governmental

contracts¹⁷ and mobile internet.

The focus of FinTech and related scholarship has often been on the consumer end of financial services (including Small and Medium Enterprises – “SMEs”) such as new modes of mobile payment,¹⁸ robo advice,¹⁹ initial coin offerings (“ICOs”),²⁰ and crowdfunding (including crowdlending and crowdinvesting).²¹ Earlier scholarship has shown the impact of technology on finance more broadly, with technological change and competition between new entrants and incumbents affecting all aspects of finance today.²² This rising prominence is also reflected in the U.S. Treasury Report on Nonbank Financials, FinTech, and Innovation released in July 2018, which highlighted the interplay of licensed bank incumbents and new innovative lending and

authorities to supervise commercial activities and vital government-provided services); Usha Rodrigues, *Law and the Blockchain*, 104 IOWA L. REV. 679, 708-27 (2019) (analyzing default rules from corporate, partnership and contract law that could fill the gaps in smart contracts); Dirk Zetsche, Ross Buckley & Douglas Arner, *The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain*, 2018 U. ILL. L. REV. 1361, 1382-1402 (arguing that existing doctrines of contract, corporate and partnership law apply to distributed ledgers and could establish a participant’s liability).

¹⁷ Jeremy M. Sklaroff, *Smart Contracts and the Cost of Inflexibility*, 166 U. PA. L. REV. 263 (2017); Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 DUKE L. J. 313 (2017).

¹⁸ See Adam J. Levitin, *Pandora’s Digital Box: The Promise and Perils of Digital Wallets*, 166 U. PA. L. REV. 305 (2017).

¹⁹ See Tom Baker & Benedict G. C. Dellaert, *Regulating Robo Advice Across the Financial Services Industry*, 103 IOWA L. REV. 713 (2018); Megan Ki, *Are Robots Good Fiduciaries? Regulating Robo-Advisors Under the Investment Advisers Act of 1940*, 117 Colum. L. Rev. 1543 (2017); see also U.S. TREASURY, A FINANCIAL SYSTEM THAT CREATES ECONOMIC OPPORTUNITIES: NONBANK FINANCIALS, FINTECH, AND INNOVATION 159-64 (July 2018), <https://home.treasury.gov/sites/default/files/2018-07/A-Financial-System-that-Creates-Economic-Opportunities---Nonbank-Financi....pdf> (proposing to streamline licensing in an effort to allow financial planners’ platform-based financial advice in all U.S. states); INTERNATIONAL ORGANIZATION OF SECURITIES COMMISSIONS (IOSCO), RESEARCH REPORT ON FINANCIAL TECHNOLOGIES (FINTECH) 24-26, 29-36 (FEB. 2017), <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD554.pdf> (discussing regulatory challenges relating to robo-advice).

²⁰ Shaanan Cohn, David A. Hoffman, Jeremy Sklaroff & David Wishnick, *Coin-Operated Capitalism*, 119 COLUM. L. REV. 591 (2019) (describing ICO technology and its limitations); Dirk Zetsche, Ross Buckley, Douglas Arner, Linus Föhr, *The ICO Gold Rush: It’s a Scam, It’s a Bubble, It’s a Super Challenge for Regulators*; 60 HARV. INT’L L. J. 267 (2019); Randolph Robinson, *The New Digital Wild West: Regulating the Explosion of Initial Coin Offerings*, 85 TENN. L. REV. 897 (2018).

²¹ See C. Steven Bradford, *Crowdfunding and the Federal Securities Laws*, 1 COLUMB. L. REV. 1 (2012); Joseph M. Green & John F. Coyle, *Crowdfunding and the Not-So-Safe SAFE*, 102 VA. L. REV. ONL. 168 (2016); Darian M. Ibrahim, *Equity Crowdfunding: A Market for Lemons?*, 100 MINN. L. REV. 561 (2015); Jason W. Parsont, *Crowdfunding: The Real and the Illusory Exemption*, 4 HARV. BUS. L. REV. 281 (2014).

²² Arner et al., *supra* note 13, at 1275.

funding platforms.²³

Yet scholarship on the technological links between the most important financial intermediaries, including credit institutions, investment banks, insurance companies and investment and pension funds is – despite the significance of rapidly emerging transformations – often comparatively overlooked. Scholars have analyzed the impact of regulatory technology (“RegTech”)²⁴ but, with the exception of electronic Know Your Customer (“e-KYC”), digital identity tools,²⁵ and reporting and disclosure systems,²⁶ the literature remains underdeveloped. In particular, existing scholarship is conspicuously silent on the largely hidden “Financial Operating Systems” – or FOS – which underpin entire portions of the financial system and which we examine in detail.

This Article fills that fundamental gap by focusing on the technological core of the global financial system and analyzing examples of FOS that play increasingly critical roles in the \$50 trillion asset management industry. We discuss three central examples: (1) the back-office infrastructure that links the largest asset managers globally (an FOS appropriately named Aladdin); (2) investment platforms that bundle customer liquidity at the consumer-facing, front-end (such as Charles Schwab, Fidelity, J.P. Morgan Chase, Goldman Sachs, and others), which link public investment funds to an ever-increasing portion of investments in global financial markets; and (3) comprehensive financial ecosystems that combine the front-end and back-end of the asset management industry into a single FOS, linking vast numbers of individuals to finance through technology (with China’s massive Alibaba and its group member Ant Financial leading the way, while many U.S. examples follow suit).

²³ See U.S. TREASURY, *supra* note 19, at 81-158 (only pages 159-164 are devoted to wealth management; the link to asset management is not discussed at all). Strangely, the Treasury’s asset management and insurance report does not link the emerging market concentration to technology, see U.S. TREASURY, A FINANCIAL SYSTEM THAT CREATES ECONOMIC OPPORTUNITIES: ASSET MANAGEMENT AND INSURANCE 16-17 (OCT. 2017), https://www.treasury.gov/press-center/press-releases/documents/a-financial-system-that-creates-economic-opportunities-asset_management-insurance.pdf.

²⁴ See Kenneth A. Bamberger, *Technologies of Compliance: Risk and Regulation in a Digital Age*, 88 TEX. L. REV. 669 (2010) (discussing the digitalization of compliance and risk management at an early stage); Lawrence G. Baxter, *Adaptive Financial Regulation and RegTech: A Concept Article on Realistic Protection for Victims of Bank Failures*, 66 DUKE L.J. 567, 572 (2016) (arguing that technology assists banking regulators in updating regulation and keeping up with evolving markets); Douglas Arner, Janos Barberis & Ross Buckley, *FinTech, RegTech and the Reconceptualization of Financial Regulation*, 37 NW. J. INT’L L. & BUS. 371 (2017) (arguing that regulatory technologies will fundamentally change financial services).

²⁵ See Douglas Arner, Dirk Zetsche, Ross Buckley, Janos Barberis, *The Identity Challenge in Finance: From Analogue Identity to Digitized Identification to Digital KYC Utilities*, 19 EUR. BUS. ORG. L. REV. 55 (2019).

²⁶ See U.S. DEP’T OF THE TREASURY, A FINANCIAL SYSTEM THAT CREATES ECONOMIC OPPORTUNITIES: ASSET MANAGEMENT AND INSURANCE 48-50 (OCT. 2017) (demanding that digital recipient addresses should be used for the distribution of fund disclosures to investors).

We focus on asset management and investment funds, in particular, as FinTech scholarship in this massive sector is particularly underdeveloped. Scholars, to date, have largely neglected the intersection of finance, regulation, and technology that is rapidly transforming the global investment fund industry, America's financial system, and society more broadly. This neglect is surprising as the assets held by collective investment schemes today exceed, and are growing more quickly than, those held by the banking sector: total global net assets in regulated open-ended investment funds (mutual funds, primarily) were \$51.4 trillion as of June 30, 2019, an increase of 240 percent since 2008 (\$21.7 trillion).²⁷ In the U.S., the mutual fund market grew from US\$10.2 trillion to US\$21.1 trillion from 2008 to 2018.²⁸ In the same period, U.S. bank assets grew only 60 percent, from roughly \$11 trillion to \$17.5 trillion.²⁹ Thus, although U.S. bank assets exceeded investment funds in 2008, by 2018 the opposite was true. And by year-end 2018, an estimated 101.6 million individual Americans in 57.2 million households (44.8 percent of all U.S. households) owned mutual funds.³⁰ In these investment funds, people manage their life savings, including nest-eggs for retirement, education, real estate, and emergencies. And though banks remain important sources of lending, many of their loans are in fact funded by investment funds, particularly money market and bond funds. The investment industry is also a major provider of payments, competing directly with banks and other payment services.³¹

Although regulation and finance theory often focus on the role of individuals who invest in individual stocks, the reality today is dominated by individuals investing through funds – often passive funds – which are controlled by a small number of investment advisory firms.³² This intersection

²⁷ See M. Szimigiera, *Assets of regulated open-end funds worldwide from 1st quarter 2015 to 2nd quarter 2019 (in trillion U.S. dollars)*, STATISTA (Oct. 4, 2019), <https://www.statista.com/statistics/536902/assets-of-open-end-funds-globally/>.

²⁸ INVESTMENT COMPANY INSTITUTE, *INVESTMENT COMPANY FACTBOOK 2019*, at 2.

²⁹ FRED ECONOMIC DATA ST. LOUIS FED, *TOTAL ASSETS, ALL COMMERCIAL BANKS* (Jan. 1, 2008 through Oct. 31, 2019), <https://fred.stlouisfed.org/series/TLAACBW027SBOG>.

³⁰ INVESTMENT COMPANY INSTITUTE, *INVESTMENT COMPANY FACTBOOK 2019*, at 2.

³¹ Some U.S. money market funds offer access to the investors' fund by ATM, check or bill pay, very similar to more conventional payment systems. See Money Market Fund Reform Proposed Rule, 74 Fed. Reg. at 32,688 ("Commonly offered features, such as check-writing privileges, exchange privileges, and near-immediate liquidity, have contributed to the popularity of money market funds."); William A. Birdthistle, *Breaking Bucks in Money Market Funds*, 2010 WISC. L. REV. 1155, 1161 (stating that "money market funds look and feel a great deal more like bank savings accounts than the mutual funds they are.").

³² See John C. Coates, *The Future of Corporate Governance Part I: The Problem of Twelve 2*, Harvard Public Law Working Paper No. 19-07 (2018) (arguing that control of most public companies will soon be concentrated in the hands of a very small number of people, *i.e.* large management companies); Lucian Bebchuck & Scott Hirst, *The Specter of the Giant Three*, 99

of mass passive investment and technology, in particular in the context of FOS, is underpinning the transformation of the U.S. and global asset management industries. This Article is the first to focus on the technology (rather than the more popular topic of investor appetite), and reveals technology to be the most important driver of growth in the investment-fund – and indeed every – financial industry today. In addition, we analyze how best to regulate these emerging financial operating systems.

The Article is organized as follows. In Part I, we define Financial Operating Systems and describe the rise and magnitude of the most prominent FOS. We draw on three examples from the investment fund industry relating to back-end (risk and back-office management), front-end (investment platforms), and combined front- and back-end financial ecosystems. We show that essential functions for investment funds are increasingly aggregated and performed by FOS. We then analyze the respective financial dimensions involved in this phenomenon and differentiate FOS from other forms of technological evolution in finance.

In Part II, we show that FOS possess the characteristics of a platform industry (demonstrating network effects and economies of scope and scale), and predict that a small number – or perhaps even only one – FOS is likely to become dominant in any given sector, integrating more and more functions of financial intermediation along the way.

In Part III, we argue that FOS currently escape meaningful regulation, triggering important critical risks. By scrutinizing national security, consumer protection, antitrust, systemic risk and conflicts of law perspectives, we find traditional securities regulation – with its focus on disclosure, intermediaries, and distribution – to be ill-equipped to deal with FOS.

In Part IV, we evaluate possible alternative regulatory approaches, which range from adopting a wait-and-see approach (with or without pro-innovative tools such as regulatory sandboxes and special charters) to a strong interventionist approach that would treat FOS as utilities (and thus possibly even trigger nationalization). Between those extremes lie regulatory efforts that could enhance competition and moderate interventions through indirect regulation by targeting delegation arrangements and involving a public agency in the partial or full ownership of each FOS. The optimal approach likely depends on the stage of evolution of the FOS: the stronger the position of a FOS in any given financial services market, the stronger the case for an interventionist approach.

Part V concludes.

I. THE RISE OF FINANCIAL OPERATING SYSTEMS

B.U. L. REV. 721 (2019) (arguing that the three largest index fund managers – BlackRock, Vanguard, and State Street Global Advisors – will continue to grow).

We begin with a history and analysis of the rise of Financial Operating Systems. Drawing on three examples – from back-end, front-end, and full ecosystem services – we show that the crucial functions related to investment funds (including fund distribution, risk analysis, portfolio composition, and custody) are already being performed by FOS, and we delineate the respective financial dimensions and differences between FOS and other, existing types of FinTech. Following this structural exegesis of FOS, we examine BlackRock’s operating system, Aladdin, and discuss a number of front-end systems that have evolved in the U.S. and internationally. We then explain the evolution of the Alibaba and Ant Financial ecosystem, which covers both the front and back end of finance, before we examine a variety of other FOS from different parts of the investment value chain.

A. Features of Financial Operating Systems

Before engaging in our full account of specific examples, *infra* at I.B. to I.E., we begin with a theoretical conceptualization of Financial Operating Systems, which first requires a definition and then a delineation from “traditional” FinTechs and existing capital market infrastructure.

1. Definition

Financial Operating Systems are multilateral IT systems that connect a network of participating institutions to one another and to the operator of each system for the purpose of conducting financial transactions. Each FOS facilitates or executes decisions with regard to financial transactions taken by third parties (*e.g.*, the payer, the investor, the broker, etc.). Today, an FOS is a core feature of any form of financial market infrastructure (such as payment systems, securities exchanges, or title registries). In this sense, FOS may themselves be “financial market infrastructure,” but are not necessarily so.³³ For instance, robo advisors may form part of an FOS but will run on an FOS,³⁴ as FOS are technologically required for robo advisors to function. We will return to this permutation in the context of our discussion of major examples below.

³³ See BIS (2012), *supra* note 12, at 7 (defining Financial Market Infrastructure as a “multilateral system among participating institutions, including the operator of the system, used for the purposes of clearing, settling, or recording payments, securities, derivatives, or other financial transactions.”).

³⁴ This qualification is a crucial difference between our FOS definition and Haberly, et al.’s Digital Asset Management Platforms, *see* Daniel Haberly, Duncan MacDonald-Korth, Michael Urban & Dariusz Wójcik, *Asset Management as a Digital Platform Industry: A Global Network Perspective*, 106 GEOFORUM 167 (2019).

FOS can take various legal and organizational forms.³⁵ Examples include bank or non-bank service entities (where all linked intermediaries are contracting partners to the service entity)³⁶ or mutual associations, typically of financial institutions.³⁷ The FOS can be owned and operated by one private entity where the entity is in sole³⁸ or dispersed ownership,³⁹ or mutualized, with the users as members;⁴⁰ we also see public entities (such as central banks⁴¹) running systemically important FOS (*e.g.*, real-time gross settlement (RTGS) payment systems).

2. Delineation

At the core of this FOS definition is multilateralism; that is, the FOS connects multiple users. This networked feature is also true of traditional FinTechs, but they are more typically start-up companies focusing on transformation of consumer finance through technology.

We believe FOS possess three critical differences from traditional FinTechs. First, although most FinTech scholarship to date focuses on applications linking retail and SME clients to FinTech firms,⁴² FOS are principally a form of financial market infrastructure⁴³ that links multiple financial intermediaries together. Examples of financial market infrastructure include the Federal Reserve's NSS,⁴⁴ SWIFT, and Visa, which link banks executing payment transactions from payer to payee, and may include a link to

³⁵ See BIS (2012), *supra* note 12, at 7 (detailing variety on financial market infrastructure).

³⁶ Visa is structured as a bank while SWIFT is not.

³⁷ The stock exchanges as constituted until recent decades were the standard example.

³⁸ For example, the NYSE today, with the trading conglomerate Intercontinental Exchange as sole owner.

³⁹ For example, Nasdaq, Inc., Euronext S.A.

⁴⁰ For example, the user-owned Depository Trust & Clearing Corporation (DTCC), located in New York City, the world's largest financial value processor.

⁴¹ For example, the U.S. Federal Reserve currently functions as operator of the National Settlement Service (NSS), the Fedwire® Funds Service as well as, together with the Electronic Payments Network (EPN), the Automated Clearing House (ACH) system, through which depository institutions send each other batches of electronic credit and debit transfers. The Federal Reserve committed to develop and operate the FedNow Service, a real-time payment and settlement service starting operations in 2023; see *Federal Reserve Announces Plan to Develop a New Round-the-Clock Real-Time Payment and Settlement Service to Support Faster Payments*, Board of Governors of the Federal Reserve System (Aug. 5, 2019), <https://www.federalreserve.gov/newsevents/pressreleases/other20190805a.htm>. Other examples include the ECB's payment-vs-delivery system Target-2-Securities and the Bank of England's CHAST system.

