

## Essays on Fintech, Self-Regulating Organizations, Autonomous Finance, Self-Sovereign Identity, and Micro-Investment



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**ABSTRACT:** This paper discusses five topics: FinTech, self-regulating organizations, autonomous finance, self-sovereign identity, and micro-investment. In the first section, FinTech is defined, and FinTech use cases are described. The second section, which deals with self-regulating entities, defines the notion and highlights the Financial Industry Regulatory Authority. The third section concerns autonomous finance, where it is defined, its adoption by the financial world, its relationship with consumers, and the regulatory challenges with autonomous finance are evaluated. The fourth section addresses self-sovereign identity, where it is defined, various use cases are outlined, existing data breaches, and how to mitigate such regulatory risks. The final section discusses micro-investment, including its definition and characteristics, how micro-investment can be a long-term investment strategy, and how micro-investment can be a viable strategy for retirement planning. The article concludes by pointing out that although these topics are burning issues in finance, they are also replete with advantages and disadvantages of their own.

**KEYWORDS:** Autonomous Finance • Fintech • Micro-Investment • Self-Regulating Organizations • Self-Sovereign Identity

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Donald L. Buresh earned his Ph.D. in engineering and technology management from Northcentral University. His dissertation assessed customer satisfaction for both agile-driven and plan-driven software development projects. Dr. Buresh earned a J.D. from The John Marshall Law School in Chicago, Illinois, focusing on cyber law and intellectual property. He also earned an LL.M. in intellectual property from the University of Illinois Chicago Law School (formerly, The John Marshall Law School) and an LL.M. in cybersecurity and privacy from Albany Law School, graduating summa cum laude. Dr. Buresh received an M.P.S. in cybersecurity policy and an M.S. in cybersecurity, concentrating in cyber intelligence, both from Utica College. He has an M.B.A. from the University of Massachusetts Lowell, focusing on operations management, an M.A. in economics from Boston College, and a B.S. from the University of Illinois-Chicago, majoring in mathematics and philosophy. Dr. Buresh is a member of Delta Mu Delta, Sigma Iota Epsilon, Epsilon Pi Tau, Phi Delta Phi, Phi Alpha Delta, and Phi Theta Kappa. He has over 25 years of paid professional experience in Information Technology and has taught economics, project management, quality management, management of non-profits, negotiation skills, managerial ethics, and cybersecurity at several universities. Dr. Buresh is an avid Chicago White Sox fan and keeps active by fencing épée and foil at a local fencing club. Dr. Buresh is a member of the Florida Bar.

### List of Abbreviations

Abbreviation	Description
AI	Artificial Intelligence
AUM	Assets Under Management
B2B	Business-to-Business
B2C	Business-to-Consumer
BA	Biometric Authentication
CeFi	Centralized Finance
CFO	Chief Financial Officer
CRD	Central Registry Depository
dApp	Decentralized Application
DCA	Dollar Cost Averaging
DeFi	Decentralized Finance

DID	Decentralized Identifiers
DoJ	U.S. Department of Justice
ECOA	Equal Credit Opportunity Act
ERP	Enterprise Resource Planning
FDIC	Federal Deposit Insurance Corp.
FINRA	Financial Industry Regulatory Authority
FINRA-IEF	Financial Industry Regulatory Authority – Investor Education Foundation
FinTech	Financial Technology
FTC	Federal Trade Commission
GDPR	General Data Protection Regulation
IAM	Identity Access Management
ICO	Initial Coin Offering
KYC	Know Your Customer
ML	Machine Learning
NASD	National Association of Security Dealers
NLP	Natural Language Processing
NYSE	New York Stock Exchange
O2C	Order to Customer
P2P	Peer-to-Peer
PCI-DSS	Payment Card Industry – Data Services Standard
PFM	Personal Financial Management
PII	Personally Identifiable Information
PKI	Public Key Infrastructure
R2R	Report to Report
RPA	Robotic Processing Automation
SEC	Securities and Exchange Commission
SRO	Self-Regulatory Organization
SSI	Self-Sovereign Identity
SSO	Single Sign On
W3C-VCDM	World Wide Web Consortium Verifiable Credentials Data Model
YNAB	You Need a Budget
ZKP	Zero-Knowledge Proof

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**INTRODUCTION**

This paper discusses five topics, including FinTech, self-regulating organizations, autonomous finance, self-sovereign identity, and micro-investment. In the first section, FinTech is defined, and FinTech use cases are described. The second section, which deals with self-regulating entities, defines the notion and highlights the Financial Industry Regulatory Authority. The third section is concerned with autonomous finance, where it is defined, its adoption by the financial world, its relationship with consumers, and the regulatory challenges with autonomous finance are evaluated. The fourth section addresses self-sovereign identity, where it is defined, various use cases are outlined, existing data breaches, and how to mitigate such regulatory risks. The final section discusses micro-investment, including its definition and characteristics, how micro-investment can be a long-term

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investment strategy, and how micro-investment can be a viable strategy for retirement planning. The article concludes by pointing out that although these topics are burning issues in finance, they are also replete with advantages and disadvantages of their own.

### FINTECH AND ITS USE CASES

This section discusses the financial technology (FinTech) industry. First, FinTech is a new technology that attempts to improve and automate financial services. The second subsection describes six FinTech use cases: FinTech banks, digital payments, personal financial management apps, wealth management, FinTech lenders, and embedded finance. The conclusion states that the author believes that water-powered vehicles are the wave of the future. Internal combustion engines have outlived their usefulness, and lithium-battery-powered automobiles can be viewed as a temporary solution due to the planet's limited lithium supply.

#### Definition of FinTech

According to Kagan, FinTech describes “new technology that seeks to improve and automate the delivery and use of financial services.”<sup>1</sup> The idea behind FinTech is to assist companies, business owners, and consumers in managing their financial operations, processes, and lives.<sup>2</sup> FinTech is composed of software on computers and smartphones that concerns the backend systems of financial institutions such as banks.<sup>3</sup> However, FinTech currently applies to education, retail banking, fundraising for nonprofit entities, and investment management organizations.<sup>4</sup> FinTech also includes the development and use of cryptocurrencies like Bitcoin and Ethereum. Even so, the traditional banking industry and its multitrillion-dollar capitalization contain the bulk of monetary transactions.<sup>5</sup>

According to FinTech Weekly, FinTech is “something that improves the traditional financial system, without totally breaking with it, but only giving people a more consumer-oriented and inclusive experience.”<sup>6</sup> The primary purposes of FinTech are:<sup>7</sup>

- To improve the traditional financial industry; and
- To uncover new solutions to the challenges that individuals are experiencing in the current economy.

Although this is a broad definition of FinTech, its advantage is that it gives one a flavor of how FinTech is perceived in the financial industry.

#### FinTech Use Cases

FinTech encompasses a variety of use cases in business-to-business (B2B), business-to-consumer (B2C), and peer-to-peer (P2P) financial markets. Some examples include:<sup>8</sup>

- FinTech banks;
- Digital payments;
- Personal financial management apps;
- Wealth management;
- FinTech lenders; and
- Embedded finance.

FinTech banks, also known as neobanks, usually offer banking accounts via mobile apps, possessing low-cost credit, cash-back rewards, high-yield savings accounts, loans, credit cards, or investment products.<sup>9</sup> FinTech banks typically operate without physical facilities or branches because they do not have bank charters. They frequently partner with traditional banks to ensure that accounts are insured by the Federal Deposit Insurance Corp. (FDIC).<sup>10</sup> However, when FinTech banks manage non-deposit investments, the

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<sup>1</sup> Julia Kagan, Financial Technology (Fintech): Its Uses and Impact on Our Lives, *Investopedia* (Mar. 25, 2024), available at <https://www.investopedia.com/terms/f/fintech.asp>,

<sup>2</sup> *Id.*

<sup>3</sup> *Id.*

<sup>4</sup> *Id.*

<sup>5</sup> *Id.*

<sup>6</sup> FinTech Weekly Staff, FinTech Definition, *FinTech Weekly* (Mar. 12, 2024), available at <https://www.fintechweekly.com/fintech-definition>.

<sup>7</sup> *Id.*

<sup>8</sup> Justin Trificana, What Is Fintech? 6 Main Types of Fintech and How They Work, *Plaid* (Aug. 9, 2023), available at <https://plaid.com/resources/fintech/what-is-fintech/>.

<sup>9</sup> Spencer Tierney, 13 Neobanks or Banking Fintech Firms and What They Offer, *Nerd Wallet* (Jul. 28, 2023), available at <https://www.nerdwallet.com/article/banking/neobanks-fintechs-to-watch>.

<sup>10</sup> *Id.*

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FDIC does not insure the accounts.<sup>11</sup> Even so, Grant reported that traditional banks are exiting their partnerships with FinTech banks.<sup>12</sup> Before April 2024, when Synapse Financial Technologies filed for bankruptcy, FinTech banks displayed the FDIC name and logo on their websites and marketing materials.<sup>13</sup> Synapse customers informed the bankruptcy court that they believed their accounts were FDIC-insured.<sup>14</sup> They were quite surprised when their money was inaccessible.

Digital payments are rising. A digital payment, also known as an electronic payment, is “the transfer of value from one payment account to another using a digital device or channel.”<sup>15</sup> As of 2023, 41 percent of Americans claimed that their payments were digital, whereas in 2018, digital payments for Americans were 29 percent.<sup>16</sup> Payment apps and services are growing dramatically because direct bank transfers are substantially less expensive than employing credit cards, where authenticating customers is becoming increasingly fast and easy.<sup>17</sup>

Personal financial management (PFM) apps help users consolidate their various accounts into a single dashboard, making it easier to stay current with their financial situations.<sup>18</sup> These apps help people manage and budget their money effectively. Various budgeting apps exist, including Quicken Simplifi (best for managing household finances), YNAB (You Need A Budget) (best for setting goals), CountAbout (best for sole proprietors and freelancers), and Credit Karma (best for tracking credit scores).<sup>19</sup> There are risks to consider when using PFM apps. If a smartphone is lost or stolen, it is best to have previously specified security settings, such as two-factor authentication.<sup>20</sup> Another risk is that PFM apps could leak personal information to businesses, data brokers, or governments that may misuse the data.<sup>21</sup>

Wealth management assists financial advisers and wealth management platforms collect account information to increase assets under management (AUM) while delivering credible financial advice.<sup>22</sup> Wealth management is a financial advisory service that aids affluent people in managing their wealth.<sup>23</sup> Wealth management typically takes a comprehensive approach to satisfy the complex needs of the well-to-do.<sup>24</sup> A wealth manager typically generates a strategic plan that usually encompasses wills, trusts, powers of attorney, business succession, and wealth transfer.<sup>25</sup>

FinTech lenders sometimes have difficulty understanding their applicants’ financial situation because they must work and spend time obtaining client financial information, such as income, account balances, and asset history.<sup>26</sup> FinTech lenders employ data-driven processes and technology for underwriting, pricing, servicing, and delivering financial resources to borrowers. They can impart the benefits of lower lending costs to their borrowers.<sup>27</sup> However, the cost of lending by FinTech lenders can also increase because their clientele may have a poor financial track record or no record at all.

Finally, embedded finance is “financial services offered seamlessly in consumers’ everyday experiences through non-financial products and services.”<sup>28</sup> The idea behind embedded finance is to integrate banking and other financial services with nonfinancial apps and services.<sup>29</sup> Embedded finance places checking and savings accounts, loans, insurance, debit cards, and other

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<sup>11</sup> *Id.*

<sup>12</sup> Gene A. Grant II, Fintech Banking Doomed To Disappear, But Customers Will Benefit, *Forbes* (Oct. 15, 2024), available at <https://www.forbes.com/sites/digital-assets/2024/10/15/fintech-banking-doomed-to-disappear-but-customers-will-benefit/>.

<sup>13</sup> *Id.*

<sup>14</sup> *Id.*

<sup>15</sup> BTCA Staff, Why Digital Payments?, *Better Than Cash Alliance* (2024), available at <https://www.betterthancash.org/define-digital-payments>.

<sup>16</sup> Justin Trificana, *supra*, note 8.

<sup>17</sup> *Id.*

<sup>18</sup> *Id.*

<sup>19</sup> Rachel Murphy, Best Budgeting Apps of October 2024, *Forbes Advisor* (Oct. 14, 2024), available at <https://www.forbes.com/advisor/banking/best-budgeting-apps/>.

<sup>20</sup> Scott Medintz, Benefits and Risks of Using Personal Financial Apps and Websites, *Consumer Reports* (Jan. 4, 2024), available at <https://www.consumerreports.org/money/personal-finance/benefits-and-risks-of-using-personal-financial-apps-websites-a8590361886/#:~:text=Another%20concern%20about%20financial%20technology,that%20could%20use%20it%20inappropriately>.

<sup>21</sup> *Id.*

<sup>22</sup> Justin Trificana, *supra*, note 8.

<sup>23</sup> Akhilesh Ganti, Wealth Management Meaning and What Wealth Managers Charge, *Investopedia* (Aug. 23, 2024), available at <https://www.investopedia.com/terms/w/wealthmanagement.asp>.

<sup>24</sup> *Id.*

<sup>25</sup> *Id.*

<sup>26</sup> Justin Trificana, *supra*, note 8.

<sup>27</sup> Julapa Jagtiani, & Catharine Lemieux, FinTech Lending: Financial Inclusion, Risk Pricing, and Alternative Information, *Federal Deposit Insurance Corp.* (Jun. 16, 2017), available at <https://www.fdic.gov/system/files/2024-08/14-jagtiani.pdf>.

<sup>28</sup> Justin Trificana, *supra*, note 8.

<sup>29</sup> Adam Hayes, Embedded Finance: Everything You Need to Know, *Investopedia* (Mar. 29, 2024), available at <https://www.investopedia.com/what-is-embedded-finance-8417153>.

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investment tools into platforms that are usually not financially driven.<sup>30</sup> This is not a new idea. Automobile manufacturers have offered car loans for decades, while department stores have had store cards for eons.<sup>31</sup> Embedded finance is expected to generate \$230 billion in revenue in 2025, increasing tenfold from 2020.<sup>32</sup>

### FinTech and Its Use Cases Conclusion

In conclusion, the section defined FinTech and discussed several FinTech use cases. It should be remembered that FinTech is an innovative financing technique best suited for private innovative projects that would not necessarily be susceptible to traditional finance. An example where FinTech might promote a disruptive technology would be a water-powered automobile. It should be remembered that water is composed of two atoms of hydrogen and one atom of oxygen. Under controlled conditions, the hydrogen could be burned in the presence of oxygen, where oxygen is also a by-product.

A water-powered automobile seems a reasonable alternative to cars powered by internal combustion engines and lithium-battery-powered vehicles. The internal combustion engine has seemingly outlived its usefulness because of the pollution it generates. Vehicles powered by lithium batteries seem to be a stopgap measure because the amount of lithium on the planet is simply insufficient to meet the demand for transportation. If water-powered vehicles proved not economically viable, society is faced with the proposition of returning to the horse-and-buggy of the 19th Century or being unable to engage in international trade. Water is plentiful, and no greenhouse gases are released into the atmosphere. It may be an ideal solution where FinTech could be a perfect financial fit.

## SELF-REGULATION IN THE FINTECH INDUSTRY

This section answers the question of whether self-regulation in the financial industry is appropriate for the United States. In particular, it discusses whether the Financial Industry Regulatory Authority (FINRA) is an effective self-regulatory body in the financial industry. The piece first defines a self-regulatory organization. FINRA is described in some detail, pointing out what it does and providing several examples of disciplinary actions taken by FINRA. Finally, the essay responds to the question in the affirmative. FINRA is indeed an effective self-regulating organization.