⁴² See *supra* note 13 to 26 and accompanying text.

⁴³ For a delineation of these classical capital market infrastructure and FOS discussed herein see next section I.A.3.

⁴⁴ See *supra* note 40.

the central bank to ensure liquidity. NASDAQ's systems, similarly, link brokerage firms with traded securities and their central clearing houses. The DTCC⁴⁵ in the U.S. or Target-2-Securities⁴⁶ in the European Union ensure that the transfer of securities and derivatives can occur among local and global custodians and central securities depositories. Bloomberg and Refinitiv link professional participants with data and markets in order to permit seamless execution of transactions, similar to rating agencies operating an information network that links active traders with the rating agency's rating reports. A blockchain system could be conceived of as both a currency or another form of FOS; for instance, the "utility settlement coin" of FNLITY⁴⁷ or the Facebook led "Libra," which comprises a cryptocurrency, electronic payment system, and framework of digital identity⁴⁸ systems.⁴⁹

Second, in an effort to disintermediate, FinTech often takes the form of a marketplace, brokering various services and goods. These transaction platforms are certainly the most high-profile tech businesses.⁵⁰ FOS, by contrast, function as *innovation* platforms. According to Peter Evans and Annabelle Gawer, "[an] innovation platform is a technology, product or service that serves as a foundation on top of which other firms (loosely organized into an innovative ecosystem) develop complementary technologies, products or services."⁵¹ In the non-financial sector, Microsoft, SAP, Oracle, and Intel offer the core innovation platforms, as does the Apple IOS. In a similar vein, FOS "establish a core package of tools and standards that serve as a foundation for third-party software or content,"⁵² where content can include data of all kinds and data-analytic tools, as well as contracting, execution, and settlement systems.

Third, most FinTechs and other platforms are structured as corporations, since they provide their transaction platform as a service to others, and seek to capitalize by charging fees of some kind (though there are also a range of open-

⁴⁵ See *supra* note 41.

⁴⁶ See *supra* note 41.

⁴⁷ See Paul Vigna, *UBS-Led Group to Launch Blockchain-Based Trade-Settlement Platform*, WALL STREET JOURNAL (Jun. 3, 2019), available at <https://www.wsj.com/articles/ubs-led-group-to-launch-blockchain-based-trade-settlement-platform-11559554201>.

⁴⁸ See Zetsche et al., *supra* note 4, at __.

⁴⁹ See George S. Geis, *Traceable Shares and Corporate Law*, 113 NW. U. L. REV. 227 (2018); Federico Panisi, Ross Buckley & Douglas Arner, *Blockchain and Public Companies: A Revolution in Share Ownership Transparency, Proxy-Voting and Corporate Governance*, 2 STANF. J. BLOCKCHAIN L. & POL'Y 2019.

⁵⁰ See Peter C. Evans & Annabelle Gawer, *The Rise of the Platform Enterprise: Global Survey* 14 (Jan 2016), https://www.thege.net/app/uploads/2016/01/PDF-WEB-Platform-Survey_01_12.pdf (stating that of 176 platform firms that were surveyed in 2016 globally 160 platforms were transaction platforms).

⁵¹ See *id.*, at 9.

⁵² See Haberly et al, *supra* note 34, at 169-170.

source models embedded in foundations or non-profit entities). FOS, by contrast, take different organizational forms, depending on whether cooperation is necessary or the service can be operated by a single firm.

3. *FOS vs. Financial Market Infrastructure*

FOS and other providers of financial market infrastructure (“FMI”), as defined by the Bank of International Settlement,⁵³ are related but different. Centralized FMI systems have existed for some time, and examples include the payment system run by America’s central bank, National Settlement Service⁵⁴; stock exchange electronic trading systems; and the electronic information exchange and messaging system, SWIFT, which connects more than 11,000 financial institutions around the world⁵⁵; as well as the U.S. central clearing and settlement platform, DTCC,⁵⁶ and the European Central Bank’s Target-2-Securities. All these examples provide crucial functions for their segment of the global financial system, with many other intermediaries and services depending on and linked to their services.

FOS are a form of FMI, yet FMI, in their classic incarnation, differ from our focus: existing FMIs are too narrow, too mechanical, and too limited in scope to serve the function of fully fledged “operating systems.” In particular, FMIs’ focus has been to make markets and processes more efficient and secure by targeting pain points – on trust and transaction costs – within the financial system, while generally avoiding direct contact with the retail client base. FOS, by contrast, aim to provide an entire ecosystem with multiple services between clients and regulated intermediaries, either directly (where the client becomes a FOS client) or indirectly, where the FOS serves the intermediary so that the intermediary can offer better products less expensively. To extend the computer metaphor, FMI have largely been applications rather than integrative operating systems. As FOS continue to evolve, it will be important to understand the level of foundational complexity introduced by FOS compared to traditional FMIs.

B. FOS at the Back-End: Aladdin

To date, Blackrock’s Aladdin is the Financial Operating System with by far the greatest impact on asset managers in the U.S. and around the world.

⁵³ See BIS, *supra* note 12.

⁵⁴ See https://www.federalreserve.gov/paymentsystems/natl_about.htm.

⁵⁵ See <https://www.swift.com/>.

⁵⁶ See www.dtcc.com.

1. Aladdin's Activities

Aladdin is a FOS that provides tools that allow asset managers to “communicate effectively, address problems quickly, and make informed decisions at every step of the investment process.”⁵⁷ BlackRock started to develop Aladdin, called “one of the earliest FinTechs,”⁵⁸ for its own portfolio and risk management, investment processes, and trade execution in 1993. From there, Aladdin moved into automatic position-keeping, record-keeping, and the control of risk exposure.⁵⁹ In 1994, BlackRock was engaged to price and manage General Electric’s complex bond portfolio, and integrated a broker-dealer system into Aladdin, allowing for automatic portfolio rebalancing by the mid-1990s.⁶⁰ Aladdin’s capabilities became known to the world during the financial crisis of 2008, when governments globally struggled to evaluate the risk exposure underlying the portfolios of global investment banks. By excluding the investment banks themselves, due to their obvious conflicts, and by using the reach of Aladdin’s data and analytical tools, BlackRock was able to execute the multi-billion-dollar refinancing deals that kept the U.S. financial system from collapsing,⁶¹ turning BlackRock into “the leading manager of Washington’s bailout of Wall Street.”⁶²

The platform has expanded since into risk analysis and other parts of the investment process, and evolved into an end-to-end investment platform that, according to BlackRock, “combines sophisticated risk analytics with comprehensive portfolio management, trading and operations tools on a single platform to power informed decision-making, effective risk management, efficient trading and operational scale.”⁶³ Today, serving clients that range from private to institutional funds, “Aladdin is an operating system for investment managers that seeks to connect the information, people and technology needed to manage money in real time.”⁶⁴

⁵⁷ See Aladdin® Platform Overview - Highlights, BLACK ROCK <https://www.BlackRock.com/aladdin/offerings/aladdin-overview>. See also “The Monolith and the Markets”, *The Economist*, Dec 7, 2013.

⁵⁸ See Will Dunn, *Meet Aladdin, The Computer “more powerful than traditional politics,”* THE NEW STATESMAN (Apr. 6, 2018), <https://www.newstatesman.com/spotlight/2018/04/meet-aladdin-computer-more-powerful-traditional-politics> (citing Jody Kochansky, BlackRock’s managing director and head of the Aladdin Product Group, a division of BlackRock).

⁵⁹ See Dunn, *supra* note 58.

⁶⁰ See Dunn, *supra* note 58 (citing Jody Kochansky, BlackRock’s managing director and head of the Aladdin Product Group, a division of BlackRock).

⁶¹ *Ibid.*

⁶² See Suzanna Andrews, *Larry Fink’s \$12 Trillion Shadow*, VANITY FAIR (Mar. 2, 2010), <https://www.vanityfair.com/news/2010/04/fink-201004>.

⁶³ See Aladdin® Platform Overview, *supra* note 57.

⁶⁴ See Aladdin® Platform Overview, *supra* note 57.

2. The Power and Reach of Aladdin

Aladdin is a hosted service: the technical infrastructure, system administration, and interfacing with data providers and industry utilities are operated by BlackRock's IT and technical staff of more than 600, who focus on creating data and analyses for clients.⁶⁵

The scale of Aladdin is undeniably impressive, inspiring descriptions like “the Android of Finance”⁶⁶ or “Amazon of Wall Street.”⁶⁷ More than \$20 trillion in assets, around ten per cent of the world's financial assets, depend on Aladdin's services – this figure is equal to four times the value of all cash in the world,⁶⁸ the annual GDP of the U.S., or the total U.S. stock market capitalization.⁶⁹ Approximately 25,000 investment professionals globally – 13,000 from BlackRock and 12,000 from BlackRock's clients – rely on Aladdin. More than 1,000 internal and external developers work continuously on the ongoing development of the FOS.⁷⁰ Overall, Aladdin hosts the portfolios of 210 institutions worldwide, including some of the largest asset owners (*e.g.*, California State Teachers' Retirement System (CalSTRS)) and competitors including Schroders and Vanguard.⁷¹

Aladdin had its origin in risk management, and in that arena it remains particularly effective. It became a powerful tool through its early introduction of Monte Carlo simulations, which replicate the unpredictability of the real world within a deterministic order of mathematics, by using random numbers rather than data reflecting past events, which produces more comprehensive and more granular risk reports than other organizations could provide.⁷² Today, in its risk management capacity, Aladdin monitors more than 2,000 “risk factors each day – from interest rates to currencies – and performs 5,000 portfolio stress tests and 180 million option-adjusted calculations each week.”⁷³

⁶⁵ See Aladdin® Platform Overview, *supra* note 57.

⁶⁶ Erik Schatzker, *Larry Fink Q&A: “I don't identify as powerful”*, BLOOMBERG (18 April 2017), <https://www.bloomberg.com/features/2017-BlackRock-larry-fink-interview/>.

⁶⁷ Antoine Gara, *BlackRock's Edge: Why Technology Is Creating the Amazon of Wall Street*, FORBES (Dec. 26, 2017), <https://www.forbes.com/sites/antoinegara/2017/12/19/BlackRocks-edge-why-technology-is-creating-a-6-trillion-amazon-of-wall-street/>.

⁶⁸ See Dunn, *supra* note 58.

⁶⁹ See Haberly et al, *supra* note 34, at 176-180.

⁷⁰ See Aladdin® Platform Overview, *supra* note 57.

⁷¹ See Amy Whyte, *Can Anyone Bury Aladdin*, INST. INVESTOR (Oct. 1, 2018), <https://www.institutionalinvestor.com/article/b1b672fxtfp11/Can-Anyone-Bury-BlackRock>.

⁷² See Dunn, *supra* note 58.

⁷³ See Benefits for Risk Managers, BLACK ROCK, <https://www.BlackRock.com/aladdin/benefits/risk-managers>.

3. Aladdin's Advantage: Data Control

Aladdin's greatest competitive advantage is its control over financial data. Insights from other network and data economies demonstrate that ownership of data produces economies of scale: the more data Aladdin can collect and analyze, the better the services Aladdin can provide to the portfolios of BlackRock and its clients. This data-driven scale inheres in the network effects and scale economics embedded in software generally, where the costs of all design, development, and coding are borne by the first version, while all subsequent copies can be produced at practically zero further cost.⁷⁴

4. Aladdin's Competitors

Aladdin is not short of competitors, though most are unknown to the millions of retail investors who rely upon their services. Copenhagen-based SimCorp established its Dimension platform as a challenger, claiming that Dimension would compete with Aladdin on a global basis.⁷⁵ Other providers of risk data modelling include MSCI Barra, Bloomberg, and Refinitiv.⁷⁶ When Refinitiv was recently acquired by the London Stock Exchange ("LSE"), the LSE's CEO justified this \$27 billion acquisition by stressing – consistent with our analysis – that “data capabilities will define the success of financial market infrastructure business.”⁷⁷ J.P. Morgan Chase is also now licensing its trading and investment analytics platform Athena to third parties.⁷⁸ We understand this move as an effort to capitalize on the trading and investment data created by clients of J.P. Morgan Chase's \$25 trillion custody business – and to defend their clients at the same time against data-only competitors.

C. FOS at the Front-End: Investment Platforms

If Aladdin is fundamentally about integrating active asset managers, data, analytics, and market infrastructure in order to enhance efficiency and performance, investment platforms are fundamentally about building an underlying operating system to link individual investors to information and

⁷⁴ See Michael L. Katz & Carl Shapiro, *Antitrust in Software Markets* ___, in COMPETITION, INNOVATION AND THE MICROSOFT MONOPOLY: ANTITRUST IN THE DIGITAL MARKETPLACE (Jeffrey A. Eisenbach and Thomas M. Lenard, eds.) (1999); Richard A. Posner, *Antitrust in the New Economy* 3 (John M. Olin Program in Law and Economics Working Paper No. 106, 2000).

⁷⁵ See Whyte, *supra* note 71.

⁷⁶ See (citing Aladdin's Jody Kochansky who mentions MSCI Barra and Bloomberg as risk model providers that may have “still greater influence” than Aladdin.).

⁷⁷ See Philip Stafford, *LSE needs to Beat Bloomberg at its Own Game*, FINANCIAL TIMES, Aug. 19, 2019.

⁷⁸ See CNBC, *J.P. Morgan Sells Trading Software to Custody and Fund Services Clients*

products. The products are typically investment funds – increasingly passive investment funds – such as the ever-growing universe of exchange-traded funds (“ETFs”), which hold \$4.6 trillion⁷⁹ in U.S. and international markets.

1. Incumbent Investment Platforms

While Aladdin functions at the back-end of the investment process, in recent years a number of FOS have emerged with a focus upon the front-end, including large incumbents gaining massively in scale and size. This growth is particularly true in the fund industry, where major fund distribution platforms have expanded.⁸⁰ For instance, fund management giant Fidelity provides its clients an investment platform through which they can steer their investment streams, analyze their portfolios, and access advisory services by Fidelity, including receiving a “retirement score in 60 seconds.”⁸¹ Another fund management giant, Vanguard, provides a system for accessing Vanguard’s universe of passive funds as well as the firm’s robo advisory services. Services for professional investors include the creation and evaluation of client portfolios, a product comparison with Vanguard and non-Vanguard products, as well as the provision of a model portfolio – in short, robo advisory services.⁸² Similar front-end FOS are being developed by broker-dealers including Charles Schwab, whose FOS provides access to Schwab’s and others’ financial products, advisory services and analytical tools, and particularly stresses the fact that it charges “\$0 commissions on online stock, ETF, and options trade” and has “2,000+ commission-free ETFs and 4,000+ no-load, no-transaction-fee mutual funds,” aimed at cost-sensitive clients.⁸³ With a possible merger pending between Schwab and TD Ameritrade, their joint FOS promises to expand its reach over retail users and assets dramatically.

J.P. Morgan Chase has acquired a number of innovative investment firms,⁸⁴ combining them with its own operations to form the new platform, You

⁷⁹ See M. Szmigiera, *Worldwide ETF Assets Under Management 2003-2018*, STATISTA, Jul. 22, 2019.

⁸⁰ On the emerging trend to fund distribution platforms see IOSCO, Research Report on Financial Technologies (FinTech), Feb. 2017, online <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD554.pdf>, p. 22, 25, 68 (discussing fund distribution platforms).

⁸¹ <https://www.fidelity.com/>.

⁸² <https://advisors.vanguard.com/advisors-home>.

⁸³ https://www.schwab.com/public/schwab/investing/why_choose_schwab/compare_us.

⁸⁴ The You Invest formation came on top of a number of start-up acquisitions in the payment sector that serve to strengthen J.P. Morgan’s technology core, including InstMed, a solutions provider for health care related payments for more than \$500 million in June 2019 and, in an effort to improve services for its 4 million small business clients, WePay, a competitor to PayPal and Stripe, for approximately \$220 million in 2017.

Invest.⁸⁵ The services, again, include financial products, advice, and analysis. As a bank, J.P. Morgan can expand its FOS to be a full financial supermarket for consumers, covering deposit, lending, payment, investment, trading, and insurance. It also provides access to J.P. Morgan's lending and asset management operations to support the firm's business clients.⁸⁶

Another U.S. firm particularly active in creating FOS on the front end is Goldman Sachs. Goldman used the online deposit platform, bank license, customers and \$16 billion deposits of its 2016 acquisition of GE Capital Bank to create its digital platform, Marcus.⁸⁷ And by way of "acqui-hire," it added a small business lending P2P team from Bond Street Marketplace in 2017; the consumer FinTech team from credit card startup, Final, in January 2018; and claritymoney with its personal financial management tool as a mobile storefront and one million customers for \$100 million in April 2018.⁸⁸

In addition, Goldman acquired the wealth platform United Capital for \$750 million, completing the cornerstones of a digital platform. Although the United Capital acquisition may seem unrelated to Marcus,⁸⁹ Goldman's May 2019 press release reveals an intention to build a FOS: "United Capital will enhance Goldman Sachs' ability to cover a broad range of clients in Ayco's growing corporate client base with financial planning solutions through an advisor-led, tech-enabled platform with considerable sale and geographic footprint. These efforts will complement the digitally empowered consumer platform for individuals from Marcus by Goldman Sachs, and will ultimately provide a full-range of services across the wealth spectrum."⁹⁰

Fidelity and Vanguard are, at their core, investment advisers (*i.e.*, managers of mutual funds), Charles Schwab is originally a broker-dealer, J.P. Morgan a bank, and Goldman Sachs – until 2008 – an investment bank. Notwithstanding these entirely different core functions, evolutionary trajectories, and regulatory regimes, the FOS of all five look remarkably similar. We will discuss this

⁸⁵ <https://www.chase.com/personal/investments/you-invest>.

⁸⁶ <https://www.chase.com/personal/investments/you-invest>, sub 'We're here to help you manage your money today and tomorrow'.

⁸⁷ See <https://www.marcus.com/us/en>.

⁸⁸ See Peter Rudegeair & Liz Hoffman, *Goldman Nabs FinTech Group in Push to Boost Online Lending*, WALL STREET J. (Sept. 13, 2017 5:11pm ET), <https://www.wsj.com/articles/goldman-nabs-FinTech-group-in-push-to-boost-online-lending-1505337060>; Luisa Beltran, *Goldman closes buy of Clarity Money*, PE HUB (Apr. 15, 2018), <https://www.pehub.com/2018/04/goldman-closes-buy-clarity-money/>.

⁸⁹ Reuters, *Goldman Sachs to buy wealth manager United Capital for \$750 million*, REUTERS (May 16, 2019 3:11 PM), <https://www.reuters.com/article/us-unitedcapitalfinancial-m-a-goldmansac/goldman-sachs-to-buy-wealth-manager-united-capital-for-750-million-idUSKCN1SM1IH>.

⁹⁰ Goldman Sachs, Press Release Goldman Sachs Announces Acquisition of United Capital, GOLDMAN SACHS (May 16, 2019), <https://www.goldmansachs.com/media-relations/press-releases/current/announcement-16-may-2019.html>.

important convergence in further detail below.⁹¹

2. The Size and Growth of Fund Management

The sheer size and growth of Charles Schwab, Fidelity, and Vanguard are impressive indeed, particularly relative to other parts of the economy: Vanguard's assets under management have skyrocketed to \$6.7 trillion today from \$1.6 trillion as of December 31, 2013 – a hefty 420 percent increase⁹² – with \$3 trillion of that growth due to flows into passive index funds.⁹³ In the five-year period from December 31, 2013, to December 31, 2018, Fidelity generated 400 percent growth (from \$1.3 trillion to \$5.2 trillion).⁹⁴ Though smaller, Schwab's 164 percent increase in assets under management within five years (from \$2.3 trillion to \$3.7 trillion)⁹⁵ is still quite remarkable. Schwab's recent TD Ameritrade acquisition will add another 11 million customers and \$1 trillion in assets, resulting in total assets of \$4.7 trillion (and growth of 205 percent).⁹⁶ Together, Schwab/TD Ameritrade will serve a total of 26 million customers (up 236 percent from 5 years earlier), Vanguard 30 million customers, and Fidelity 20 million customers.⁹⁷

These numbers have prompted concerns about undue concentration of equities in the hands of such a small number of institutional investors.⁹⁸ These

⁹¹ See *infra*, Section III.

⁹² See Jonathan Williams, *AUM growth at 10 largest fund managers outstrips sector – Top 400*, IPE.COM (Jun. 10, 2013), <https://www.ipe.com/top-400/aum-growth-at-10-largest-fund-managers-outstrips-sector-top-400/53219.article> (showing data for 2013) and Vanguard, *Who we are*, VANGUARD (Dec. 31, 2018), <https://about.vanguard.com/who-we-are/fast-facts/>.

⁹³ Landon Thomas Jr., *Vanguard is Growing Faster Than Everybody Else Combined*, NEW YORK TIMES (Apr. 17, 2017 12:12 PM), <https://www.cnbc.com/2017/04/16/vanguard-is-growing-faster-than-everybody-else-combined.html>.

⁹⁴ See IPE, *supra* note 92, and Fidelity, <https://www.fidelity.com/about-fidelity/fidelity-by-numbers/overview> (Dec. 31, 2018).

⁹⁵ See Charles Schwab, *Press Release Schwab Reports Fourth Quarter Net Income Up 51% Year-Over-Year*, CHARLES SCHWAB (Jan. 16, 2014), <https://pressroom.abouschwab.com/press-release/corporate-and-financial-news/schwab-reports-fourth-quarter-net-income-51-year-over-year> (detailing figures per Dec. 31, 2013); Charles Schwab, *Press Release Schwab Reports Net Income of \$937 Million, Up 8%, Posting the Strongest Second Quarter in Company History*, CHARLES SCHWAB (Jul. 16, 2019), <https://pressroom.abouschwab.com/press-release/corporate-and-financial-news/schwab-reports-net-income-937-million-8-posting-strongest> (detailing figures per Jun. 30, 2019).

⁹⁶ See TD Ameritrade, *About TD Ameritrade*, TD AMERITRADE, <https://www.tdameritrade.com/about-us.page>.

⁹⁷ See *supra*, notes 92, 94 and 95.

⁹⁸ See *supra* note 32 (from a corporate governance perspective). See also, from a market stability perspective, INTERNATIONAL MONETARY FUND, *GLOBAL FINANCIAL STABILITY REPORT: NAVIGATING MONETARY POLICY CHALLENGES AND MANAGING RISKS* (Apr. 2015),

concerns reflect the cost sensitivity of investors as a major cause of this exceptional concentration, yet fail to analyze why Vanguard and others are able to offer such funds at very competitive terms. We argue that the effectiveness of their underlying FOS explains much of the success of these entities.

3. The Investment Platform Advantage: Liquidity Control

Though driven by a desire to monopolize critical data, the major advantage of investment platforms stems from their aggregation of liquidity: that is, they essentially control the flow of their clients' money. Clients are attracted by the prospect of low fees for transactions and advice, and willingly relinquish control over their asset streams to the platform providers, which then control the liquidity to negotiate advantageous contract terms with custodians, other advisers, broker-dealers, and stock exchanges. The main threat investment platforms employ – to ensure optimal terms for themselves and their clients – is not necessarily the threat of defection to a different service provider; rather with sufficient clients on the platform, the platform provider itself can offer custodial, advisory, broker-dealer, and even exchange services. The true value, hence, is their clients' bundled spending power that can be employed either to extract better terms from counterparties or to assume the counterparty's functions if the counterparty does not give in to the investment platform's pressure. In this way, investment platforms squeeze the profit margins out of the back-end of the investment chain, and counter the threat of getting squeezed and automated away by the back-end FOS gradually approaching their clients by integrating ever more front-end institutions. For this strategy to succeed, client numbers and asset streams on the front-end are crucial, which explains the universal race for client numbers and asset size.

D. Front-to-Back FOS: Financial Ecosystems

While Aladdin's strength lies in data control, and investment platforms aggregate data, investments, and liquidity control, some FOS – which we call financial ecosystems – benefit from the control of *both* data and liquidity via the provision of comprehensive front-to-back financial services. That is, they cover the full value chain of asset management, from customers' payment and custodial accounts to broker-dealer, advisory and exchange services. While many incumbents such as BlackRock and Goldman Sachs are seeking to pursue this strategy (*see infra*, at E.3.), the big platform technology firms (“BigTechs”)

<https://www.imf.org/en/Publications/GFSR/Issues/2016/12/31/Navigating-Monetary-Policy-Challenges-and-Managing-Risks>; Sophie Steins Bisschop, Martijn Boermans & Jon Frost, *European bond markets: Do illiquidity and concentration aggravate price shocks?*, 141 ECON. LETTERS 141, 143 (2016).

are leading the way, particularly China's Ant Financial.

1. The Ant Ecosystem

Though it is almost unknown in Europe and the United States, the most impressive financial ecosystem has been created by Ant Financial, the financial arm of the Chinese BigTech, Alibaba.⁹⁹ Developed originally as a support function for e-commerce in an emerging environment, Ant Financial today comprises a payment system, a custody function for its clients, robo advisory and asset management services, and credit, investment, and insurance products of its own and other firms.¹⁰⁰ A particularly interesting service within the Ant ecosystem is the money market mutual fund Yu'e Bao, which at its largest reached \$250 billion in assets from 600 million clients, making it by far the world's largest money market fund, at the time outdistancing the second-largest fund of this kind by a margin of \$100 billion.¹⁰¹ Most recently, Ant has entered into a joint venture with Vanguard to combine Vanguard's investment platform and passive investment fund ecosystem with the Ant / Alibaba ecosystem.¹⁰² Ant has also become one of the largest providers of both consumer and SME lending in China.¹⁰³

Ant's objective is to provide a comprehensive ecosystem that allows customers to buy whatever they want through e-commerce platforms and physical and virtual merchants throughout the world via Alipay, which now has more than 700 million Chinese active users.¹⁰⁴ Those individuals and firms

⁹⁹ See on Ant Financial's role in finance FINANCIAL STABILITY BOARD ("FSB"), BIGTECH IN FINANCE - MARKET DEVELOPMENTS AND POTENTIAL FINANCIAL STABILITY IMPLICATIONS 4-11 (Dec. 9, 2019), <https://www.fsb.org/wp-content/uploads/P091219-1.pdf>; Jon Frost, Leonardo Gambacorta, Yi Huang, Hyun Song Shin & Pablo Zbinden, *BigTech and the changing structure of financial intermediation* 7-10 (BIS Working Paper 779/2019), <https://www.bis.org/publ/work779.pdf> (detailing the impact of Ant Financial on the Chinese credit market).

¹⁰⁰ *Ibid.*

¹⁰¹ See Bloomberg News, *World's No. 1 Money Market Fund Shrinks By \$120 Billion*, BLOOMBERG (Sept. 6, 2019), <https://www.bloomberg.com/news/articles/2019-09-05/world-s-no-1-money-market-fund-shrinks-by-120-billion-in-china>.

¹⁰² See Reuters, *China's Ant Financial, Vanguard form Shanghai-based venture: government records*, REUTERS (Jun. 10, 2019), <https://www.reuters.com/article/us-vanguard-china/chinas-ant-financial-vanguard-form-shanghai-based-venture-government-records-idUSKCN1TB178>.

¹⁰³ See Stella Yifan Xie, *A \$7 Credit Limit: Jack Ma's Ant Lures Hundreds of Millions of Borrowers*, WALL STREET J. (Dec. 8, 2019), <https://www.wsj.com/articles/a-7-credit-limit-jack-mas-ant-lures-hundreds-of-millions-of-borrowers-11575811989> (stating that Ant's "mega microlending business has ballooned by offering tiny loans" of up to \$7, turning Ant "into one of China's largest providers of personal credit lines.").

¹⁰⁴ See China Daily, *China's Alipay now has over 900m users worldwide*, CHINA DAILY (Nov. 30, 2018), <http://www.chinadaily.com.cn/a/201811/30/WS5c00a1d3a310eff30328c073.html>.

can, in turn, use the funds in Ant's Alipay system for other payments or investment, earning attractive returns through money market funds, an increasing range of ETFs, and other investment products including insurance.

Ant funds itself through fees, sales of data, and borrowing in China's Interbank Bond Market, China's electronic bond and money market platform, and a back-end FOS operated by China's central bank, the People's Bank of China. It then lends to individuals to help them buy products through Alibaba and other vendors while also providing credit to businesses to enable them to expand their operations, income, and profits. Ant in turn securitizes those loans, and is one of the largest issuers of asset-backed securities in China, which it in turn sells to investors in the Interbank Bond Market. Ant also now sells insurance, including a new mutual form that gained fifty million customers in less than a year. The funds paid in premia are of course invested via its platform to generate investment returns to support payouts. The Alibaba / Ant Financial ecosystem thus covers all aspects of finance – Ant calls it “Digital Life” – from hundreds of millions of individuals and firms through its platform FOS, integrating directly with third-company providers and funding commercial borrowers both directly and through the capital markets.

2. Size and Scope of Ant Financial

Ant Financial is anything but a financial ant – it is the highest valued FinTech company in the world, and the world's most valuable unicorn. With a recent valuation of \$150 billion, Ant Financial is fifty percent more valuable than Goldman Sachs, which is valued at “only” \$99 billion.¹⁰⁵ In 2018, the firm raised \$14 billion in venture capital financing, or 36 percent of all VC funding worldwide that year. Ant Financial alone raised more money than all US FinTech companies combined.¹⁰⁶ Alipay, its payments services, had more than 1.2 billion active users worldwide as of June 30, 2019 and a share in the Chinese payments market of 54.2%, executing more than \$16 trillion in transactions, an amount that exceeds China's annual GDP.¹⁰⁷

The power of Ant Financial extends beyond payments. It “also owns and operates an open insurance marketplace with over 80 insurance companies on

¹⁰⁵ See Anais Concepcion, *How Ant Financial Became the Largest FinTech in the World*, APPLICO (Mar. 4, 2018), <https://www.applicoinc.com/blog/ant-financial-services-platform-largest-FinTech-in-world/>.

¹⁰⁶ Reuters, *FinTech companies raised a record \$39.6 billion in 2018*, REUTERS (Jan. 19, 2019), <https://www.reuters.com/article/us-fintech-funding/fintech-companies-raised-a-record-396-billion-in-2018-research-idUSKCN1PN0EL>.

¹⁰⁷ See Xinhua, *supra* note 10; CBNEDITOR, *Q2 Mobile Payments Transaction Volume in China Rises 22.6% YoY: iResearch Report*, CHINA BANK. NEWS (2019), <http://www.chinabankingnews.com/2019/10/17/q2-mobile-payments-transaction-volume-in-china-rises-22-6-yoy-iresearch-report/>; own calculations.

the platform that reaches over 400 million users.... All of China's 116 mutual fund managers are on the platform that reaches 180 million users."¹⁰⁸ Thus the scope of economic and financial disruption caused by a potential failure or hacking of Ant Financial's platform is breathtaking.

3. Liquidity and Data Control

When compared to back-end and front-end FOS, the striking factor behind Ant's FOS is that it exercises control over clients' liquidity *and* data. Employing its data power, Ant can offer – where profitable, based on client and transaction data – any financial services to any client at any time. Employing its liquidity power, Ant Financial can push insurance companies or asset management firms for rebates, discounts, and commissions. That liquidity power means that no financial services firm targeting the Chinese market can afford to be removed from Ant's platform.

4. The Ant Clones: Emerging Financial Ecosystems

Unsurprisingly, in light of the high value assigned by investors to large financial ecosystems like Ant Financial, a number of firms are seeking to mimic Ant's business model. For example, Charles River – a competitor of Aladdin – has joined forces with State Street to deliver the “first-ever global, front-to-back, client servicing platform from a single provider.”¹⁰⁹ This claim is obviously ill-founded given its belated emulation of Ant Financial's ecosystem, not to mention the competing financial ecosystems provided by Tencent¹¹⁰ and Baidu in China which – even though much smaller than Ant Financial's – are giants in terms of user numbers.¹¹¹ Also, Ping An, the world's largest insurance company, is building a similar integrated ecosystem for its 574 million internet users, integrating finance, insurance, health care, and property, following the adage “one customer, multiple products, and one-stop services.”¹¹²

In other parts of the world, and the U.S. in particular, all manner of FOS providers are attempting to follow Ant Financial's example to establish and expand financial ecosystems. Most notably, the world's largest asset manager, BlackRock, has introduced a front-end FOS following its 2015 acquisition of

¹⁰⁸ See Concepcion, *supra* note 105, *passim*.

¹⁰⁹ See Whyte, *supra* note 71.

¹¹⁰ Tencent currently is discussing cooperation with Blackrock in the Chinese asset management market. See Annie Mass, *BlackRock in Talks With Tencent to Explore China Expansion*, BLOOMBERG (Oct. 2, 2019 4:00 PM), <https://www.bloomberg.com/news/articles/2019-10-02/blackrock-in-talks-with-tencent-to-explore-expansion-in-china>.

¹¹¹ See FSB, *supra* note 99, at 5-11; Frost et al., *supra* note 99, at 3, 7-11.

¹¹² See <https://www.pingan.com/us-en.shtml>.

robo advisory firm Future Advisor.¹¹³ Similarly, Apple is seeking to build a financial ecosystem with Apple Pay as a key access point for retail consumers; expansion into other financial services has started with the Apple Card announced in August 2019.¹¹⁴ Facebook's intended launch of Libra also potentially forms the basis of a similar strategy.

E. FinTech FOS: Neo-Investment Platforms

The examples we have provided are the most obvious and enormous, in terms of scale and numbers, but are by no means the only ones currently in operation. Investment platforms similar to those of Fidelity, Schwab, Vanguard and J.P. Morgan Chase, created by financial entrepreneurs, have emerged recently under the label of "robo adviser."¹¹⁵ Some robo advisers, including Robin Hood,¹¹⁶ have collected several million clients, primarily attracted by low or even zero asset management fees.¹¹⁷ These firms are often seeking to build FOS. They are, however, at a huge disadvantage of scale compared with incumbents like BlackRock, Fidelity, Schwab, Vanguard, Goldman Sachs, and J.P. Morgan Chase. Consequently, many of these firms are being acquired by incumbents looking to build FOS, with the FinTech startup being acquired for its technology, which is then combined with the scale of customers, assets, and brand of the established incumbent in order to build proprietary ecosystems to compete with the other major players.