### Definition of Self-Regulatory Organizations

According to Hayes, a self-regulatory organization (SRO) is an “entity such as a non-governmental organization, which has the power to create and enforce stand-alone industry and professional regulations and standards on its own.”<sup>33</sup> The goal of an SRO for financial SROs, including a stock exchange, is to create regulations, rules, and procedural standards that uphold ethics, equality, and professionalism.<sup>34</sup> An effective SRO can enforce standards on its members, whereas a government can dictate its general policies, rules and laws.<sup>35</sup> Industries have established SROs to maintain competitiveness and safety when governmental oversight is lacking. Examples of financial SROs include:<sup>36</sup>

- The New York Stock Exchange;
- The Financial Planning Association;
- Chicago Board of Trade;
- American Council of Life Insurers;
- Financial Industry Regulatory Authority;
- Fixed Income Clearing Corporation;
- Options Clearing Corporation; and
- American Institute of Certified Public Accounts.

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<sup>30</sup> *Id.*

<sup>31</sup> *Id.*

<sup>32</sup> Justin Trificana, *supra*, note 8.

<sup>33</sup> Adam Hayes, Self-Regulatory Organization (SRO): Definition and Examples, *Investopedia* (Apr. 30, 2024), available at <https://www.investopedia.com/terms/s/sro.asp>.

<sup>34</sup> *Id.*

<sup>35</sup> *Id.*

<sup>36</sup> *Id.*

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### Financial Industry Regulatory Authority

FINRA, an SRO, is an “independent, nongovernmental organization that writes and enforces the rules governing registered brokers and broker-dealer firms in the United States.”<sup>37</sup> FINRA’s mission is to “safeguard the investing public against fraud and bad practices.”<sup>38</sup> This is achieved by:<sup>39</sup>

- Detering misconduct by enforcing the rules;
- Detecting and preventing wrongdoing in the United States financial markets;
- Disciplining financial companies that violate the rules;
- Educating and informing investors; and
- Resolving securities disputes.

FINRA generates and enforces rules and regulations for every brokerage firm and broker in the United States. FINRA registers and licenses all brokers, where brokers must pass a qualifying examination and satisfy continuing education requirements.<sup>40</sup> The organization ensures that broker-dealers comply with its rules, federal securities laws, and the Municipal Securities Rulemaking Board, where financial examiners conduct routine examinations and inquiries due to investor complaints and suspicious activities.<sup>41</sup> FINRA also reviews all broker advertisements, websites, sales brochures, and other customer communications (about 100,000 per year) to ensure the information presented is fair, balanced, and accurate.<sup>42</sup>

FINRA employs technological tools and data-gathering techniques to detect insider trading and other strategies used to gain an unfair advantage. FINRA processes between 37 billion and 75 billion transactions daily to develop a comprehensive perspective of market trading. FINRA also shares information with other federal and state regulators in its efforts to detect and fight fraud.<sup>43</sup>

FINRA possesses the experts, technology, and authority to respond to wrongdoing in a timely manner. If brokers violate the rules, FINRA can fine, suspend, or expel them. Brokers that broke FINRA rules between May and July 2017 include:<sup>44</sup>

- Deutsche Bank was fined a total of \$2.5 million;
- Citigroup was fined a total of \$1 million;
- J.P. Morgan was fined a total of \$800,000; and
- Interactive Brokers was fined a total of \$450,000.

In September 2024, some of the firms that FINRA prosecuted included:<sup>45</sup>

- Merrill Lynch, Pierce, Fenner & Smith Incorporated (CRD #7691, New York, New York) was censured and fined \$1.5 million;
- RBC Capital Markets, LLC (CRD #31194, New York, New York) was censured and fined \$75 thousand;
- SI Securities, LLC (CRD #170937, Boston, Massachusetts) was censured and fined \$185 thousand;
- UBS Financial Services Inc. (CRD #8174, Weehawken, New Jersey) was censured and fined \$850 thousand;
- Western International Securities, Inc. (CRD #39262, Pasadena, California) was censured and fined \$475 thousand; and
- Pershing LLC (CRD #7560, Jersey City, New Jersey) was censured and fined \$1.4 million.

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<sup>37</sup> Liz Manning, Financial Industry Regulatory Authority (FINRA) Definition, *Investopedia* (Oct. 1, 2024), available at <https://www.investopedia.com/terms/f/finra.asp>.

<sup>38</sup> FINRA Staff, Five Steps to Protecting Market Integrity, *Financial Industry Regulatory Authority* (n.d.), available at <https://www.finra.org/about/what-we-do/five-steps-protecting-market-integrity>.

<sup>39</sup> *Id.*

<sup>40</sup> *Id.*

<sup>41</sup> *Id.*

<sup>42</sup> *Id.*

<sup>43</sup> *Id.*

<sup>44</sup> Ray Pellecchia, & Nancy Condon, FINRA, Bats, NASDAQ, and NYSE Fine Firms for Market Access Rule Violations, *Financial Industry Regulatory Authority* (Jul. 27, 2017), available at <https://www.finra.org/media-center/news-releases/2017/finra-bats-nasdaq-and-nyse-fine-firms-market-access-rule-violations>.

<sup>45</sup> FINRA Staff, Disciplinary and Other FINRA Actions, *Financial Industry Regulatory Authority* (Sep. 20-24), available at [https://www.finra.org/sites/default/files/2024-09/Disciplinary\\_Actions\\_September\\_2024.pdf](https://www.finra.org/sites/default/files/2024-09/Disciplinary_Actions_September_2024.pdf).

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The FINRA Investor Education Foundation (FINRA-IEF) teaches investors to protect themselves from financial fraud.<sup>46</sup> The FINRA website provides dozens of free resources regarding investing to help them avoid fraud, including online calculators and investor alerts.<sup>47</sup> Finally, FINRA administers the largest forum in the United States dedicated to resolving securities-related disputes among investors, individual brokers, and securities firms. The forum addresses approximately 100 percent of all securities-related arbitrations and mediations from 69 locations in 50 states and Puerto Rico.<sup>48</sup>

In 2007, Congress created FINRA by merging the National Association of Securities Dealers (NASD) and the member regulation, enforcement, and arbitration operations of the New York Stock Exchange (NYSE), removing redundant regulation, cost, and complexity.<sup>49</sup> The U.S. Securities and Exchange Commission (SEC) is the regulator of last resort in the United States, and regulates FINRA.<sup>50</sup> FINRA oversees more than 624,000 United States brokers.<sup>51</sup>

### Self-Regulation and the FinTech Industry Conclusion

Is self-regulation in the financial industry appropriate for the United States? Presuming that the discussion is asking whether FINRA is effectively regulating the financial industry in the United States, based on the information above, the answer to the question is yes. FINRA has been more than adequately defined by Congress. Its powers and authority are extensive and permeate throughout the financial industry. Furthermore, FINRA is regulated by the SEC, which in turn has a memorandum of understanding with the U.S. Department of Justice (DoJ).<sup>52</sup> Although not part of the DoJ, the SEC, and by implication, FINRA, fosters communication and cooperation between the agencies that enhance fairness and competition in the financial industry by exchanging information for regulatory functions. Thus, as an arm of the SEC, FINRA helps promote regulatory compliance and, as an SRO, is an essential ingredient to the regulatory framework. FINRA demonstrates that self-regulation works.

## AUTONOMOUS FINANCE

This section discusses autonomous finance, whether it should be adopted in the financial world, how it could be used by consumers, and the regulatory challenges facing autonomous finance. First, the section defines autonomous finance, and then talks about autonomous finance and its adoption by the financial world. Third, the consumer and autonomous finance are described. Fourth, the regulatory challenges facing autonomous finance are outlined. The essay concludes by observing that autonomous finance can be a great friend or a cruel taskmaster. It depends on how individuals use the tools. Hopefully, customers will have sufficient maturity to ensure that autonomous finance works to their advantage and not their disadvantage.