As we discuss in more detail in Part III, scale is central to network and data effects so the trend is already very much toward concentration. The question will be how far this process can go.

¹¹³ See Samantha Sharf, *BlackRock To Buy FutureAdvisor, Signaling Robo-Advice Is Here To Stay*, FORBES (Aug. 26, 2015 04:02pm), <https://www.forbes.com/sites/samanthasharf/2015/08/26/blackrock-to-buy-futureadvisor-signaling-robo-advice-is-here-to-stay/#7df91bc63023>.

¹¹⁴ See Ben Gilbert, *The Apple Card is a brilliant move by Apple to keep people shackled to the iPhone*, BUSINESS INSIDER (Aug. 12, 2019), <https://www.businessinsider.com/apple-card-only-works-with-iphone-2019-8?r=DE&IR=T>.

¹¹⁵ See on robo-advisors references *supra*, note 19.

¹¹⁶ See Tyler Clifford, *Reaching 10 million users is a 'testament' to our mission to democratize investing, Robinhood co-CEO says*, CNBC (Dec. 4, 2019 6:54pm), <https://www.cnbc.com/2019/12/04/robinhood-co-ceo-10-million-users-are-a-testament-to-our-mission.html> (stating that Robin Hood has more than 10 million client accounts).

¹¹⁷ See, e.g., William A. Birdthistle & Daniel J. Hemel, *Next Stop for Mutual-Fund Fees: Zero*, WALL ST. J. (Jun. 10, 2018, 1:42pm), <https://www.wsj.com/articles/next-stop-for-mutual-fund-fees-zero-1528652532>; William A. Birdthistle, *Free Funds: Retirement Savings as Public Infrastructure*, in RESEARCH HANDBOOK ON THE REGULATION OF MUTUAL FUNDS 267 (eds. William A. Birdthistle & John Morley) (2018).

II. FOS AND THE PLATFORM ECONOMY

In this section, we argue that FOS exhibit technical and economic characteristics most typically associated with “platform industries,” focusing on the context of asset management. We outline the different services characteristic of an investment fund as the core of asset management, discuss the features that turn asset management and other FOS into platforms, and then examine the pro-concentration effects of platform technology. We then present a three-stage argument for the proposition that a small number of FOS are likely to become dominant in any given financial sector, with important implications for the financial system, the economy and our societies more generally.

A. *Investment Funds as Network of Contracts*

Funds are the primary way in which many investors connect to the global financial system: wealthy institutions and high-net-worth individuals may be partial to investing in hedge funds, venture capital funds, or private equity funds, while over one hundred million Americans secure much of their financial well-being in retirement through mutual funds. These funds rely on a network of contracts, and the performance of these contracts is increasingly dominated by FOS. Even without FOS, investment funds experience periods of instability.¹¹⁸ To the extent FOS are vulnerable, nothing less than the trillions of dollars under management are at risk.

For all the popularity and ubiquity of these funds in the U.S. economy, they remain a curious species, and for a good reason: investment funds are, structurally and operationally, like neither stocks and bonds, ordinary businesses, nor bank accounts with which consumers are more familiar. A fund investment is, in principle, an equity arrangement. When an investment fund produces a disappointing return, investors in an investment fund enjoy no legal recourse or protected status. Equity, with its potential for outrageous fortune and total loss, is an inherently riskier proposition than debt, with its limited interest payments in good times and higher bankruptcy priorities in bad times.

When compared to other equity investments, perhaps the most striking overall characteristic of all funds, but in particular mutual funds and most especially so in the hugely popular passive index funds, is the funds’ and their investors’ notable helplessness; its function resides on the performance of a complex array of services. Yet, due to their unique structure they have remained

¹¹⁸ As to runs on money market funds, *see* references *supra* note 31. On investors’ susceptibility to bad news see Itay Goldstein, Hao Jiang & David Ng, *Investor Flows and Fragility in Corporate Bond Funds*, 126 J. Fin. Econ. 592 (2017) (arguing that investors of corporate bond funds respond to bad news more strongly than to good news).

remarkably successful.¹¹⁹ To understand funds, then, we must understand the cast of specialist economic actors who, closely cooperating, form a complex network of contracts that we together call “a fund.”

1. Investment Companies, Investment Advisers, Custodians

Investment companies, investment advisers and custodians form the core of the fund structure. If one invests money to buy shares of equity (“stock”) in Ford or Exxon, one expects those companies to use the money to build more cars or to drill for more oil. As stockholders in such a company, shareholders will benefit if the company’s performance – or, perhaps more accurately, its perceived performance – improves. Mutual funds do not provide goods or services to customers in this way but, rather, as *investment companies*, they provide their users with a means of investing in other securities.

In mutual funds, the *investment adviser* is the central actor charged with investment decisions on behalf of the fund. But they do more: Investment advisers run mutual funds. They manage and direct almost every facet of the business. The SEC has noted that “the term ‘investment adviser’ is to some extent a misnomer” because an adviser is “no mere consultant” but “almost always controls the fund.”¹²⁰ In return, these advisers owe fiduciary duties to their own shareholders and to the funds they manage.

The term *investment adviser* usually refers not to an individual human being but to a professional investment organization with many employees. Many investment advisers are household names, such as Fidelity Management and Research, which manages the Fidelity funds; the Vanguard Group, which manages the Vanguard funds; Pacific Investment Management Company, which manages the PIMCO funds; and Franklin Advisers, which manages the Franklin Templeton funds; as well as T. Rowe Price Associates, BlackRock Advisors, J.P. Morgan Asset Management; and many others.

So, in whom or what do fund investors invest? Not the investment adviser, as one might expect, given the names of funds that seem to indicate the contrary.¹²¹ Instead, mutual fund investors are shareholders in the new,

¹¹⁹ See John Morley, *The Separation of Funds and Managers: A Theory of Investment Fund Structure and Regulation*, 123 YALE L. J. 1118, 1243-1267 (2014); see generally RESEARCH HANDBOOK ON THE REGULATION OF MUTUAL FUNDS (William Birdthistle & John Morley, eds., 2018).

¹²⁰ See *In re Steadman Sec. Corp.*, 46 S.E.C. 896, 920 n.81 (1977).

¹²¹ The funds managed by investment advisers almost always come with the advisers’ names on them. In turn, one might reasonably believe that handing over \$1,000 to Fidelity constitutes, if not a bank-like promise, then some sort of investment in Fidelity itself; after all, Fidelity is the name on the investment. Funds managed by Fidelity include the Fidelity Value Discovery Fund, the Fidelity Select Air Transport Fund, the Fidelity Spartan 500 Index Fund, and

separate *investment company* that the investment adviser creates. Adviser and fund are linked through the *investment advisory agreement*, which is a contract pursuant to which the adviser operates the fund in exchange for a percentage of the assets of the fund. Investors in a fund are not generally shareholders of the investment adviser; rather, they are related to the adviser only through a contractual arrangement. The shares investors hold are a separate pool of assets legally owned by the investment company, yet managed by the investment adviser. The sums fund shareholders contribute go into a combined pool of money that the adviser then uses to buy and sell other investments, such as stocks, bonds, real estate: these investments are called *portfolio securities*.

So, fund shareholders own shares of the mutual fund (such as the Vanguard Total Stock Market Index Fund), while the mutual fund owns the portfolio securities (such as Ford or IBM). And each fund shareholder invests in the hope that a fund's portfolio securities will increase in value in order to raise the corresponding value of her fund shares, after fees.¹²²

Mutual funds are legally obliged to retain the services of a *custodian*. This custodian is usually a large financial institution charged with taking legal custody of a fund's assets, in an effort to hold and safeguard these assets on behalf of the fund and its investors during the lifetime of the fund. Typically, this role is filled by a major commercial bank, not necessarily because banks are impregnable but because banks are intensely regulated by federal banking laws. As the legal holder of a fund's cash and portfolio investments, a custodian must segregate the fund's assets from the adviser's assets. In order for any transactions to occur in the fund's portfolio, the custodian must receive lawful instructions from a fund's investment adviser.

This choreography, in which an adviser must transmit orders to the custodian instructing the custodian to release certain fund assets for the acquisition of particular stocks for the fund's portfolio, is intended to thwart fraud or theft in a fund. A custodian also stands as a heavily regulated, and usually financially stable, third party between the adviser and the fund, ensuring that in a legal proceeding the custodian's large balance sheet may well be more attractive as a defendant than the investment adviser's smaller one. Custodians may be the likeliest targets to sue if assets are lost or stolen.

These steps are intended to help reduce cases in which an investment adviser simply pockets investors' money and flees with it to an undisclosed island in the Caribbean. Bernie Madoff's Ponzi schemes were operated in lightly regulated or, indeed, unregulated private investment funds that did not

hundreds of other funds with the name *Fidelity*. Funds managed by Janus include the Janus Fund, the Janus Enterprise Fund, the Janus Venture Fund, and approximately thirty other funds with the name *Janus* in their title.

¹²² Note: the custodian, considered below at II.4., holds the portfolio securities on behalf of the investor / fund.

require custodians. We cannot know whether Madoff's perverse ambitions would have foiled even a diligent custodian, but the presence of any custodian might have made his machinations more difficult to perpetrate or more easily traceable. Indeed, of the problems from which mutual funds suffer, rarely have they had anything to do with corrupt custodians.

2. Distributor, Administrator, Transfer Agents

A number of other service providers perform important functions for the contract network we refer to as fund. The *distributor* assists in taking a fund public by distributing the shares of the fund. Parties to whom the distributor distributes those shares are investors who wish to become shareholders in the mutual fund; *i.e.*, the distributor persuades investors to place their money in the fund. An investment adviser often chooses to outsource some of the back-office tasks to an *administrator*; this entity will then be responsible for preparing and filing materials with regulators such as the SEC, with taxing authorities such as the Internal Revenue Service, and with any other governmental agencies. A *transfer agent* must manage the quotidian requirements of administering millions of client accounts for all of the shareholders in a fund, provide regular statements of their holdings and sporadic shareholder notices, access to websites with disclosures about the funds, and toll-free telephone numbers for the investing public. The fund also needs *brokers* for trading securities for their portfolios, accountants to conduct periodic audits of all the money flowing in and out of the fund and the public statements of the fund's financial condition, and last but not least legal counsel to ensure compliance with the complex web of investment fund regulations, and deal, at certain challenging times, with litigation.

3. Provider Collaboration: The Entry Gate for FOS

Each of the service providers serve specialist functions; each of these functions depends on data access, connectivity and algorithmic support: the investment adviser needs to select investments, instruct the broker and measure and control the risks taken. The quicker this can take place, the better, with all of this today performed digitally and often in milliseconds. When the custodian controls whether the adviser has complied with investment limits, when the accountant reviews valuations, and the transfer agent manages investors' deposits based on the inflows on the fund's accounts, they do so digitally and in almost real-time exchange with all other providers. This intense level of collaboration is the unique feature of the fund that makes the fund structure particularly receptive to datafication: taking human agents out of the loop enhances speed and reduces human-related agency costs, in terms of wages,

errors, self-interest, and bias. But this is also the reason why FOS in the investment fund industry have arisen and raise such significant concerns.

B. FOS as Platform Industry

FOS are transforming the asset management industry into a platform industry. In common language, platforms are “a place or opportunity for communicating ideas and information.”¹²³ In the FOS context, the term “platform” refers to a systems architecture where multiple applications are linked to and through one technical infrastructure so that users merely need to install one major integrating software system in order to run all applications written for that system.¹²⁴

1. The FOS Winner-Take-All Race

Functioning as “spider in the web,” the FOS platform gathers data concerning users and their activities, and in turn enjoys the best information for further developing platform applications and services to users, resulting in a gradual expansion of the platform in scale and scope. In turn, the overhead costs of the services provided experience gradual decline, compared to the socio-economic value provided. We observe “some mixture of both technology-enabled efficiency enhancement, and technology-enabled organizational arbitrage,” enabled by the control the platform providers gain over markets while enhancing their efficiency.¹²⁵

Risk management systems drawing on deep data pools, for instance, are expected to gain ever-greater predictive powers; platform providers can generate additional returns by leveraging this data power into related, yet new, types of business (in the absence of legal restrictions). If Aladdin’s risk management data reflect the exposures of the portfolios managed by some of the world’s largest asset managers (although in an anonymized way and with information barriers preventing the transfer of inside information), these data form the basis of “collective intelligence”, that is they are the very reason that other clients seek to license Aladdin’s services.¹²⁶

The growth of platforms is turning into a winner-take-all race, resulting in

¹²³ *Platform*, Merriam-Webster Thesaurus (online, <https://www.merriam-webster.com/thesaurus/platform>).

¹²⁴ See also MARC H. MEYER & ALVIN P. LEHNERD, *THE POWER OF PRODUCT PLATFORMS* (1997) (defining a platform as “a set of common components, modules, or parts from which a stream of derivative products can be efficiently created and launched.”).

¹²⁵ See Haberly, et al., *supra* note 34, at 168.

¹²⁶ And of course these data could be used for front running the strategies of these managers, hence rules addressing data confidentiality, use, and protection are key.

technology-induced centralization in the hands of the platform provider,¹²⁷ defying FinTech's tendency toward disintermediation and decentralization.¹²⁸

2. Platform Scholarship

The debate over whether information markets are unique, and thus whether their legal ordering must also be unique, dates to the debate between Judge Frank H. Easterbrook and Professor Lawrence Lessig over “The Law of the Horse.”¹²⁹ Contemporary scholarship, it seems, sides with Professor Lessig. Features of technology platforms have been a major focus of interest of contemporary legal scholarship.¹³⁰ Scholars first examined why platform firms give away access to core technologies¹³¹ and concluded that “open source” enables rapid innovation while retaining some profits by restricting access to useful innovators. Today the platform economy is seen as a paradigm shift for social issues that touches all aspects of society, on topics ranging from

¹²⁷ See *More Knock-On than Network*, THE ECONOMIST, Jun. 28, 2018, <https://www.economist.com/special-report/2018/06/28/the-story-of-the-internet-is-all-about-layers>.

¹²⁸ See on disintermediation and decentralization through financial technologies Max Kanaskar, *The Five D's of Fintech* (Jan. 28, 2019), <https://maxkanaskar.wordpress.com/2018/01/09/the-five-ds-of-fintech-disintermediation/>. Certainly cloud computing and open-source software have both served to lower the barriers to entry that FinTechs face. As against this, however, are the incredible economies of scope and scale that FOS offer.

¹²⁹ See Frank H. Easterbrook, *Cyberspace and the Law of the Horse*, 1996 U. CHI. LEGAL F. 207 (1996) (arguing that discussing the law of computer systems results in “multidisciplinary dilettantism,” since “[b]eliefs lawyers hold about computers, and predictions they make about new technology, are highly likely to be false” and arguing that there is no more a “law of cyberspace” than there is a “law of the horse”); Lawrence Lessig, *The Law of The Horse: What Cyberlaw Might Teach*, 113 HARV L. REV. 501 (1999) (responding and arguing that thinking about how law and cyberspace connect would assist in illuminating the entire law, as Judge Easterbrook had demanded).

¹³⁰ The platform economy is sometimes also called the gig economy (or euphemistically hailed as the “collaborative economy”); see Vassilis Hatzopoulos & Sofia Roma, *Caring for Sharing? The Collaborative Economy under EU Law*, 54 COMMON MARKET L. REV. 81 (2017) or “sharing economy”, but see Shu-Yi Oei, *The Trouble with Gig Talk: Choice of Narrative and the Worker Classification Fights*, 81 L. & CONTEMP. PROBL. 107 (2018) (arguing that euphemistic terms such as sharing economy influence the outcome of legal classification issues); Abbey Stemler, *The Myth of the Sharing Economy and its Implications for Regulating Innovation*, 67 EMORY L.J. 197, 209 (2017) (arguing that the term supports the claim that platforms are unique and should be subject to new and different regulation or no regulation at all). We prefer the term platform economy due to its technical, non-political character, and its wide-spread acceptance in business-focused academic circles. See DAVIS S. EVANS & RICHARD L. SCHMALENSEE, *MATCHMAKERS: THE NEW ECONOMICS OF MULTISIDED PLATFORMS* (2016).

¹³¹ Jonathan M. Barnett, *The Host's Dilemma: Strategic Forfeiture in Platform Markets for Informational Goods*, 124 HARV. L. REV. 1861 (2011).

privacy,¹³² product liability,¹³³ public housing,¹³⁴ discrimination,¹³⁵ labor and employment law,¹³⁶ and tax law.¹³⁷ Platforms are also at the heart of the discussions on “fake news”¹³⁸ as well as provider manipulation of consumer prices,¹³⁹ search results¹⁴⁰ and scoring power.¹⁴¹

C. Pro-Concentration Effects

Notwithstanding scholarly interest in the subject and, “although platforms

¹³² See Anita L. Allen, *Protecting One’s Own Privacy in a Big Data Economy*, 130 HARV. L. REV. F. 71 (2016); Mary Madden et al., *Privacy, Poverty, and Big Data: A Matrix of Vulnerabilities for the Poor*, 95 WASH. L. REV. 53 (2017).