### Definition of Autonomous Finance

Autonomous finance is concerned with the “use of advanced technology, such as artificial intelligence and machine learning, to automate and streamline financial processes.”<sup>53</sup> Autonomous finance employs the “power of algorithms and data analysis to provide personalized financial planning and automate transactions and investments.”<sup>54</sup> The critical components of automated finance are artificial intelligence and machine learning.<sup>55</sup> According to Aptitude Software, automated finance is a “self-learning and self-improving finance function, where tasks are optimized and intelligent, systems are efficient and interoperable, and an enterprise-wide data platform supports real-time insights, enabling autonomous finance to be a strategic and trusted advisor to the business.”<sup>56</sup> For Volopay, autonomous finance is “when a company seeks assistance from high-end technologies like artificial intelligence not just to automate financial operations but also to make complex decisions.”<sup>57</sup> For example, if autonomous finance is compared to a

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<sup>46</sup> FINRA Staff, *supra*, note 38.

<sup>47</sup> *Id.*

<sup>48</sup> *Id.*

<sup>49</sup> Liz Manning, *supra*, note 37.

<sup>50</sup> *Id.*

<sup>51</sup> *Id.*

<sup>52</sup> SEC Staff, Securities and Exchange Commission and Justice Department’s Antitrust Division Sign Historic Memorandum of Understanding, *U.S. Securities and Exchange Commission* (Jun. 22, 2020), available at <https://www.sec.gov/newsroom/press-releases/2020-140>.

<sup>53</sup> Yukov Staff, Understanding the Concept of Autonomous Finance, *Yukov* (n.d.), available at <https://yukoy.io/blog/autonomous-finance/#:~:text=Autonomous%20finance%20refers%20to%20the,and%20automate%20transactions%20and%20investments>.

<sup>54</sup> *Id.*

<sup>55</sup> *Id.*

<sup>56</sup> Sarah Werner, Autonomous Finance: Defined, *Aptitude Software* (May 6, 2024), available at <https://www.apitudesoftware.com/blog/autonomous-finance-defined/>.

<sup>57</sup> Volopay Staff, What Is Autonomous Finance and Why Is It Important?, *Volopay* (Apr. 5, 2024), available at <https://www.volopay.com/blog/what-is-autonomous-finance/>.

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self-driving car, where the car makes the driving decisions, the passenger is the company's finance manager.<sup>58</sup> Thus, autonomous finance is like a robot that makes its own decisions, whereas humans are merely experiencing the robot's decisions.

### Autonomous Finance and Its Adoption by the Financial World

Autonomous finance permits companies to automate and streamline finance tasks by using artificial intelligence (AI), machine learning (ML), natural language processing (NLP), and robotic process automation (RPA).<sup>59</sup> The goal of autonomous finance is to increase efficiency and productivity by optimally allocating resources to enhance customer experience.<sup>60</sup>

According to Fisher, the five stages of autonomous finance are:<sup>61</sup>

- Level 0 – 100 percent manual financial operations;
- Level 1 – Introduction to automation;
- Level 2 – 80 percent automation of processes;
- Level 3 – Introduction to autonomy; and
- Level 4 – 80 percent autonomy from end to end.

At level 0, firms use manual and labor-intensive processes and error-prone spreadsheets. At level 1, companies automate repetitive, manual tasks. At level 2, companies employ accounting software, such as enterprise resource planning (ERP), to automate account reconciliation, cash application, e-invoicing, etc. At level 3, AI and ML are leveraged to exchange data across financial functions, such as order-to-cash (O2C), record-to-report (R2R), and Treasury. At level 5, the goal is to automate the entire financial process by implementing AI throughout the firm.<sup>62</sup>

Chief Financial Officers (CFOs) can drive autonomous finance by experimenting, trusting technology, and leading by example.<sup>63</sup> The benefits of autonomous finance include improved vendor and customer experience, enhanced efficiency, accurate cash forecasting, increased productivity, improved compliance and auditability, and better resource allocation.<sup>64</sup> The critical components of autonomous finance are data and analytics, blockchain technology, artificial intelligence, cloud computing, and human talent who can effectively implement autonomous finance.<sup>65</sup> According to Allied Market Research, the autonomous finance market will reach approximately \$82.6 billion globally by 2032, with a compound annual growth rate of 18.2 percent.<sup>66</sup> Autonomous finance is here to stay.

### Autonomous Finance and Consumers

In 2021, the Salesforce *State of the Connected Customer* report surveyed over 15,000 consumers and business buyers. The report observed that 68 percent of the participants felt that COVID-19 increased their expectations regarding corporate digital capabilities.<sup>67</sup> Also, 66 percent of customers expect companies to understand their needs.<sup>68</sup> These statistics point to how important it is to understand one's customers and the potential for AI to help increase one's understanding.

Although customer expectations are significant, only 27 percent of the participants believed that financial services are completely customer-centric, and less than half of the participants generally trust finance companies.<sup>69</sup> This lack of trust is a barrier to implementing autonomous finance because it relies on personal information that customers are unlikely to volunteer.<sup>70</sup> Thus, it is imperative to promote transparency to build trust by explaining to customers why personal data is being collected, how it will be

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<sup>58</sup> *Id.*

<sup>59</sup> Rachele Fisher, A Complete Guide on Shift to Autonomous Finance for Businesses, *High Radius* (Aug. 18, 2024), available at <https://www.highradius.com/resources/Blog/shift-from-automated-to-autonomous-finance/#:~:text=Autonomous%20finance%20allows%20you%20to,and%20enhances%20the%20customer%20experience>.

<sup>60</sup> *Id.*

<sup>61</sup> *Id.*

<sup>62</sup> *Id.*

<sup>63</sup> *Id.*

<sup>64</sup> *Id.*

<sup>65</sup> *Id.*

<sup>66</sup> AMR Staff, Autonomous Finance Market to Reach \$82.58 Billion, Globally, by 2032 at 18.2% CAGR: Allied Market Research, *Allied Market Research* (Nov. 19, 2023), available at <https://www.prnewswire.com/news-releases/autonomous-finance-market-to-reach-82-58-billion-globally-by-2032-at-18-2-cagr-allied-market-research-301992309.html>.

<sup>67</sup> Digital Experience, Autonomous Finance Is Here and It's Reinventing Customer Expectations, *Telus Digital Experience* (Jun. 22, 2021), available at <https://www.telusdigital.com/insights/digital-experience/article/autonomous-finance-customer-expectations>.

<sup>68</sup> *Id.*

<sup>69</sup> *Id.*

<sup>70</sup> *Id.*



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used, and under what conditions it will be destroyed.<sup>71</sup> Even so, customer acquaintance with AI is rising. There was a 6 percent increase in customers who can think of an example of AI being used in their daily lives. Millennials and younger customers are more willing to engage with autonomous finance.<sup>72</sup>

The benefits that autonomous finance brings to consumers include:<sup>73</sup>

- **Simplicity** – Autonomous finance demands less manual effort from customers.
- **Cost savings** – An algorithm-driven financial approach saves customers money by understanding their needs, behaviors, and goals while optimizing their portfolios.
- **Proactive support** – Autonomous finance engages proactive support when conversations occur when a customer demonstrates specific behaviors, making the support personalized.

These benefits are significant when time is of the essence.

### Autonomous Finance and Regulatory Challenges

Various financial regulations indirectly govern AI by establishing standards for fairness, transparency, data protection, and cybersecurity. The critical regulatory bodies include:<sup>74</sup>

- **Securities and Exchange Commission (SEC)** – Oversees securities markets by requiring that AI-driven trading platforms and robo-advisors comply with securities laws.
- **Financial Industry Regulatory Authority (FINRA)** – Focuses on protecting investors by safeguarding broker-dealer fairness in AI trading and investor advice.
- **General Data Protection Regulation (GDPR) in Europe** – The GDPR possesses strict rules on collecting, storing, using, and destroying privacy data, which affects AI systems that process personal data of EU citizens.

Furthermore, in the United States, the Equal Credit Opportunity Act (ECOA) determines how AI software must be designed to avoid biased decision-making in lending and credit scoring.<sup>75</sup> Compliance requirements from the SEC and FINRA demand that AI systems be transparent, explainable, and free from manipulative practices.<sup>76</sup> In dealing with AI technologies, a thorough understanding of traditional financial regulations is imperative. Thus, the regulatory challenge is to ensure that institutions that are engaging in autonomous finance remain compliant with the regulations that govern traditional financial institutions.

### Autonomous Finance Conclusion

In conclusion, as technology becomes ubiquitous and as we rely more heavily on it with each passing day, autonomous finance is likely here to stay. However, if the use of autonomous finance leads to a depression or a major recession, where individuals give up their free agency and depend on AI algorithms to make their financial decisions, then autonomous finance will likely be given the scrutiny that it deserves. It may be comforting to accept AI decisions passively, but nothing can substitute for critical thinking. It should be remembered that AI decision-making is the result of software programming. If the programming is wrong or biased, the AI decision will reflect that bias. It is pre-determined. Computers do what the software tells it to do, not what is wanted, desired, or believed. In that sense, autonomous finance is constrained by its programming. In contrast, individuals can think outside the box and sometimes way outside the box. Autonomous finance can benefit humanity if one is cognizant of this fact. But if one forgets, autonomous finance can become a cruel taskmaster. The choice is ours to make. We will hopefully choose wisely.

## SELF-SOVEREIGN IDENTITY

This section discusses self-sovereign identity (SSI). First, SSI is defined as a model for managing one's digital identity. Second, various SSI use cases for regulated and unregulated financial entities are described. The use cases are categorized according to their characteristics, such as know your customer (KYC) or identity access management, not whether they apply to regulated or unregulated financial organizations. Some use cases relate to regulated firms, other use cases pertain to unregulated companies, and still other use cases concern both. Third, SSI and data breaches are highlighted, where the cybersecurity surrounding digital wallets, blockchain technology, and zero-knowledge proofs (ZKPs) are outlined. Fourth, SSI and regulatory risks are summarized. Fifth,

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<sup>71</sup> *Id.*

<sup>72</sup> *Id.*

<sup>73</sup> *Id.*

<sup>74</sup> Fredrik Filipsson, Navigating Regulatory Challenges for AI in Finance, *Redress Compliance* (Jul. 23, 2024), available at <https://redresscompliance.com/navigating-regulatory-challenges-for-ai-in-finance/#:~:text=What%20are%20the%20main%20regulatory,and%20explainability%20of%20AI%20systems.>

<sup>75</sup> *Id.*

<sup>76</sup> *Id.*

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several regulatory risk suggestions are explained. Finally, the section concludes by observing that SSI is a technology quickly becoming ubiquitous, even though it is the source of potential legal, regulatory, and societal problems. Progress is sometimes helter-skelter, and SSI is no exception to the rule.

### Definition of Self-Sovereign Identity

According to Gillis, SSI is a “model for managing digital identities in which individuals or businesses have sole ownership over the ability to control their accounts and personal data.”<sup>77</sup> Individuals with SSI store their data on their own devices and then provide it for verification and transaction without relying on a central data repository.<sup>78</sup> Because all identity management models require identifiers that determine users are who they say they are, intermediaries are unnecessary with SSI.<sup>79</sup> In other words, a user’s SSI can be registered on a blockchain, where an individual can share the identifying information when conducting a transaction.

Hendrickson states that SSI is a “digital identity model that gives individuals full control over their personal data, eliminating the need for centralized authorities.”<sup>80</sup> SSI leverages blockchain and decentralized identifiers (DIDs) to generate seemingly tamper-proof identify management systems.<sup>81</sup> With SSI, A driver’s license, passport, or professional certifications are stored in an encrypted digital wallet.<sup>82</sup> One advantage of SSI is that it minimizes data breaches and identity theft because personally identifiable information (PII) is not stored in a centralized database.<sup>83</sup> Finally, SSI ensures that individuals have complete autonomy over their PII, only sharing data when required by a transaction or verification process, thereby enhancing privacy and security.<sup>84</sup>

### Self-Sovereign Identity Use Cases for Financial Institutions

SSI has numerous use cases involving financial institutions. These use cases include the following topics:

- Know your customer;
- Online financial application tracking;
- Identity verification;
- Identity access management;
- Self-service account management; and
- Verification credentials such as digital signatures.

The financial use cases for each one of these categories is discussed in turn.

#### **Know Your Customer**

KYC is one of the most known SSI applications in the regulated banking sector.<sup>85</sup> Many processes in finance require customers to identify themselves, such as transactions that require user identification verification. SSI is an advantage because it is a seamless verification methodology, thereby improving a customer’s experience while delivering a compliant service.<sup>86</sup> In other words, SSI makes KYC recyclable. SSI also applies to business-to-business use cases by supporting traceable and auditable PII. Finally, for regulated financial organizations, SSI speeds up the onboarding process for new customers by reducing an unnecessary paper trail for mobile banking.<sup>87</sup>

Beyond traditional banking, SSI can be robustly applied to centralized finance (CeFi) and decentralized finance (DeFi). SSI bridges traditional data-heavy communications with an anonymous DeFi approach to identity verification and CeFi’s financial infrastructure.<sup>88</sup> SSI aligns with CeFi and DeFi’s vision of offering a virtual continuum of financial services without concern about the technology employed. Another advantage of SSI is that an individual can silo their identity, where one can share a small piece

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<sup>77</sup> Alexander S. Gillis, Self-Sovereign Identity, *Tech Target* (Dec. 2022), available at <https://www.techtarget.com/searchsecurity/definition/self-sovereign-identity>.

<sup>78</sup> *Id.*

<sup>79</sup> *Id.*

<sup>80</sup> Lauren Hendrickson, Your Guide to Self-Sovereign Identity (SSI), *Identity* (Oct. 14, 2024), available at <https://www.identity.com/self-sovereign-identity/>.

<sup>81</sup> *Id.*

<sup>82</sup> *Id.*

<sup>83</sup> *Id.*

<sup>84</sup> *Id.*

<sup>85</sup> Eduardo Hotta, Self-Sovereign Identity Use Cases, *Cheqd* (Jan. 11, 2022), available at <https://cheqd.io/blog/self-sovereign-identity-use-cases/#:~:text=When%20it%20comes%20to%20use,while%20providing%20a%20compliant%20service>.

<sup>86</sup> *Id.*

<sup>87</sup> *Id.*

<sup>88</sup> *Id.*

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of identity information without disclosing their complete identity.<sup>89</sup> This means that test payments are not needed to test digital wallets. Another possibility is to perform KYC loan pools, keeping only yes or no responses.<sup>90</sup>

### *Online Financial Application Tracking*

According to Roy, a 2021 survey by Deloitte found that 72 percent of customers were willing to explore online transaction methods for day-to-day banking, mutual fund investments, and insurance purchases.<sup>91</sup> With SSI, customers can track and check the current status of online financial applications.<sup>92</sup> Due to reduced human interaction, SSI provides standardization and compliance for regulated and non-regulated financial institutions.<sup>93</sup> The variance of service is diminished due to stricter adherence to policies and protocols, where customers receive personalized experiences while creating useful analytics for financial institutions.<sup>94</sup>

### *Identity Verification*

In traditional banking, identifying customers is a critical issue. SSI can allow customers to create bank accounts in seconds, rather than waiting hours or days for a financial institution to verify an individual's identity via utility bills, passport, employee contracts, etc.<sup>95</sup> With SSI identity verification, financial service providers can issue credit scores and income statements to expedite credit and loan applications.<sup>96</sup> SSI also shares decentralization principles with DeFi, ensuring that individuals do not need to go through a KYC or registration process for every decentralized application (dApp).<sup>97</sup> The primary use cases for SSI in DeFi are KYC activities for crypto initial coin offerings (ICOs) and secure DeFi onboarding. Via SSI, DeFi exchanges could offer reusable KYC credentials that any financial service could employ.<sup>98</sup>

### *Identity Access Management*

Identity access management (IAM) in the financial sector ensures that the appropriate individuals can access the correct information.<sup>99</sup> With SSI, banking and other financial institutions can safeguard and manage privileged accounts using enterprise password security by providing seamless and secure user authentication in native, web, mobile, and cloud environments.<sup>100</sup> Single sign-on (SSO), multifactor authentication (MFA), and biometric authentication (BA) can assure that financial customers are who they say they are so that they are recognized instantly before any transactions are processed.<sup>101</sup>