¹³³ See David Berke, *Products Liability in the Sharing Economy*, 33 YALE J. ON REG. 603 (2016).

¹³⁴ Nestor M. Davidson & John Infranca, *The Sharing Economy as an Urban Phenomenon*, 34 YALE L. & POL’Y REV. 215 (2016);

¹³⁵ See Sandra G. Mayson, *Bias in, Bias out*, 128 YALE L. J. 2122 (2019); Nancy Leong & Aaron Belzer, *The New Public Accommodations: Race Discrimination in the Platform Economy*, 105 GEO. L.J. 1271 (2017) (discussing race discrimination); Arianne Renan Barzilay & Anat Ben-David, *Platform Inequality: Gender in the Gig-Economy*, 47 SETON HALL L. REV. 393 (2017) (discussing gender discrimination in the sharing economy).

¹³⁶ See Brishen Rogers, *Employment Rights in the Platform Economy: Getting Back to Basics*, 10 HARV. L. & POL’Y REV. 479 (2016); Matthew T. Bodie, *Lessons from the Dramatists Guild for the Platform Economy*, 2017 U. CHI. LEGAL F. 17 (2017).

¹³⁷ From a scholarly perspective see Kathleen D. Thomas, *Taxing the Gig Economy*, 166 U. PA. L. REV. 1415 (2018) (discussing current taxation of online workers as “business owners” and proposing a taxation model closer to that of wage earners, based on a “standard business deduction” irrespective of the legal form of work); Shu-Yi Oei & Diane Ring, *Can Sharing be Taxed?*, 93 WASH. U. L. REV. 989, 1028–29 (2016) (analyzing online firms’ first mover advantage and rent seeking through regulatory arbitrage, gaps and ambiguities in the law); Shu-Yi Oei & Diane Ring, *The Tax Lives of Uber Drivers: Evidence from Internet Discussion Forums*, 8 COLUM. J. TAX L. 56, 60 (2017) (analyzing a series of postings by rideshare drivers on internet discussion forums and arguing that the forum participants had difficulties to understand concepts of expenses and deductions; *i.e.*, the fundamentals of business taxation).

¹³⁸ See Kate Klonick, *The New Governors: The People, Rules, and Processes Governing Online Speech*, 131 HARV. L. REV. 1598 (2018); Nabiha Syed, *Real Talk About Fake News: Towards a Better Theory for Platform Governance*, 127 YALE L.J.F. 337 (2017); Jack M. Balkin, *Free Speech in an Algorithmic Society: Big Data, Private Governance, and New School Speech Regulation*, 51 U.C. DAVIS L. REV. 1149 (2018).

¹³⁹ Oren Bar-Gill, *Algorithmic Price Discrimination: When Demand Is a Function of Both Preferences and (Mis)Perceptions*, 86 U. CHI. L. REV. ____ (forthcoming 2020).

¹⁴⁰ FRANK PASQUALE, *THE BLACK BOX SOCIETY* (2015).

¹⁴¹ Ryan Calo, *Digital Market Manipulation*, 82 GEO. WASH. L. REV. 995 (2014); Ryan Calo, *Response, Consumer Subject Review Boards: A Thought Experiment*, 66 STAN. L. REV. ONL. 97 (2013); Danielle K. Citron & Frank A. Pasquale, *The Scored Society: Due Process for Automated Predictions*, 89 WASH. L. REV. 1 (2014). See on remedies Andrew D. Selbst, *Disparate Impact in Big Data Policing*, 52 GA. L. REV. 109 (2018); Frank A. Pasquale & Oren Bracha, *Federal Search Commission? Access, Fairness, and Accountability in the Law of Search*, 93 CORN. L. REV. 1149 (2008).

form the backbone of the internet economy, the way that platform economics implicates existing laws is relatively undertheorized.”¹⁴² This undertheorization is particularly true for FOS. To the best of our knowledge, FOS, in the platform context, have not been examined from a legal perspective.¹⁴³ We explore the forces driving the winner-takes-all race among FOS. Three factors together lead to a friction in the market that prevents private ordering from leading to socially optimal outcomes, in the sense that market forces ensure competition among FOS providers: traditional scale economies, data-driven economics of scale, and network effects.¹⁴⁴

1. Conventional Scale Economies

Economies of scale refer to the reduction of per-unit production costs as a consequence of producing units in larger quantities.¹⁴⁵ FOS exhibit conventional economies of scale created by the primarily fixed costs of providing the FOS service to an unlimited number of users. FOS are based on applications and interfaces operating on high-frequency servers. Once the interfaces have been defined, the applications coded, and the servers set up, connecting all additional clients comes at very low marginal costs. Where additional users mean additional marginal costs for energy and data warehousing, these additional costs per user are offset by the additional data these users create, allowing the platform provider to choose, more or less freely, which services the platform charges clients for, and which services are provided to them apparently for free.

This practice is particularly true in the asset management industry – particularly the investment fund industry – where large entities can invest in software programming and development themselves, while small asset managers are usually price takers (unless they have in-house software programming expertise) who must pay (in proportion to their business size) high software licensing and data warehousing fees. The more important the

¹⁴² See Lina M. Khan, *Amazon's Antitrust Paradox*, 126 YALE L.J. 710, 789 (2017); see also David Singh Grewal, *Before Peer Production: Infrastructure Gaps and the Architecture of Openness in Synthetic Biology*, 20 STAN. TECH. L. REV. 143, 196 (2017) (arguing that platforms are “relatively under-theorized.”).

¹⁴³ The platform perspective of FOS has been analyzed from a geographical perspective only, see Haberly, et al., *supra* note **Fehler! Textmarke nicht definiert.**, at 169.

¹⁴⁴ See Haberly, et al., *supra* note **Fehler! Textmarke nicht definiert.**, at 169.

¹⁴⁵ These scale economies are particularly present in software markets where the costs of the original application (“first: copy) are enormous, while the costs of the second through N copies are minimal and become close to zero. While licensing models and modern anti-piracy devices restrict software users from making use of these characteristics, the software producer and licensor are not bound by these restrictions and is free, in principle, if pressed by its competitor to reduce the price.

technology is for the industry, and the more software tools are required, the higher these costs are in proportion to other expenses, and the greater the incentive to sign up to an existing FOS that relieves the small managers of this burden. Given that technology is swiftly rising in importance, smaller asset managers have no choice but to sign up to a FOS or to accept the fate of being inhibited in their growth by IT limitations and costs. In turn, BlackRock's Aladdin not only provides savings for BlackRock's own funds, but generates licensing fees from competing asset managers.

2. Data-driven Economies of Scale

The second type of scale economies result from the data collected and used for the application. In simple terms: "More information lets firms develop better services, which attracts more users, which in-turn generate more data."¹⁴⁶ Where risk management depends on data, we would expect better predictions if the FOS can collect more and better structured data. To ensure this sequence, Aladdin's new AI laboratory in California exists to prepare Aladdin for the AI future, by creating new, AI-based services.

3. Network Effects

FOS also exhibit network effects. Network effects occur where an additional user of a service adds value to that product for other users. So, the more users, the greater the benefit.¹⁴⁷ For instance, a telephone is of little use unless it can be used to call other people. The more people who can be called, the more valuable the phone. Applied to the fund context, the more a fund administration, asset management or depositary software can communicate with other participants in fund administration, as well as depositaries, stock exchanges, and alternative markets, the more valuable the virtual network created by the FOS becomes.

Network effects are particularly prominent in the asset management FOS context. First, the value of the software based "network" grows in proportion to the numbers of copies installed in fund firms; the look and feel of software becomes embedded in human processes. Users know where to click, which shortcuts to use, and how to upload data or link to the internet. The more software is used among fund administrators and asset managers, the more those users expect this software and their features in their work environment.

¹⁴⁶ See *A New School in Chicago*, THE ECONOMIST, June 30, 2018, <https://www.economist.com/special-report/2018/06/28/how-regulators-can-prevent-excessive-concentration-online>.

¹⁴⁷ See AMRIT TIWANA, PLATFORM ECOSYSTEMS – ALIGNING ARCHITECTURE, GOVERNANCE, AND STRATEGY 23-48 (2014), ¶2.2.3.

Second, any additional user adds data to the existing pool. Where risk management can draw on more data from more firms, the predictive power of the FOS algorithms improves. Take again the example of BlackRock's Aladdin: firm-specific data pools suffer from data shortages in relation to low frequency risk events. Among these, internal fraud, business disruption, and IT failures are potentially of "high severity"; that is, these operational risks could threaten the existence of a financial institution.¹⁴⁸ Aladdin's predictive power is not impaired by such data shortages when it can use the data of all its asset manager clients rather than just that those generated by BlackRock itself. In this case, *all* network participants benefit from pooling risk data.

BlackRock is very clear in stressing these network effects of Aladdin:

More than just technology, Aladdin powers your firm's Collective Intelligence by providing tools to help your organization communicate effectively, address problems more quickly, and make decisions at every step of the investment process. And Aladdin's Collective Intelligence gets better with every new user, and every new asset that joins the platform.¹⁴⁹

It is thus clear that FOS in the asset management increasingly show the concentration characteristics of other platform industries and that these aspects can also be seen increasingly in other forms of FOS.

III. THE NEED FOR REGULATING FINANCIAL OPERATING SYSTEMS

While network effects, conventional economics of scale, and data-driven scale economies explain the dramatic rise and scope of FOS, they also draw the attention of financial regulators, commentators, and scholars. The success of FOS raise questions about how they ensure that investor protection, market efficiency, and integrity – as well as systemic financial stability – can be maintained under conditions of ever-increasing market concentration. We outline, first, the positive effects provided by FOS, and then explore why FOS have escaped meaningful regulation, before arguing for an array of possible ways in which FOS might be optimally regulated.

¹⁴⁸ See BASEL COMMITTEE ON BANKING SUPERVISION ("BCBS"), SOUND PRACTICES FOR THE MANAGEMENT AND SUPERVISION OF OPERATIONAL RISK 18 (2003) (stating that "banks may not have much internal data for certain low frequency operational risk loss types."); BCBS, OPERATIONAL RISK – SUPERVISORY GUIDELINES FOR THE ADVANCED MEASUREMENT APPROACHES 49-50 (June 2011) (stating that "many banks have limited high severity internal loss events to inform the tail of the distribution(s) for their capital charge modelling").

¹⁴⁹ See BlackRock, Aladdin – Powering collective intelligence, BLACKROCK, <https://www.BlackRock.com/aladdin/benefits/organizations>.

A. *Optimizing Tech-Based Fund Services*

From the perspective of end-user clients, FOS as tech platforms can reduce their costs by bundling all platform clients' purchasing power, by improving performance through tech-driven customization, by reducing inefficiencies stemming from manual work and data shortages, and by reducing search and transaction costs. At the same time, FOS can enable entirely new markets and rapidly enhance innovation, by offering innovations developed by one FOS participant to all other FOS users.¹⁵⁰ All of these benefits come with little operational effort on the clients' part, as the FOS act as meta-integrating technology, or "super applications." FOS "could be the steady hand that the markets of the future will need. A powerful stabilizing technology such as Aladdin could yet be the source of 'Great Moderation' that neoliberalism tried to deliver."¹⁵¹ If this were the case, we would expect FOS to have a salutary effect on capital markets.

Fields that might embrace this kind of innovation include, for instance, robo-advice for specialist strategies, automated fund formation, and valuation of illiquid assets. In particular, smaller specialist firms that focus on non-core parts of the investment value chain could capitalize on scale economies created through access to larger numbers of clients via FOS, if their services can be efficiently integrated into the FOS client's existing business model.

Although robo-advice has been discussed most prominently from the retail perspective as a disruptor of traditional asset management, for instance, FOS support the optimization of wholesale and institutional asset management strategies. This development is not a surprise: already today, most investment decisions with regard to liquid financial assets rely on technological support. Algorithms select potential assets according to a number of predetermined preference values, such as valuation in correlation to peers, liquidity on exchanges, profit per share, etc.¹⁵² The same level of tech support exists in risk management systems where warnings inform the risk manager that a risk budget has been depleted and risk mitigation, through hedging or closing of

¹⁵⁰ For studies on the platform economy dating back to the early 2000s see Jean-Charles Rochet & Jean Tirole, *Platform Competition in Two-Sided Markets*, 1:4 J. EUR. ECON. ASSOCIATION 990 (2003); for contemporary works see Evans & Schmalensee, *supra* note 130; ANNABELLE GAWER, PLATFORMS, MARKETS AND INNOVATION (2010); AMRIT TIWANA, PLATFORM ECOSYSTEMS: ALIGNING ARCHITECTURE, GOVERNANCE, AND STRATEGY 61-69 (2014), ¶4.3.2.

¹⁵¹ See Dunn, *supra* note 58, *passim*.

¹⁵² Regulators distinguish between fully automated robo-adviser platforms, and human assisted robo-advisory platforms. See IOSCO, RESEARCH REPORT ON FINANCIAL TECHNOLOGIES (FINTECH) 25-26 (FEB. 2017), <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD554.pdf>.

positions, is necessary. Without tech support, human decision makers are slower and more error-prone due to human foibles, and – in markets where algorithmic trading prevails – doomed to lose out to their tech-powered competitors.¹⁵³ The acquisition of robo advisors by US asset management giants Vanguard, BlackRock, Charles Schwab, and Fidelity can be understood in this light, as can the dominance in U.S. trading of a small number of tech focused quantitative firms, led by Citadel and Virtu.

Administration is also on the verge of digitization, with “KYC utilities” emerging.¹⁵⁴ These systems identify new clients based on networked sources of data for know-your-customer (“KYC”), customer due diligence (“CDD”) account opening and maintenance processes under anti-money laundering (“AML”) and countering the financing of terrorism (“CFT”) regulations. Where several fund managers serve the same clients, economic logic pushes for client onboarding to be performed by a single entity. In turn, client onboarding is outsourced to specialist service providers which engage in tech-based background checks and build large databases that include the potential investors in several hundred asset managers. In some cases, to maximize network effects of data, governments build systems, such as Singapore’s MyInfo or India Stack, which are designed both to increase efficiencies (reducing transaction and other costs) as well as to aggregate data to better identify potential risks, thereby better achieving regulatory objectives.

The same trend is noteworthy for transfer agents. For instance, Delaware has taken steps to ensure that shareholder identification can take place in real time using blockchain technology, via which all investor data are spread over a network. If broker-dealers and banks in which investors hold their deposit accounts submit data of those buying and selling fund units immediately via blockchain to the fund manager, the register of fund investors will be complete and more up-to-date. The register function will be replaced by a data feed connecting it to the blockchain, unless the law allows for the blockchain to *be* the register itself.¹⁵⁵

B. FOS Escape Regulation

Regulators around the world have worked to identify nonbank systemically important financial institutions (SIFIs).¹⁵⁶ Yet, the U.S. *Financial Stability*

¹⁵³ JON BECKETT, *NEW FUND ORDER – A DIGITAL DEATH FOR FUND SELECTION?*, 32 et seq. (2016).

¹⁵⁴ See Arner et al., *supra* note 25, at 71-76.

¹⁵⁵ See references *supra* note 49.

¹⁵⁶ For the U.S., see Authority to Require Supervision and Regulation of Certain Nonbank Financial Companies, 84 Fed. Reg. 9028 (proposed March 13, 2019) (to be codified at 12 C.F.R. pt. 1310).

Oversight Council has not determined that any of the world's largest asset managers is a non-bank SIFI (and, as at the time of writing, no other institution is designated as a non-bank SIFI). We agree, as the non-bank SIFI determination looks at the nature, scope, size, scale, concentration, and interconnectedness of the institution, *i.e.* its balance sheet size, assets held and exposures to counterparties, while the point we stress in this article is the FOS' function as liquidity bundle, data warehouse and financial infrastructure. At the same time, none of the U.S. FOS has been determined to be a systemically important Financial Market Utility, and hence subject to the heightened prudential, risk management and supervisory provisions of Title VIII of the Dodd-Frank Act for important market infrastructure.¹⁵⁷

This is evidence of how FOS escape regulation. Such a result is in line with scholarship analyzing platform environments which finds traditional regulation fails because of circumvention and regulatory arbitrage.¹⁵⁸ The main reason for *financial* regulation's failure is that three disparate sources contribute to the role of FOS as "spider in the web": applications, data and servers. These three together create the network effects, yet neither data collection, software ("app") development, nor server processing qualifies as a licensed activity, so bundling the three functions likewise does not trigger the need for any financial regulatory license.

Though some believe turning entity-focused regulation into activity-based regulation would address these issues, that would not be so for FOS. In a typical FOS, *institutional clients* perform the regulated activity, while the FOS primarily provides the IT backbone. Even if operating a FOS were defined as a regulated activity (as is the case with the operation of payment or securities settlement systems), regulating one FOS provider based on its regulated

¹⁵⁷ Reflecting its size, scope, and scale, Ant Financial was reportedly designated a systemically important financial institution ("SIFI") by the PBOC in late 2018. See Gabriel Wildau, *China to Designate More Financial Groups as "Too Big To Fail,"* FIN. TIMES, Nov. 27, 2018, available at <https://www.ft.com/content/22279e54-f22d-11e8-ae55-df4bf40f9d0d>.

¹⁵⁸ See Orly Lobel, *The Law of the Platform*, 87 MINN. L. REV. 101 (2016) (analyzing the effectiveness of regulation in a platform environment, arguing that the platform economy defies conventional regulatory theory, and holding that legal disruption by the platform economy should be viewed as a feature rather than a bug of regulatory limits); Julie E. Cohen, *Law for the Platform Economy*, 51 U.C. DAVIS L. REV. 133 (2017) (arguing that the platform is the core organizational form of the informational economy, replacing and rematerializing existing traditional markets, and that "legal institutions, including both entitlements and regulatory institutions, have systematically facilitated the platform economy's emergence," and analyzing challenges that platform-based information intermediation for regulatory institutions); Jordan Barry & Elizabeth Pollman, *Regulatory Entrepreneurship*, 90 S. CAL. L. REV. 383, 383 (2017) (dubbing the platform businesses as "regulatory entrepreneurs" that seek to initiate tailor-made regulation in their favor); Paul Ohm & Blake E. Reid, *Regulating Software When Everything Has Software*, 84 GEO. WASH. L. REV. 1672 (2016) (analyzing the challenges regulators and coders face given the proliferation of software and code).

activities is rarely sufficient to reflect the exposures and dependency of all users. Then come matters of jurisdiction. For instance, a fully developed financial ecosystem would need multiple licenses from multiple regulators across many jurisdictions. With such a patchwork of multiple licenses, none of the regulators is likely to have full oversight of all the financial activities.

C. Four Possible Justifications for FOS Regulation

The arguments in favor of regulating FOS flow from four main established rationales of financial law: market efficiency, financial stability, market integrity, and client protection. A careful exegesis suggests that FOS raise some degree of concern with regard to all four of these regulatory paradigms.

1. Market Efficiency

Within the market efficiency paradigm, the concentration of many services in the hands of one FOS, and the dependency of the FOS clients on the FOS, provide valid reasons for concern. In the comprehensive version of FOS – financial ecosystems – clients will be served literally from their birth to death by one FOS providing not only financial, but also many other, services ranging from transport to food supply. At the same time, if the growth factors discussed *supra* exhibit their true power, only a very limited number of FOS will survive to provide these services, perhaps only three to five. The corollary of “winner-takes-all” is “everyone-else-loses.”

This prediction is not unique to FOS, but a well-discussed characteristic of all platform industries.¹⁵⁹ With general use applications like search engines, social media, and so forth, consumers thirty years ago had a choice between many different platforms, including Netscape, Yahoo and others. Today, for mass scale applications, only one or two dominant platforms are used by far the most users: Google is the dominant search engine, Facebook the dominant social media platform, MS Office the dominant office platform, and so forth. As a historical matter, all American information markets have turned into monopolies or oligopolies over time,¹⁶⁰ and this increasingly appears to describe the evolution of cloud services markets.¹⁶¹

In the same way, one or two of the FOS providers will most likely emerge

¹⁵⁹ See Khan, *supra* note 142, at 785.

¹⁶⁰ See TIM WU, THE MASTER SWITCH: THE RISE AND FALL OF INFORMATION EMPIRES 280-299 (2010) (arguing that American information industries tend to press towards monopolies); see also on the promise and perils of technology-driven competition ARIEL EZRACHI & MAURICE E. STUCKE, VIRTUAL COMPETITION: THE PROMISE AND PERILS OF THE ALGORITHM-DRIVEN ECONOMY (2006).

¹⁶¹ See FSB, THIRD-PARTY DEPENDENCIES IN CLOUD SERVICES: CONSIDERATIONS ON FINANCIAL STABILITY IMPLICATIONS (Dec. 2019).

as winners of the winner-take-all FOS race. Those FOS will be the ones that can best capitalize on the three growth factors discussed above: conventional and data-driven economies of scope, scale, and network effects.

Financial law so far does little to hinder market concentration; quite the opposite. When the law asks for new reports and processes, some (particularly larger) firms will technologize and comply, expanding the FOS service range. Others, in particular small and mid-size entities incapable of meeting reporting demands on their own, will rely on the FOS to comply, in return for ceding a part of their profits. This dynamic will effectively turn the reliant providers into a part of the larger FOS, a merger not in name but in function. A larger entity will, part-by-part, consume the portion of the pie made consumable by their activities. Ever-fewer entities with larger scale economies will capitalize on more expensive-to-build and higher value technology. Initial evidence of this trajectory already exists in how the ten largest asset managers including BlackRock, Vanguard and Fidelity have outgrown the remainder of the industry.¹⁶² This projected trajectory is likely to occur, in the absence of legal barriers (such as the prohibition of bundling of certain functions within a FOS) or disruptive technological innovations that reduce the platform's usefulness.

Most scholarship so far has turned to antitrust law to provide salutary legal barriers to this future. For instance, while government agencies such as the Department of Justice often treat platform-based products and non-platform goods alike, antitrust scholarship increasingly treats platforms as unique.¹⁶³ Specifically, scholars note the attractiveness of network participation achieved through data collection, and that network effects erect insurmountable barriers to entry for new competitors.¹⁶⁴ Where investors – due to data and network

¹⁶² See Pooneh Baghai, Onur Erzan, Ju-Hon Kwek, *North American asset management in 2018: The New Great Game*, MCKINSEY&COMPANY (Nov. 2018), <https://www.mckinsey.com/~media/McKinsey/Industries/Financial%20Services/Our%20Insights/The%20new%20Great%20Game%20in%20North%20American%20asset%20management/North-American-asset-management-2018-vf.ashx> (stating that ‘the industry’s largest firms accounted for a disproportionate share of growth, with a set of “trillionaires” generating over 80 percent of all positive organic growth and several making significant gains in share even outside of passive products.’).

¹⁶³ See David S. Evans, *The Antitrust Economics of Multi-Sided Platform Markets*, 20 YALE J. ON REG. 325 (2003); Khan, *supra* note 142, at 784 (2017); Frank Pasquale, *Two Narratives of Platform Capitalism*, 35 YALE L. & POL’Y REV. 309, 311 (2016) (developing a counter-narrative to the dominant neo-liberal view on the platform economy).

¹⁶⁴ See Adam Candeub, *Behavioral Economics, Internet Search, and Antitrust*, 9 I/S 407, 409 (2014) (arguing that switching costs prevent users from selecting new service providers in the absence of widespread malfunctioning of the system); Nathan Newman, *Search, Antitrust, and the Economics of the Control of User Data*, 31 YALE J. REG. 401 (2014) (arguing in favor of a stronger focus on the anticompetitive effects of a firm’s control of the users’ personal data); Frank Pasquale, *Privacy, Antitrust, and Power*, 20 GEO. MASON. L. REV. 1009 (2013) (arguing in favor of considering data control when assessing a firm’s market share).

effects – reward size over profit, predatory pricing becomes highly rational (even as the prevailing doctrine treats it as irrational and therefore implausible). Thus, striving for dominance today, even where costly, is a worthwhile strategy since it ensures monopoly rents in the future. Platforms are further able to “exploit information collected on companies using its services to undermine them as competitors.”¹⁶⁵

In turn, economists have started to model platforms as two-sided markets, where the client demand side is subject to different assumptions than the FOS provider supply side.¹⁶⁶

We need not, however, recapitulate the dicta of antitrust scholars. For our purposes, we need here simply stress that market concentration provides not only an antitrust but also a financial law challenge: the fewer FOS providers that compete, the fewer incentives to innovation that will exist and the greater are potential systemic risks from size (“too-big-to-fail”) or interconnection (“too-connected-to-fail”). While FOS assist in optimizing fund services in the short term, benefits may be reversed once the FOS provider gains a monopoly position. That is, innovation is likely to be slower than in the absence of a dominant platform. Consequently, the financial regulatory rationale of securing market efficiency long-term justifies FOS oversight.

2. Systemically Important Financial Operating Systems (SI-FOS)

The primary regulatory concern relates to the stability of the financial system. This stability is threatened if an entity that is important for the financial system fails. The crisis of 2008 taught us much about this systemic risk.¹⁶⁷

Generally speaking, an entity is systemically important if it is of such size or level of interconnectedness that its failure or default would put at risk the very existence of many other financial service providers exposed to that entity as counterparties. Size-related systemic risk is traditionally covered in

¹⁶⁵ See Khan, *supra* note 142, at 754-787 (2017); K. Sabeel Rahman & Lina Khan, *Restoring Competition in the U.S. Economy*, in UNTAMED: HOW TO CHECK CORPORATE, FINANCIAL AND MONOPOLY POWER 18, 18 (Nell Abernathy et al. eds.) (2016) (finding that the harms from dominant platform firms include lower wages for employees, lower rates of new business creation, lower rates of local ownership, and concentration of power); MARK R. PATTERSON, *ANTITRUST LAW IN THE NEW ECONOMY: GOOGLE, YELP, LIBOR, AND THE CONTROL OF INFORMATION* (2017) (arguing in favor of conceptualizing data as a product, since data although different from traditional goods, poses similar problems in antitrust terms, such as monopoly and collusion).

¹⁶⁶ See Rochet & Tirole, *supra* note 150, *passim*.

¹⁶⁷ See Howell Jackson, *Thinking Hard About Systemic Risk*, in SYSTEMIC RISK IN THE FINANCIAL SECTOR 2-3 (Arner et al, 2019).

discussions of too-big-to-fail (“TBTF¹⁶⁸”) risks. Large banks governed under special regulations for global systemically important financial institutions (“G-SIFIs”) provide the most important example. Another source of systemic risk stems from interconnectivity, referred to as too-connected-too-fail (“TCTF”). Consider, as examples, a stock exchange or central securities depository (“CSD”). All financial institutions that trade rely on both a stock exchange and a CSD for trading, clearing, and settlement. If a stock exchange or a CSD defaults, trading of products may stop due to loss of pricing and liquidity functions from which all market participants benefit. This failure would impact a wide range of counterparties and potentially impact the overall functioning of, or confidence in, the system.

FOS in the asset management industry are not quite exposed to financial risk in the same sense as banks. All a bank’s losses and profits accumulate on the bank’s own balance sheet. If a bank client defaults, the bank will write off the credit, and the principal written off will be much higher than the bank’s income generated through provision of the credit. By contrast, asset managers and the related service providers’ services are, for the most part, off-balance sheet; that is, losses and profit accumulate in separate accounts held in the clients’ names. FOS do, however, generate a significant degree of operational risk, particularly risks that the FOS operations fail for human or, increasingly, technical reasons.¹⁶⁹

These operational risks are increasingly of systemic dimensions, under both the TBTF and the TCTF paradigms. As to TBTF, the sheer size and scope of financial ecosystems indicate the potential of platform businesses like FOS to jump from too-small-too-care to TBTF within a short time. Consider, again, the magnitude of Ant Financial,¹⁷⁰ after just a few years of uninhibited growth, including its money market fund Yu’e Bao which needed only six years to become the world’s largest; the assets served by BlackRock’s Aladdin, which all but dwarf the assets of the largest banks globally (all of which are listed by the Financial Stability Board as global SIFIs); as well as the astonishing growth rates of both front-end and back-end FOS providers.¹⁷¹

As to TCTF, FOS provide the core functions of their clients’ business. If

¹⁶⁸ See for a classification of TBTF Saule T. Omarova, *The 'Too Big To Fail' Problem*, 103 MINN. L. REV. 2495, 2499-2504 (2019).

¹⁶⁹ See Ross Buckley, Douglas Arner, Dirk Zetzsche & Eriks Selga, *The Dark Side of Digital Financial Transformation: The New Risks of FinTech and the Rise of TechRisk*, __ SING. J. LEG. ST. __ (forthcoming 2020).

¹⁷⁰ Recall Ant’s SIFI designation; *supra* note 156.

¹⁷¹ As to front-end FOS, the IOSCO, the global standard setter for securities regulation (and thus asset and funds management), examining the impact of fund distribution platforms on the asset management industry, found that these platforms have experienced rapid growth in recent years. See IOSCO, RESEARCH REPORT ON FINANCIAL TECHNOLOGIES (FINTECH) 22, 25, 68-9 (FEB- 2017), online <https://www.iosco.org/library/pubdocs/pdf/IOSCOPD554.pdf>.

the FOS fails, the FOS clients will often be hindered from communicating with *their* clients, nor will the FOS clients be able to perform the services their clients expect. Losses generated by FOS malfunctions will thus spread to their clients' clients into the overall financial and non-financial economy. This domino effect will be so because Aladdin connects people and processes of various asset managers, a fact BlackRock refers to as "Collective Intelligence."¹⁷² All those connected may suffer from Aladdin's temporary service interruption, experiencing a state of "Collective Stupidity." More generally, FOS function as the spider in the web, and as such represent the single point of failure for not only one, but many institutional and retail clients. As the CEO of New York Life Investors, an Aladdin client managing \$240 billion in assets, states, "Aladdin is like oxygen. Without it we wouldn't be able to function."¹⁷³

Furthermore, the value managed using Aladdin increases the risk of investor herding behavior since these amounts may have the ability to set market trends. Aladdin's clients, implicitly coordinated through Aladdin's risk analysis, may find the same type of assets attractive, or unattractive, at the same time.¹⁷⁴ If this is the case, Aladdin's risk analysis needs to be accurate or widespread asset mispricing and misallocation may occur. Regulators need to be aware of what to do in case Aladdin gets it wrong, producing potentially systemic mispricing and trading activity.

The TBTF and TCTF perspective explain filmmaker Adam Curtis' description of Aladdin as "a kind of power never seen before ... more powerful in some respects than traditional politics."¹⁷⁵

3. National Security

Within the market integrity paradigm, FOS may attract illicit activity. Putting money laundering and terrorist financing concerns aside,¹⁷⁶ More importantly, as an extension of systemic importance, FOS may constitute a challenge to national security simply because they represent a single point of failure. Any foreign or terrorist power interested in creating civil unrest could focus their corruptive efforts on a FOS. Cyber risks in particular raise significant national security concerns, making resilience a first order focus.

¹⁷² See Aladdin® Platform Overview, *supra* note 57.

¹⁷³ See Gara, *supra* note 67.

¹⁷⁴ See Dunn, *supra* note 58 (citing Stanley Pignall, *The Economist's* finance correspondent and drawing analogies to credit rating agencies' recommendation of subprime real estate-linked financial products in 2008).

¹⁷⁵ See Dunn, *supra* note 58.

¹⁷⁶ In most cases, AML/CTF concerns relate to client onboarding. The KYC processes could be performed by the FOS itself or its clients. In this regard few *additional* risks stem from the fact that a FOS stands at the center of many financial service relationships.

4. Client Protection

FOS also create a variety of risks for investors. The number of investors who directly rely upon the current financial order for their personal fiscal health has increased dramatically over time as ever more investors now direct their retirement savings through defined contribution plans. As many as fifty-five million households in the United States alone direct their personal savings into mutual funds. Thus, the financial landscape features increasing numbers of participants with decreasing degrees of financial sophistication. Accordingly, the number and vulnerability of targets to the risks of FOS failure are high and rising each year.

Where the fund is essentially the product of a network of contracts, the core issue of fund governance is aligning the multiple intermediaries' with the investors' interest.¹⁷⁷ Adding a FOS in between investor / clients on one side, and the portfolio assets on the other, creates benefits for clients (where the bundling of data and liquidity generates returns),¹⁷⁸ but may also add one layer of complexity which could increase risks for investors.

Scholars stress that platforms enhance both information asymmetries and the opportunity for manipulation on the side of the platform providers, arguing that the consumer-clients of platforms are at the FOS providers' mercy.¹⁷⁹ The situation is not entirely the same in the investment fund context, since the investment advisors' and custodians' clients are at times sophisticated regulated financial intermediaries, including pension funds. Regulated intermediaries are by law required to understand the technology used and engage with platform providers about service quality and stability. Where consumers are present, mandatory financial legislation addresses typical consumer related risks such as fraud and excessive, sometimes hidden, fees charged by intermediaries to consumers. Though we do not argue that the applicable financial legislation is perfect – that would be far from the truth – the additional transparency of platform technologies paired with mandatory disclosure requirements of financial law and financial supervision might improve the situation for consumers. At the very least, we expect typical consumer-related risks such as fraud and excessive or hidden fees charged by intermediaries to be less important. For instance, the front-end FOS discussed *supra* compete today with regard to the best costs analysis tools. We expect

¹⁷⁷ JON BECKETT, *NEW FUND ORDER – A DIGITAL DEATH FOR FUND SELECTION?*, 32 et seq. (2016).

¹⁷⁸ *See supra*, at IV.A.