### *Self-Service Account Management*

Customers can manage their identity details, such as password resets and communication preferences with SSI.<sup>102</sup> Online application tracking software can collect data analytics and personalize the experience when performing mobile financial transactions.<sup>103</sup> Customers can establish alerts to check on low account balances, upcoming transactions, overdue payments, wire transfers, push notifications, potential fraud updates, etc.<sup>104</sup> Given the volumes of data financial service providers deal with, online application tracking through biometric and voice-based authentication can simplify the process.<sup>105</sup> Financial institutions must comply with various laws and regulations, such as the Payment Card Industry Data Services Standard (PCI-DSS) and the General

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<sup>89</sup> *Id.*

<sup>90</sup> *Id.*

<sup>91</sup> Anwesha Roy, A Guide to Self-Service CX in Financial Services, *CX Today* (May 5, 2021), available at <https://www.cxtoday.com/contact-centre/a-guide-to-self-service-cx-in-financial-services/#:~:text=Online%20application%20tracker%20-%20Customers%20can%20track,use%20cases%20for%20self-service%20in%20financial%20services.>

<sup>92</sup> *Id.*

<sup>93</sup> *Id.*

<sup>94</sup> *Id.*

<sup>95</sup> Irene Hernández, 35 Use Cases of Decentralized Identities That Will Make Your Life Easier, *Gataca* (Apr. 6, 2022), available at [https://gataca.io/blog/ssi-essentials-35-use-cases-of-decentralized-identities-that-will-make-your-life-easier/#:~:text=It%20is%20not%20farfetched%20to,called%20Verifiable%20Credentials%20\(VCs\).](https://gataca.io/blog/ssi-essentials-35-use-cases-of-decentralized-identities-that-will-make-your-life-easier/#:~:text=It%20is%20not%20farfetched%20to,called%20Verifiable%20Credentials%20(VCs).)

<sup>96</sup> *Id.*

<sup>97</sup> *Id.*

<sup>98</sup> *Id.*

<sup>99</sup> Veritis Staff, 5 Reasons Why Financial Sector Needs Identity and Access Management (IAM), *Veritis* (n.d.), available at <https://www.veritis.com/blog/5-reasons-why-financial-sector-needs-identity-and-access-management-iam/#:~:text=2%20Enhances%20End-user%20Experience,trust%2C%20and%20enhance%20user%20experience.>

<sup>100</sup> *Id.*

<sup>101</sup> *Id.*

<sup>102</sup> Anwesha Roy, *supra*, note 91.

<sup>103</sup> *Id.*

<sup>104</sup> *Id.*

<sup>105</sup> *Id.*

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Data Protection Regulation (GDPR).<sup>106</sup> Self-service account management makes it painless to revoke consent and request that personal data be destroyed.<sup>107</sup>

### *Verification Credentials such as Digital Signatures*

SSI permits financial customers to store digitized pre-verified documents on their phones so they may be shared with centralized and decentralized financial institutions.<sup>108</sup> SSI can enhance the integrity of contractual agreements by allowing parties to use digital signatures to sign and verify documents.<sup>109</sup> These documents can include an individual's driver's license, passport, utility bills, employee contracts, digital signature, etc. Verifiable credentials (VCs) are stored in a standard digitized format that is cryptographically secure, verifiable via machines, and warrants privacy by employing selective disclosure.<sup>110</sup> VCs are secure digital documents that can be shared and verified automatically.<sup>111</sup> It should be remembered that VCs explicitly adhere to the World Wide Web Consortium Verifiable Credentials Data Model (W3C-VCDM).<sup>112</sup> VCs can also conform to other data models, such as the ISO/IEC 18013-5 model, also known as the mobile driving license (mDL).<sup>113</sup>

### **Self-Sovereign Identity and Data Breaches**

Any data stored on a computer is subject to a data breach, regardless of whether the financial institution is regulated or unregulated. If the machine is connected to the Internet, a data breach can arise from cybercriminals who use their computers to break into the targeted machine. If the machine is not connected to the Internet, a data breach can still occur, particularly if an individual inserts a USB drive into a machine previously infected with a virus, a Trojan, or a worm.

SSI is critical for online security because it deals with the vulnerabilities and inefficiencies inherent in centralized data storage and credential verification systems.<sup>114</sup> Centralized data storage systems are prone to cyberattacks, making them unreliable when vital verifications are obligatory.<sup>115</sup> Secondly, with centralized data storage systems, credential verification can be time-consuming, possibly resulting in increased fraudulent IDs and unrestrained certifications.<sup>116</sup> SSI employs several methods to thwart data breaches, including digital wallets, blockchain technology, and zero-knowledge proofs.

### *Digital Wallets*

Financial customers store their identity credentials in a digital wallet on their mobile device so that they can manage their credentials directly.<sup>117</sup> Digital wallets are critical for managing digital identities because, unlike traditional methods that depend on email or downloads, digital wallets store encrypted credentials on an individual's mobile device, thereby streamlining access.<sup>118</sup> A digital wallet user can share PII with financial and other organizations requiring identity proof. This software device empowers individuals to manage their SSI effectively.<sup>119</sup>

Digital wallets can be spoofed. A malicious actor can generate a fake digital wallet that looks legitimate and then give their payment information on a fake platform by using phishing tactics or by creating fake websites that appear to be genuine digital wallets.<sup>120</sup> Digital wallets can be spoofed by malicious actors when they use:<sup>121</sup>

- Phishing attacks;
- Fake apps;

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<sup>106</sup> *Id.*

<sup>107</sup> *Id.*

<sup>108</sup> Esther Sauri, What Are Verifiable Credentials?, *Gatica* (Sep. 19, 2023), available at [https://gataca.io/blog/what-are-verifiable-credentials/#:~:text=Verifiable%20credentials%20\(or%20VCs\)%20are,Mobile%20Driving%20License%20\(mDL\)](https://gataca.io/blog/what-are-verifiable-credentials/#:~:text=Verifiable%20credentials%20(or%20VCs)%20are,Mobile%20Driving%20License%20(mDL)).

<sup>109</sup> *Id.*

<sup>110</sup> *Id.*

<sup>111</sup> *Id.*

<sup>112</sup> W3C Staff, Verifiable Credentials Data Model v2.0, *W3C* (Oct. 19, 2024), available at <https://www.w3.org/TR/vc-data-model-2.0/>.

<sup>113</sup> ISO/IEC Staff, ISO/IEC 18013-5:2021, *International Standards Organization* (Edition 1, 2021), available at <https://www.iso.org/standard/69084.html>.

<sup>114</sup> Lauren Hendrickson, *supra*, note 80.

<sup>115</sup> *Id.*

<sup>116</sup> *Id.*

<sup>117</sup> *Id.*

<sup>118</sup> *Id.*

<sup>119</sup> *Id.*

<sup>120</sup> Team Focal, Digital Wallet Fraud: Trends, Challenges, and Insights, *Focal* (Jul. 28, 2024), available at <https://www.getfocal.ai/blog/digital-wallet-fraud#:~:text=There%20are%20several%20problems%20with,Data%20Breaches>.

<sup>121</sup> Fraud.com Staff, Digital Wallet Fraud – What Is It and How It's Prevented, *Fraud.com* (n.d.), available at <https://www.fraud.com/post/digital-wallet-fraud>.

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- Social engineering; and
- Man-in-the-middle attacks.

Individuals can protect themselves from digital wallet fraud by choosing to:<sup>122</sup>

- Only download apps from official app stores;
- Be cautious with links in emails and texts;
- Use strong passwords and enable two-factor authentication;
- Be aware of public Wi-Fi risks.