¹⁷⁹ *See Ryan Calo & Alex Rosenblat, The Taking Economy: Uber, Information, and Power*, 117 *COLUM. L. REV.* 1623 (2017); Giancarlo Frosio, *Reforming Intermediary Liability in the Platform Economy: A European Digital Single Market Strategy*, 112 *NW. U.L. REV.* 19 (2017).

this trend to continue.

Notwithstanding the foregoing, an obvious additional risk centers on the technology: all clients are linked through the FOS. Algorithms must be sufficiently mature to reflect the interests of a large number and potentially diverse group of clients, ranging from consumers, sophisticated investors, and wholesale clients to other financial intermediaries, and sufficiently robust to withstand a number of unforeseen events, ranging from natural disasters resulting in power outages to cyberattacks.

Another source of risk comes from the platform user guidelines, such as with soft commissioning based on platform turn-over. Many front-end FOS require providers of fund products to offer any product offered via the FOS to the FOS' clients for a certain amount of time, and ensure a minimum amount of investment on offer. The same is true for soft commissions where the shelf time granted by the platform depends on the overall volume on offer by any given fund manager. The motive for including such clauses lies in the platform providers' costs structure: including a new product on the platform generates some fixed costs on the side of the platform provider. The minimum requirements should ensure that those fixed costs are recovered, usually through distribution fees, sales commissions, or some type of soft dollars (such as research).

Minimum requirements relating to time and volume (or related sales incentives), however, can come with downsides for investors. Imagine a small and mid-cap fund investing in enterprises up to 1,000 employees, and with a maximum firm value of \$10 million. The investment opportunities in such markets are limited. A fund manager driven only by its investors' interests would stop issuing units once the investment opportunities become less attractive. Although bonus structures (through carried interest and other means) align fund managers' and investors' interests, the minimum requirements defined in the platform user guidelines can conflict with these. If, in compliance with such guidelines, the fund collects more inflows than can be invested profitably, the returns for the funds' investors will be diluted, and all investors will suffer.

Further complexity comes from the competition among some of the FOS clients simultaneously served by the very same FOS. The divergent interests of FOS clients require strictly segregated handling of clients' data. For instance, if both BlackRock and Schrodgers use Aladdin, they must ensure that BlackRock's trading data are not accessible to Schrodgers, and vice versa, to avoid market manipulation or insider trading. While easy to say this segregated treatment is hard to achieve. Some technology experts might have access to the two (or multiple) data streams, since they are used by the same algorithm; otherwise the economies of scale which drive FOS growth will not materialize.

In addition, there are non-fund specific downsides of platforms. For

instance, platforms disrupt the existing legal governance of contractual relationships by artificially imposing a tech intermediary between the parties.¹⁸⁰ In turn, contractual safeguards and other tools of private ordering may prove less effective.

IV. REGULATING FINANCIAL OPERATING SYSTEMS

In this section, we consider a variety of regulatory approaches to the potential risks FOS raise for investors, market structure, national security and financial stability.¹⁸¹ The main tasks of regulating asset management in the age of FOS will be to define the limits of IT-based concentration, to ensure sound investor protection, and to maintain well-functioning markets in spite of the trajectory towards ever larger FOS.

By increasing the severity of their possible regulatory intervention, regulators could adopt, first, a wait-and-see approach. And they could do so with or without pro-innovative regulators tools, such as regulatory sandboxes, test-and-learn methodologies, or special charters. Second, regulatory efforts could focus on enhancing competition. Third, regulators could intervene moderately, by regulating delegation arrangements. Fourth, regulators could require a public agency's partial or full ownership of FOS. While the full ownership of a FOS by a regulator (such as the Federal Reserve) could be forced upon the provider ex-post, via nationalization, another strong interventionist approach discussed in Part IV.D. would treat FOS as utilities. All of these, however, are fundamentally based on disclosure to and information gathering by supervisors: if supervisors do not build their knowledge about these sorts of systems as they evolve, they will not be able to take appropriate judgements in balancing risks and benefits.¹⁸²

From the outset, we exclude a potential fifth response: prohibition. Given that FOS are both crucial infrastructure for financial markets and provide enormous cost savings for investors, prohibition is inappropriate. This conclusion contrasts with other areas of FinTech innovation in which in certain cases prohibition may be an advisable response to abuses or risks.¹⁸³

¹⁸⁰ See Orly Lobel, *The Law of the Platform*, (2016) MINN. L. REV. 137 (concluding that legal disruption is a common feature of platform economies).

¹⁸¹ See Dirk Zetsche, Ross Buckley, Janos Barberis & Douglas Arner, *Regulating a Revolution: From FinTech and Regulatory Sandboxes to RegTech and Smart Regulation*, 18 FORDH. J. CORP. & FIN. L. 31, *passim* (2018).

¹⁸² See Kathryn Judge, *Information Gaps and Shadow Banking*, 103 VA. L. REV. 411, 466-480 (2017) (arguing that information asymmetry is a meaningful source of systemic risk and demanding that regulators should focus on reducing information gaps).

¹⁸³ See Zetsche et al., *supra* note 20, at 305-6 (discussing prohibition as one policy choice regarding initial coin offerings); Zetsche et al., *supra* note 181, *passim* (discussing prohibition as a regulatory option).

A. Foster Innovation: Do Nothing or Test-and-Learn

1. Do Nothing

The first possible approach to regulating FOS would simply be not to regulate them. By doing nothing to regulate FOS, the result would be either rigorous or laissez-faire depending upon whether current financial regulation applies to the operations of a particular FOS. Doing nothing might involve requiring new entrants to comply with existing financial regulations, often with highly restrictive results and adverse effects on financial innovation.

Alternately, a do-nothing approach could simultaneously accelerate financial innovation *and* exacerbate data-driven market dynamics. China, especially before 2015, is often highlighted as the leading, and a highly successful, example of the permissive approach with regard to FinTech.¹⁸⁴ While the soundness of the Chinese financial system prior to the FinTech boom may explain the benefits of doing nothing for innovation and development in this particular case,¹⁸⁵ while non-legal means allowed the political control over the emerging providers of financial ecosystems (or they owners, at least), the Chinese example also demonstrates the systemic risks that stem from unexpected and uninhibited growth of certain market participants. That growth has led, since 2015, to a much more cautious regulatory approach.¹⁸⁶ Most notably, during its unregulated period, Alibaba's financial arm laid the foundation for forming the world's largest financial ecosystem (measured by its number of clients). In our context, a laissez-faire approach would be likely to further the growth of existing FOS. This approach has largely been the one taken in most countries so far but still has the potential to result in undesirable winner-take-all outcomes.

2. Test-and-Learn: Sandboxes, Special Charters, and Innovation Hubs

In the specific context of FinTech innovation, test-and-learn approaches –

¹⁸⁴ See Weihuan Zhou, Douglas Arner & Ross Buckley, *Regulation of Digital Financial Services in China: Last Mover Advantage?*, 8 TSINGHUA CHINA L. REV. 25, 27 (2015); Arner et al., *supra* note 13, at 1298–99; Weihuan Zhou et al., *China's Regulation of Digital Financial Services: Some Recent Developments*, 90 AUSTL. L.J. 297 (2016).

¹⁸⁵ See Christian Haddad & Lars Hornuf, *The Emergence of the Global FinTech Market: Economic and Technical Determinants* 20 (CESifo Working Paper No. 6131, 2016) <https://ssrn.com/abstract=2830124> (arguing that the soundness of the financial system has a negative effect on FinTech start-up dynamics; *i.e.* financial systems with many deficits provide a vibrant environment for start-ups).

¹⁸⁶ Weihuan Zhou, *supra* note 184, at 27.

including regulatory sandboxes, innovation hubs, and special charters¹⁸⁷ – have been discussed as methods to support balanced innovation.¹⁸⁸ These tools, while far from being a panacea, do enhance the flow of information between innovative firms and their regulators. In our case, however, these tools may prove of little value since they are designed to promote testing of new technologies and business models by smallish outfits rather than to regulate existing FOS run by global players.

B. Generate Competition

A second regulatory approach could focus on enhancing competition, to ensure competitive market forces play a beneficial role rather than contributing to an already concentrated financial sector. Pro-competition measures have been considered with regard to IT / software,¹⁸⁹ critical FMIs such as payment, clearing, and settlement systems,¹⁹⁰ and in “open banking” initiatives.¹⁹¹

1. Mandating Access

Regulation could aim at securing objective, transparent, and fair risk-based rather than profit-based conditions of access. Open interfaces, open source code of the technology core, fair and non-discriminatory access requirements, and a transparent fee structure enable third-party developers to write

¹⁸⁷ A regulatory sandbox is a safe space in which innovative FinTech applications can be tested with sharply reduced regulatory requirements (subject to certain pre-conditions). An innovation hub is a portal that facilitates access of industry to regulators, and seeks to promote bespoke regulation, no-action letters, and other dispensations on a case-by-case basis. Special charters are authorizations to conduct FinTech type businesses without having to comply with the full panoply of financial regulation, though subject to special limits. See Ross P Buckley, Douglas W Arner, Robin Veidt & Dirk A Zetsche, *Building FinTech Ecosystems: Regulatory Sandboxes, Innovation Hubs and Beyond*, __ WASH. J. L. & POL'Y __ (forthcoming 2020).

¹⁸⁸ See Hilary J. Allen, *Regulatory Sandboxes*, 87 GEO. WASH. L. REV. 579-645; Chris Brummer, *Disruptive Technology and Securities Regulation*, 84 FORDH. L. REV. 977 (2015); Chris Brummer & Yesha Yadav, *FinTech and the Innovation Trilemma*, (2019) 107 GEO L.J. 235-307; Kathryn Judge, *Investor-Driven Financial Innovation*, 8 HARV. BUS. L. REV. 291 (2018); Saule Omarova, *New Tech v. New Deal: FinTech As A Systemic Phenomenon*, 36 YALE J. ON REG. 735-793 (2019); W.J. Magnuson, *Regulating FinTech*, 71 VANDERBILT L. R. 1168-1226 (2018); Zetsche et al., *supra* note 181, *passim*.

¹⁸⁹ See on Microsoft MICROSOFT ON TRIAL: LEGAL AND ECONOMIC ANALYSIS OF A TRANSATLANTIC ANTITRUST CASE (Luca Rubini, ed.) (2014).

¹⁹⁰ See, in particular, IOSCO & BIS, *supra* note 12, at 101 (discussing access conditions by providers of Financial Market Infrastructure).

¹⁹¹ See Markos Zachariadis & Pinar Ozcan, *The API Economy and Digital Transformation in Financial Services: The Case of Open Banking*. SWIFT Institute Working Paper No. 2016-001 (June 15, 2017), available at SSRN: <https://ssrn.com/abstract=2975199>.

proprietary applications for FOS clients.¹⁹² In this regard, Principle 18 of the IOSCO principles on access to the services of providers of critical Financial Market Infrastructure is relevant. In particular, that principle states that

[a]n FMI's participation requirements should be justified in terms of the safety and efficiency of the FMI and the markets it serves, be tailored to and commensurate with the FMI's specific risks, and be publicly disclosed. Subject to maintaining acceptable risk control standards, an FMI should endeavor to set requirements that have the least-restrictive impact on access that circumstances permit.

2. Diversification

Regulators could also ask FOS clients to diversify their own risks from their dependency on the FOS. Regulation could require that any *financial* firm must employ at least two or more FOS, and that these FOS be unrelated to each other. While mandatory diversification has some positive effects on market structure in the FOS market, it also comes with increased costs, imposed redundancy, additional cybersecurity risks (given that multiple FOS would have access to the firm's client data), and reduced benefits of datafication (because of slowed IT processes). Most importantly, mandated diversification could result in significant confusion among clients of front-end FOS of financial ecosystems: clients' main benefits – one look and feel, one service level, and one service quality, as well as the accumulation and best use of a client's liquidity for ensuring lower costs on the back-end – will decrease when clients need to deal with more than one FOS concurrently. Mandatory diversification, if imposed, might work only on the back-end.

An alternative to this mandatory diversification suggestion might be limiting a FOS' maximum share of clients in a given market; we discuss this more interventionist approach *infra*, at IV.D.

3. Rotation

Instead of diversification, and following the Sarbanes-Oxley Act's provisions on auditors, clients could be required to switch FOS every few years. Rotation would likely be costly: all weblinks, data interfaces, and brokerage

¹⁹² See, e.g. *United States v. Microsoft Corp.*, 231 F. Supp. 2d 144 (D.D.C. 2002) (settling the year-long U.S. Department of Justice's antitrust litigation against Microsoft on abusive terms for third-party webbrowser software and requiring Microsoft to make available for use by third parties on reasonable and non-discriminatory terms certain technology used by Microsoft server operating system products to interoperate with Windows operating system products.)

connections would need readjustment after each switch, giving the institution's clients even more reason to contract directly with the FOS provider. FOS providers will also find it difficult to negotiate fee reductions based on liquidity streams if the law mandates regular displacements of the very liquidity for which the discount provides an incentive to stay. Further, if the technology of *their* clients is linked – either technically or economically – to the FOS, an institution's clients will have even more reason to contract directly with the FOS, thereby exacerbating, rather than slowing, market concentration.

4. Open Data

Regulators could mandate that incumbents grant new entrants' access to client account data; the new entrant could then reduce a client's switching costs by securing smooth tech migration. While standardization of client data is a crucial precondition for smooth migration,¹⁹³ doubts remain about whether in fact small new entrants would benefit from such a rule. In particular, in the case of the EU's Open Banking Initiative, access to client data appear to facilitate the market access of large technology companies that have resources to (1) attract a sufficient number of new clients *and* (2) program large scale data transfer interfaces.¹⁹⁴ We thus propose requiring open client data only from firms with a strong, potentially dominant position. For instance, in an effort to hamper the further concentration in the asset management industry, an open data requirement paired with a data governance requirement could be attached once a FOS market share exceeds five percent in any asset management market, in order to break into the data-based economies of scale.

5. Unbundling of Services and Prices

Another regulatory strategy would be to mandate separate service pricing and an option for clients to source distinct and separate services from a FOS. Unbundling seeks to separate fees for different services previously sold as a package, and the prohibition of hidden bundling rebates (“tying”). Unbundling aims at two different goals. First, the price of a single service becomes transparent, allowing new entrants to review whether they can compete by offering a better single service, if they cannot compete with the whole platform. Second, unbundling prohibits the cross-subsidization of some services from the proceeds of other services for which there may be more competition.

¹⁹³ See Giuseppe Colangelo & Oscar Borgogno, *Data, Innovation and Transatlantic Competition in Finance: The Case of the Access to Account Rule 22-26*, Stanford–Vienna Transatlantic Techn. L.F., European Union Law Working Papers No. 35 (2018).

¹⁹⁴ See Dirk Zetzsche, Douglas Arner, Ross Buckley & Rolf Weber, *The EU's Future of Data-driven Finance*, __ COMM. MARKET L. REV. __ (forthcoming 2020).

Unbundling as a regulatory requirement, however, must be handled with care. Unbundling reduces some efficiencies that stem from bundled client contacts and the better data inherent in handling more and related services simultaneously.¹⁹⁵ After all, unbundling involves ripping the integrated platform apart, though its very integration is one of its main benefits. Regulators imposing unbundling requirements face the further difficulty of determining which part of a service may be untied at what point in time, without impeding innovation based upon *disintermediation*. We discuss the more interventionist variant of unbundling in which FOS would be prohibited from offering some services together with others *infra*, at IV.

6. Merger Control

Merger control is the standard antitrust approach to overly concentrated markets. Though antitrust law's main rationale is market efficiency, our analysis of FOS suggests that merger control can also be justified from a financial regulation perspective: mergers of very large platforms could be prohibited not only because of antitrust concerns, but also for client protection, innovation, and, especially, financial stability concerns.

C. Moderate Regulatory Interventions

As moderate regulatory interventions, regulators have at their disposal various types of command-and-control, self-regulatory, and co-regulatory approaches. The best approach will depend on the stage at which the FOS finds itself. As a general matter, the stronger the position of a FOS in a financial services market, the stronger the case for an intervention.¹⁹⁶

1. Command-and-Control Regulation: Licensing

a. Regulating Financial Data Gathering and Analytics

A standard response of regulators to increasing concentration within a given industry includes adding an additional layer of regulation upon participants, particularly through licensing as a regulated activity. In doing so,

¹⁹⁵ There is a wide body of antitrust literature discussing tying practices and unbundling requirements. See Keith N. Hylton & Michael Salinger, *Tying law and Policy: A Decision-Theoretic Approach*, 69 ANTITRUST L. J. 469 (2001); Nicholas Economides & Ioannis Lianos, *The Elusive Antitrust Standard on Bundling in Europe and in the United States in the Aftermath of the Microsoft Cases*, 76 ANTITRUST L. J. 483 (2009).

¹⁹⁶ For guidance, see IOSCO & BIS, *supra* note 12, at 12-13 (discussing applicability and proportionality of the FMI principles).

they enhance control over the sector and obtain better data for regulatory decisions. The difficulty in submitting FOS to regulation is finding a common denominator of activities that accurately describe the activities of most, if not all, FOS.