### **Blockchain Technology**

Blockchain is a “decentralized digital ledger that securely stores records across a network of computers in a way that is transparent, immutable, and resistant to tampering.”<sup>123</sup> The data are broken into blocks chronologically linked to the previous block.<sup>124</sup> A financial customer’s SSI can be a block on a blockchain, where the customer shares identifying data with a traditional bank or an unregulated FinTech entity.<sup>125</sup> However, a chain is only as strong as its weakest link. As of September 15, 2024, the Bitcoin blockchain was over 600 gigabytes.<sup>126</sup> Although this is a small database compared to the volumes of data stored at centralized data centers, the figure provides some measure of the data being stored and the possibility of data breaches due to the size of the attack surface.<sup>127</sup>

Although blockchain is advertised as being virtually impregnable, some examples of blockchain data breaches include:

- **Ronin Network: \$625 million** – In March 2022, Ronin Network, which supports the Axie Infinity blockchain gaming platform, was breached, where the cybercriminals absconded with \$625 million of Ether and USDC, a stablecoin. Investigators claimed that the North Korean hacking collective, the Lazarus Group, was responsible for the robbery. A month later, only \$5.7 million was recovered.<sup>128</sup>
- **Poly Network: \$611 million**—In August 2021, a single hacker seized on a vulnerability in the Poly Network decentralized finance platform and absconded with \$611 million. After appealing to the hacker on X (formerly Twitter), the project’s developers recovered \$300 million. It was later discovered that the hacker targeted the blockchain for fun.<sup>129</sup>
- **Binance BNB Bridge: \$569 million**—In October 2022, the Binance exchange was hacked for \$569 million. The cross-chain bridge, BSC Token Hub, was exploited, allowing 2 million Binance Coins (BNB) to be withdrawn. The hack occurred because of a bug in a smart contract.<sup>130</sup>
- **Coincheck: \$532 million**—In January 2018, Coincheck, a Japanese blockchain exchange, experienced a \$523 million theft of NEM coins. The vulnerability existed because a hot wallet, or a live cryptocurrency wallet, is not as secure as an offline cold storage wallet. Coincheck survived because the Monex Group, a Japanese financial services company, bought the company.<sup>131</sup>
- **FTX: \$477 million** – In November 2022, when the firm filed for Chapter 11 bankruptcy, FTX declared that \$477 million was stolen from its crypto wallets. In 2024, it was discovered that a SIM card swapping ring had gained access to an FTX employee’s account, illegally procuring millions of dollars in cryptocurrency.<sup>132</sup>

It should be remembered that blockchains rely on real-time transfers of large amounts of data.<sup>133</sup> If hackers intercept the data as it is being transferred, they can modify or capture financial data, leading a financial customer to incorrectly believe that the data

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<sup>122</sup> *Id.*

<sup>123</sup> Adam Hayes, Blockchain Facts: What Is It, How It Works, How It Can Be Used, *Investopedia* (Sep.16, 2024), available at <https://www.investopedia.com/terms/b/blockchain.asp>.

<sup>124</sup> *Id.*

<sup>125</sup> Alexander S. Gillis, *supra*, note 77.

<sup>126</sup> Adam Hayes, *supra*, note 123.

<sup>127</sup> *Id.*

<sup>128</sup> Kevin George, The Largest Cryptocurrency Hacks So Far, *Investopedia* (Nov. 2, 2024), available at [https://www.investopedia.com/news/largest-cryptocurrency-hacks-so-far-year/#:~:text=It%20has%20been%20argued%20that,and%20USDC%20\(a%20stablecoin\)](https://www.investopedia.com/news/largest-cryptocurrency-hacks-so-far-year/#:~:text=It%20has%20been%20argued%20that,and%20USDC%20(a%20stablecoin).).

<sup>129</sup> *Id.*

<sup>130</sup> *Id.*

<sup>131</sup> *Id.*

<sup>132</sup> *Id.*

<sup>133</sup> IBM Staff, What is Blockchain Security?, *International Business Machines, Inc.* (n.d.), available at <https://www.ibm.com/topics/blockchain-security#:~:text=Blockchains%20rely%20on%20real-time,the%20ability%20to%20manipulate%20it.>

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is being transferred correctly.<sup>134</sup> Also, because data mining requires a significant amount of computing power if the data miners attain more than 50 percent of the mining power, they can control the entries in the ledger and manipulate the data.<sup>135</sup>

### *Zero-Knowledge Proofs*

ZKP is a “method by which one party (the prover) can prove to another party (the verifier) that something is true, without revealing any information apart from the fact that this specific statement is true.”<sup>136</sup> A ZKP is a cryptography technique in which only the individual who knows how to decode a message can understand it.<sup>137</sup> Regarding SSI, ZKP permits financial customers to prove their identity without providing unnecessary identifying information, thereby preserving their privacy.

SSI implementation has significant issues regardless of whether a financial firm is regulated or unregulated. First, SSI suffers from backward compatibility issues because when companies install different identity and access management policies, SSI may not work correctly even when ZKP exists.<sup>138</sup> Second, there is usually a steep learning curve when comprehending and working with blockchain technology in a DeFi setting.<sup>139</sup> Third and specific to SSI, centralized databases will still be needed to generate verifiable credentials.<sup>140</sup> Fourth, another issue with SSI is that it is counterproductive for Fortune 500 company marketing efforts.<sup>141</sup> This is particularly an issue for large regulated and unregulated financial firms that manage billions, if not trillions, of investment dollars. Finally, SSI has development costs, where it is cheaper to implement public key infrastructure (PKI) solutions than dApp solutions.

Thus, although ZKP can potentially secure SSI for financial customers safely, issues outside the SSI domain threaten its cryptosecurity benefits. One should understand that, as Robert Burns so aptly put it many years ago, “the best laid plans of mice and men often go awry.”<sup>142</sup>

### **Self-Sovereign Identity and Regulatory Risks**

SSI possesses various regulatory risks for regulated and unregulated financial firms because identity management is decentralized, and individuals maintain complete control over their PII.<sup>143</sup> These risks pose challenges in data privacy, accountability, and verification, mainly when existing laws and regulations are designed for centralized identity systems. SSI can be misused when unclear legal frameworks deal with disputes and fraudulent actions. Finally, SSI has the potential to be discriminatory because not all individuals have access to the technology or resources to participate in the SSI system.<sup>144</sup> This final issue constitutes a regulatory risk for regulated and unregulated financial firms.

The critical regulatory issues are:

- Data privacy concerns;
- Accountability and enforcement issues;
- Potential for discrimination and exclusion; and
- Cybersecurity concerns.

### *Data Privacy Concerns*

Even though financial customers are knowledgeable about financial matters, with SSI, they may not fully appreciate what data they decide to share or with whom. This fact can result in privacy violations if the data sharing is not correctly managed. Even

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<sup>134</sup> *Id.*

<sup>135</sup> *Id.*

<sup>136</sup> Shafi Goldwasser, Silvio Micali, and Charles Rackoff, The Knowledge Complexity of Interactive Proof Systems, 18 *Siam Journal of Computing* 1, 186-206 (Feb. 1989), available at [https://people.csail.mit.edu/silvio/Selected%20Scientific%20Papers/Proof%20Systems/The\\_Knowledge\\_Complexity\\_Of\\_Interactive\\_Proof\\_Systems.pdf](https://people.csail.mit.edu/silvio/Selected%20Scientific%20Papers/Proof%20Systems/The_Knowledge_Complexity_Of_Interactive_Proof_Systems.pdf).

<sup>137</sup> Dock Staff, Zero-Knowledge Proofs: Non-Techie’s Guide to Online Privacy Tech, *Dock.io* (Nov. 25, 2024), available at <https://www.dock.io/post/zero-knowledge-proofs#:~:text=The%20paper's%20definition%20of%20a,developed%20from%20being%20a%20purely>.

<sup>138</sup> Nazhmudin Baimurzaev, Self-Sovereign Identity and the Challenges Facing Its Mass Adoption, *Hacker Noon* (Sep. 12, 2023), available at <https://hackernoon.com/self-sovereign-identity-and-the-challenges-facing-its-mass-adoption>.

<sup>139</sup> *Id.*

<sup>140</sup> *Id.*

<sup>141</sup> *Id.*

<sup>142</sup> Robert Burns, To a Mouse, *Dictionary.com* (n.d.), available at <https://www.dictionary.com/browse/the-best-laid-plans-of-mice-and-men-often-go-awry>. The saying is adapted from a line in the poem, which states: “The best laid schemes o' mice an' men / Gang aft a-gley.”