Given that the core of FOS activity is data collection and processing, regulators could define “financial data gathering and analytics” as a regulated activity, and provide exemptions to participants that do not meet size or scope requirements of a FOS. The result of such regulation could be a differentiated regime with tiered rules for large FOS, similar to the rules applicable to SIFIs, moderate reporting requirements for mid-size FOS, and a mere registration requirement with no additional disclosures for small FOS.

b. Indirect Regulation: Delegation and/or Counterparties

An alternative approach focuses on the FOS’ regulated clients. Rather than addressing the FOS directly, asking regulated firms to ensure a number of prerequisites would create advantages, particularly in cross-border settings, where only parts of the FOS are located within a regulators’ ambit. For instance, regulations often require regulated entities to ensure compliance with the laws of its home jurisdiction even where it delegates services to entities located in other jurisdictions. Limits of indirect regulation arise, however, when the delegating firm depends on the delegate’s services but not vice versa. This one-sided dependency can be due to a delegate’s size (rendering the delegate less dependent on a single client), the outsourcing firm’s lack of alternatives in a given sector, or where significant transaction costs hinder an easy switch. The first concern is possibly – and the following two concerns are certainly – present in the case of FOS.

A closer look reveals that regulated firms have very few means to ensure FOS stability and honest conduct. How can a client of Aladdin ensure that Aladdin performs its technology job properly? The value of many firms today is in the data, which Aladdin possesses. Clients cannot credibly put firms under pressure whose market value is many times larger than their own. (BlackRock could, for instance, readily buy the systemically important Deutsche Bank.) Nor can clients apply controls that *ensure* the technology works. In the end, financial institutions are at the mercy of FOS.

In the context of FOS, the outsourcing relationship is inverted and the tail wags the dog: indirect regulation is ill-equipped to counter the fact that the FOS is the heart of many financial firms, particularly in asset management.

c. Code Review by FSAs

A different regulatory approach could focus on the FOS’ code; *i.e.* its

technical functionality. Supervisory agencies could seek to understand the technology and require additional code aimed at meaningfully balancing private incentives with public interests. Such a code-focused approach would ask much from regulators trained in financial and legal matters.¹⁹⁷ To our knowledge, a review tool for the functionality and limits of self-learning algorithms has yet to be developed,¹⁹⁸ but FOS often rely on such algorithms. Further, model risk assessment is among the most complex tasks in modern finance; even the best funded and most sensitive organizations – including the Department of Defense and CIA – fail, at times, to combat cyber threats.

2. Encourage Self-Regulation

Self-regulation is a critical means of drawing upon the knowledge of FOS participants when regulators reach the limits of their own expertise. Providers of financial market infrastructure thus typically establish a common set of rules and procedures for all participants, a technical infrastructure, and a specialized, customized risk management framework.¹⁹⁹ While these rules and procedures often take a contractual format, a self-regulatory approach could formalize the adoption and amendment of these rules and establish a minimum publication and notice period. Regulators can use these frameworks to enhance control over FOS.

The downside of self-regulation is the dependency of the “self-regulated constituency” on adopting rules. Where the collective private and public interests collide, we might expect few serious efforts at self-regulation. In particular, although we might see the establishing of basic investor protections, the FOS provider and its participants have little interest in slowing growth by curtailing the network effects from which it benefits, and so will do little to combat antitrust concerns and size-based systemic risk. So self-regulatory organizations face the tension between remaining light touch and interest-friendly or turning, like FINRA,²⁰⁰ into more of a public oversight body focused on technicalities *in addition to* mandatory regulation.

3. Adopt Co-Regulation Approaches

¹⁹⁷ We have tackled the issues how regulators can address cyber risks elsewhere, *see* Buckley et al., *supra* note 169, at ___.

¹⁹⁸ *See* Joshua Kroll, Joanna Huey, Solon Barocas, Edward Felten, Joel Reidenberg, David Robinson & Harlan Yu, *Accountable Algorithms*, 165 U. PA. L. REV. 633 (2017).

¹⁹⁹ BIS (2012), *supra* note 12, at 7.

²⁰⁰ *See* William A. Birdthistle & M. Todd Henderson, *Becoming a Fifth Branch*, 99 CORN. L. REV. 1, 12-23 (2013) (analyzing the evolution of FINRA from a self-regulatory organization to a quasi-governmental organization).

Regulators could pursue a co-regulation strategy. Co-regulation has been defined as a “mechanism whereby [a] legislative act entrusts the attainment of the objectives defined by the legislative authority to parties which are recognized in the field (such as economic operators, the social partners, non-governmental organizations, or associations)” by setting “objectives to be attained but their achievement is entrusted to non-public actors in economic and social domains.”²⁰¹ Co-regulation has been discussed as potentially effective for non-financial platform industries, through its inclusion of a broad pool of “in the articulation, execution and evolution of policy, law, norms development, oversight and regulation,”²⁰² leading to more balanced views. Examples include agreements between local authorities and AirBnB on the collection of tourist tax.²⁰³

For FOS, regulators could seek to enter into co-regulation agreements with FOS operators that reflect public concerns such as systemic risk, customer protection, market integrity, and national security. As with any other regulatory tool, however, co-regulation has its limits when the public interest collides with the FOS provider’s private interest in making profits. Thus, although co-regulation could be a way to implement moderate investor protection and national security measures, it may be less effective with regard to the antitrust and financial stability concerns we have outlined.

D. Regulation as Public Utilities

1. Public Utility Status

In line with scholarship on platform industries,²⁰⁴ FOS could be regulated as public utilities. Regulation characteristics of public utilities include, for instance, rate regulation, minimum service level and quality assurance prescriptions, and a defined or capped rate of return on investments. This list demonstrates that traditional public utility regulation fits best for highly standardized services such as energy and water supply. Regulators seeking to set the aforementioned limits in a highly innovative, rapidly growing environment such as FOS will face potentially insurmountable challenges.

²⁰¹ See Michèle Finck, *Digital Co-Regulation: Designing a Supranational Legal Framework for the Platform Economy*, 43 EUR. L. REV. 47, 49-51 (defining co-regulation).

²⁰² See Raymond Brescia, *Regulating the Sharing Economy: New and Old Insights into an Oversight Regime for the Peer-to-Peer Economy*, 95 NEBRASKA L. REV. 87, 134 (2015).

²⁰³ See the list of examples by Finck, *supra* note 201, at 62-65#.

²⁰⁴ K. Sabeel Rahman, *The New Utilities: Private Power, Social Infrastructure, and the Revival of the Public Utility Concept*, 39 CARD. L. REV. 1621 (2018) (arguing that public utility concepts offer a framework for understanding and contesting private power in a variety of sectors, including the financial and platform markets); K. Sabeel Rahman, *Regulating Informational Infrastructure: Internet Platforms as the New Public Utilities*, 2 GEO. L. TECH. REV. 234 (2018) (detailing how the utility concept applies to internet platforms).

A less intrusive form of public utility status is the designation of FOS as Financial Market Utilities (FMU) under Title VIII of the Dodd-Frank Act, asking for advanced risk-management methods, intensified supervision and advance notice of rule changes, yet these rules drafted for clearing organizations and central counterparties would need amendments to reflect the data and liquidity dimension of FOS stressed in this Article.

2. Participation / Ownership of Public Agencies

As a form of indirect regulation, supervisory authorities could become significant shareholders or operators of a FOS. Examples include RTGS payment systems in which the technology core is developed with the involvement of central banks that, in some cases, also engage in operations. Similar approaches are now being seen in an increasing number of jurisdictions at the retail level with “faster payment systems.” Putting aside the obvious capacity constraints of many competent authorities, a stake in the FOS at the same time brings clear informational advantages for a central bank.

On the downside, authority stakes in a FOS create a potentially undesirable outcome: the FOS in which a central bank or other authorities take a stake is likely to be a monopolist. This monopolist will likely leave little room for additional market-led innovation. Governmental investment makes most sense in markets where competition is unlikely to develop in the first place, such as where existing financial institutions are insufficiently funded or tech expertise is scarce²⁰⁵ or where competition is undesirable because all financial institutions must meet the same standard in order to reduce *their customers’* transaction costs (such as in payment systems).

3. Unbundling FOS

A more interventionist approach would mandate unbundling. Unbundling is well established as an antitrust measure, yet financial law also frequently imposes separation and unbundling. Some contend, indeed, that a “core principle of banking law is the separation of banking and commerce.”²⁰⁶ At least in the U.S. pursuant to the Bank Holding Company Act of 1956, firms that own or control a U.S. bank are prohibited from engaging in business activities

²⁰⁵ We find these preconditions often met in developing and emerging economies. This explains why India’s government has developed and functions as operator of core infrastructure for financial services.

²⁰⁶ See Saule T. Omarova, *The Merchants of Wall Street: Banking, Commerce, and Commodities*, 98 MINN. L. REV. 265, 268, 274-75 (2013); see also Khan, *supra* note 142, at 794; Bernard Shull, *Banking and Commerce in the United States*, 18 J. BANKING & FIN. 255, 267 (1994).

other than banking or managing banks.²⁰⁷

Investment regulation provides for similar separation and unbundling. For instance, the role of an investment advisor is to be separated from that of, first, the investment company holding legal title to fund assets; second, the custodian which in most cases has custody of the fund's assets; and third, the broker-dealers and financial planners who assist investors in selecting funds. These unbundling requirements reflect that fund management, safekeeping, and investor roles together represent the traditional interest spheres of collective or pooled investments.²⁰⁸ In principle, whoever acts on the side of the investor, such as broker-dealers, wealth managers, estate planners or investment advisers (together referred to as "client intermediaries") is by law bound to serve the investor's individual interest, while the fund manager and custodian/depositary should be committed to the "fund" rather than individual investors.

In particular, the Investment Company Act requires mutual funds to maintain strict custody of fund assets separate from the assets of the fund manager.²⁰⁹ In principle, all investments by registered investment companies "shall be deposited in the safekeeping of, or in a vault or other depository maintained by, a bank or other company whose functions and physical facilities are supervised by Federal or State authority."²¹⁰ Third-party custody enables investment funds to control both their own assets and assets (particularly collateral) held by the custodian when the custodian experiences difficulties. The advantage of this approach was highlighted in the aftermath of the collapse of the investment bank Lehman Brothers in 2008.²¹¹

This approach reveals the insight that each core intermediary fulfils a controlling function vis-à-vis each other type of intermediary. As long as the core intermediary functions are separate, we can expect an equilibrium to exist in the relations between the different types of core intermediaries. If separation is ensured, then market forces may lead to undesirable results only within each

²⁰⁷ See Khan, *supra* note 142, at 794 (stressing the similarity of this rules with antitrust and competition policy objectives and stating that the main justifications for preserving the separation between banking and commerce include "the needs to preserve the safety and soundness of insured depository institutions, to ensure a fair and efficient flow of credit to productive [businesses], and to prevent excessive concentration of financial and economic power in the financial sector.")

²⁰⁸ See Morley, *supra* note 119, at 1238-1242.

²⁰⁹ See 17 C.F.R. § 270.17f-2 Custody of investments by registered management investment company. For further custody requirements see § 270.17f-1 (broker-dealer custody); § 270.17f-2 (b) (self-custody); § 270.17f-4 (securities depositories); § 270.17f-5 (foreign banks); § 270.17f-6 (futures commission merchants); and § 270.17f-7 (foreign securities depositories).

²¹⁰ 17 C.F.R. § 270.17f-2 (b) Custody of investments by registered management investment company.

²¹¹ See Investment Company Institute, *Comprehensive Regulatory Regime for U.S. Mutual Funds*, INVESTMENT COMPANY INSTITUTE, 3, https://www.ici.org/pdf/14_ici_usfunds_regulation.pdf.

core intermediary. The necessity of having types of intermediaries separated prompts the question whether there ought to be limits to disruption. Law is static and, for financial law, enforced by supervisory authorities. As such, law may function as a barrier to disruption. Specifically, the law may limit the extent to which tech-based innovation streamlines the value chain and the services integrated into platforms. If disruption is limited to *innovations within* each of the core intermediary functions, for structural reasons, the law must clearly define those limits.

A closer look reveals, however, that these limits are blurred. Under rule 17f-2(c), the *Investment Company Act* allows for self-custody with regard to various securities collateralized, escrowed, or in transit, or *in other transactions necessary or appropriate in the ordinary course of business relating to the management of securities*. Insolvency risk does not vanish in a world of FOS. Rather, with greater market concentration, a FOS provider's insolvency might have a more severe impact. Other jurisdictions have thus abolished self-custody and always require third-party custody of investment fund assets.²¹²

A discussion of investor protections in custody arrangements is beyond the scope of this Article. We are interested only in the limits to platform building in U.S. custody law. To address FOS-based concentration, it may be advisable to amend Rule 17f-2(c) so that the investment company and investment advisor may hold only insignificant amounts of assets of their own. The fact that “[n]early all mutual funds use a bank custodian for domestic securities, and the custody agreement is typically far more elaborate than the arrangements used for other bank clients”²¹³ suggests that this policy recommendation is in line with client expectations and industry practice.

In a similar vein, a strict line between the client intermediary function and the fund manager prevents additional conflicts of interests from greater integration of service functions. If an investment adviser provides its own products, it has an incentive to offer those to clients rather than products possibly better suited to clients. If the investment adviser functions as a custodian, it may seek to enhance profits from its custodian function by channeling investors' assets into those funds rather than recommending the best investment to its clients. Demanding strict separation of investment advice, broker-dealers, and custodians is somewhat distant from current industry practice. Broker-dealer conglomerates like Charles Schwab not only provide brokerage and investment advice – as a client intermediary – but also offer

²¹² See Directive 2011/61/EU of the European Parliament and of the Council of 8 June 2011 on Alternative Investment Fund Managers and amending Directives 2003/41/EC and 2009/65/EC and Regulations (EC) No 1060/2009 and (EU) No 1095/2010, 2011 O.J. (L. 174) 28 Article 21; and the contributions by Hooghiemstra, Siena and Zetzsche in *THE ALTERNATIVE INVESTMENT FUNDS DIRECTIVE* (Zetzsche ed., 2ND ED., 2015).

²¹³ Investment Company Institute, *supra* note 211.

ETFs, a part of their role as fund managers. This fact exposes a large possible flaw in existing securities regulation: all of these services could be provided through entities owned and controlled by one holding company. In particular, the U.S. Bank Holding Company Act allows a bank that qualifies as a “financial holding company” to conduct all activities that are “financial in nature,” including securities dealing and insurance underwriting.²¹⁴ As we have shown, many incumbents rely on this exemption to present front-to-back comprehensive financial ecosystems, putting the very policy objective at risk.

A softer form of unbundling and separation would require segregation. For instance, an investment advisor might be prohibited from booking the fund’s asset in its own accounts, though it might under certain circumstances hold the assets in an account earmarked as investors’ assets. An even softer form would merely manage conflicts: two functions could be provided by one entity, but an information barrier would have to be erected and conflicts monitored – avoided where possible and managed where unavoidable.

Along these lines, FOS regulation could require the unbundling and separation of these four functions not only legally – as the law currently does, by requiring separate legal entities to perform these tasks – but also *technically*. A technical unbundling requirement would declare a platform illegal that simultaneously provides or facilitates fund manager, fund, custodian, and investor functions, and uses both data and liquidity access to secure control over the whole fund value chain.

V. CONCLUSION

This Article offers three main contributions to financial regulation scholarship. First, we highlight the role, size, and scope of Financial Operating Systems within global finance. In the asset management industry, FOS are developing either on the front or back end and, over time, appear to be evolving into comprehensive, front-to-back financial ecosystems. Second, we show that FOS are an emerging and unappreciated species of platform industry, with many of the attendant benefits and concerns. We have argued that ever-more parts of the asset management value chain will be integrated in ever-fewer FOS. We predict the financial pressure stemming from financial ecosystems’ access to data and liquidity will simultaneously squeeze profits out of the rest of the financial system, leading to fewer and larger service providers. This evolution could be partly beneficial, as disintermediation can drive costs down. Of course, not all innovation is good per se or for all purposes. Societies – and their financial regulations – must seek to remain open to innovation, and to balance innovation against risk. Third, we have argued that law and regulation

²¹⁴ See Omarova, *supra* note 206, at 268 (citing 12 U.S.C. § 184 3(k)(1)(A)).

must respond to the emergence of FOS. We have proposed how FOS could be regulated, ranging from a fostering innovation by taking a wait-and-see approach, through a pro-competition approach to moderate regulatory interventions, and finally to strict regulation as public utilities or even via nationalization.

The options regulators should take will depend on the stage of development of FOS within their jurisdictions, particularly in terms of market share, dominance, and the significance of the functions being provided. Regulators must, however, be prepared to act quickly to curtail significant risks that can ripen in the short time it will take financial operating systems to mature from their status as too-small-to-care to too-big-to-fail. We do not yet know whether the greatest threat from financial operating systems will germinate out of their domineering success or their catastrophic failure but, in either event, the time for sober legislative and regulatory scrutiny is now.



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