<sup>143</sup> FM Contributors, Self-Sovereign Identity (SSI) and Why It Matters in 2023, *Finance Magnates* (Apr. 13, 2023), available at <https://www.financemagnates.com/fintech/data/self-sovereign-identity-ssi-and-why-it-matters-in-2023/>.

<sup>144</sup> *Id.*

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with decentralized data storage, hackers can potentially aggregate PII from various sources to profile individuals without their consent. Finally, if decentralized data crosses jurisdictions on either a national or state level, there is the likelihood that SSI will face different privacy regulations.<sup>145</sup>

### *Accountability and Enforcement Issues*

When a data breach or fraudulent activity occurs, it may be problematic for regulators to identify the responsible party because SSI is decentralized. Another accountability and enforcement issue with SSI is that many jurisdictions do not possess clear legal frameworks for enforcing regulations. SSI is new, so legislators and regulators may wait until deciding what laws and regulations should be passed or implemented.<sup>146</sup>

### *Potential for Discrimination and Exclusion*

When specific organizations are responsible for issuing verifiable credentials, there is the possibility of credential issuance bias, which could result in discriminatory practices, because not all individuals have access to the same technology. Because of the learning curve associated with SSI, individuals who are not computer literate or lack the necessary technology may not be able to adopt and manage SSI. This may not be a significant issue in the financial world, where individuals invest in regulated and unregulated companies. However, this risk may be substantial for new financial customers who are onboarding for the first time due to their financial and technological knowledge gap.<sup>147</sup> Regulators are pretty sensitive to the policies and practices of financial institutions that result in discrimination and exclusion.

### *Cybersecurity Concerns*

As previously discussed, the security of individual digital wallets that store SSI credentials could lead to severe data breaches. In particular, cybercriminals may exploit decentralized SSI vulnerabilities to pierce legitimate digital platforms by tricking financial customers into sharing sensitive PII by employing phishing attacks.<sup>148</sup> In the regulatory world, the victim of a cyber security attack is usually held accountable for the attack, even if they took all reasonable steps at the time of the attack to prevent and mitigate its effects. For example, the Federal Trade Commission (FTC) usually demands that a company that was attacked file reports for 20 years, demonstrating its commitment to preventing cyber-attacks. The tragedy of the enforcement process is that if a company is attacked again during the 20-year enforcement period, the 20-year clock begins yet another 20 years.<sup>149 150</sup>

### **Self-Sovereign Identity and Mitigating Regulatory Risks**

There are several ways to mitigate SSI regulatory risks, including:

- ***Developing clear legal frameworks*** – Federal, state, and international governments should establish well-defined laws and regulations for SSI, including, but not limited to, data privacy standards, verification processes, and accountability mechanisms.<sup>151</sup>
- ***Customer-centric design*** – SSI systems should be designed with privacy as the bulkhead of their software architecture so that there are transparent mechanisms for managing consent and controlling PII.<sup>152</sup>
- ***Collaboration with financial industry stakeholders*** – Companies in the financial sector, both regulated and unregulated, regulators, tech organizations, financial and software industry experts, and concerned individuals and entities should generate robust SSI standards and best practices. In particular, regulators should hold independent inquiries before issuing regulations so that the regulations that are issued are fair, legal, transparent, and practical.<sup>153</sup>
- ***Education and awareness campaigns*** – Regulators and other interested parties should participate in education and awareness campaigns so they understand their data privacy rights and appreciate how to manage their digital identities.<sup>154</sup>

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<sup>145</sup> *Id.*

<sup>146</sup> *Id.*

<sup>147</sup> *Id.*

<sup>148</sup> *Id.*

<sup>149</sup> Donald L. Buresh, The Application of the Federal Trade Commission Privacy and Safeguards Rules to the In the Matter of Tax Slayer, L.L.C. Case, 4 *International Journal of Social Science and Human Research* 9, 2512-20 (Sep. 2021), available at DOI: 10.47191/ijsshr/v4-i9-33.

<sup>150</sup> Donald L. Buresh, The Everalbum, Inc. Case, or How the Federal Trade Commission Protected Consumer Rights Regarding the Collection, Use, Storage, Dissemination, and Destruction of Facial Recognition Data, 4 *International Journal of Social Science and Human Research* 10, 2936-43 (Oct. 2021), available at DOI: 10.47191/ijsshr/v4-i10-38.

<sup>151</sup> FM Contributors, *supra*, note 143.

<sup>152</sup> *Id.*

<sup>153</sup> *Id.*

<sup>154</sup> *Id.*

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Thus, mitigation of regulatory risks takes time and effort. Regulators must not only understand regulatory risks but also comprehend and appreciate the technology. It should be remembered that not all implementations are created equal, so implementation guidelines should be established to minimize regulatory risk. This will hopefully prevent data breaches, reduce potential fraud, and ensure that discrimination and exclusion are abated.

### Self-Sovereign Identity Conclusion

In conclusion, SSI is a technology that meshes with the ubiquitous use of mobile devices. Autonomy from centralized control of PII is desirable, provided that the sovereignty of one's identity is preserved and not exploited. We live in an imperfect world where not everyone possesses the same resources, talents, and skills. This fact ensures that steps must be taken to safeguard PII regardless of an individual's computer and financial literacy. SSI seems to be an idea whose time has come. However, in pursuing technological mastery of individual finances, it should not be forgotten that the presence of PII on the Internet can be used by malicious actors, including governments, for nefarious purposes. Sometimes, it is crucial to walk rather than run. In embracing SSI, we must observe the highest possible implementation standards. Society should not settle for second-best. Individual personal data is at stake, and nothing less than perfection or near perfection will suffice.

### MICRO-INVESTMENT

This section discusses whether micro-investment apps can be a long-term investment strategy for retirement planning. Micro-investing is defined, and its characteristics are described. Dollar-cost averaging is outlined and followed by the types of micro-investing strategies. The steps to be taken when micro-investing are itemized, along with a partial list of prominent micro-investing apps. The discussion segues to whether micro-investing is a viable strategy for long-term investing for retirement planning. Several simple examples demonstrate the time value of money and why it is imperative to invest early in life when inflation is minimal. The essay concludes that it is good to start investing early, but it is better to be trained at an early age (e.g., as a teenager) regarding the time value of money and micro-investing.

#### Definition of a Micro-Investment App and Its Characteristics

According to Garnett, micro-investing means "investing small amounts of money, often on a recurring basis, and typically using an app to automate the process."<sup>155</sup> With micro-investing, contributions to a fund can be in small dollar amounts, with investments as low as a single dollar or spare change from everyday purchases by buying fractional shares of stock.<sup>156</sup> Micro-investing platforms usually charge a fee that can be a fixed monthly fee, a management fee based on the assets under management, or a transaction fee for every micro-investing transaction.<sup>157</sup> If an investment platform is charging a fee, it is critical to understand that the amount invested be significantly greater than the fee. Otherwise, the fee will engulf the investments, and a consumer will have little to nothing left in their account after the fee has been charged.

#### Dollar Cost Averaging

A key feature of micro-investing is that the investments are done automatically where a dollar cost averaging (DCA) strategy is employed.<sup>158</sup> A DCA strategy is an investment strategy whereby one divides the total amount one would like to invest into small increments, hoping to lower the average price and obtain better returns over the long run.<sup>159</sup> The steps to perform dollar cost averaging are:<sup>160</sup>

- Select a quality exchange-traded fund (ETF), or a diversified group of stocks;
- Determine how much to invest over what period of time;
- Divide the total investment amount by the weeks or months of the DCA period;
- Invest the same amount each week or month no matter what the current stock price is. If the prices drop, one will purchase more shares or fractional shares.

For example, suppose an individual wants to invest \$1,200 over a year. The person decides to invest once a month for 12 months. The monthly investment then equals \$100 per month. Suppose that in six of the 12 months, the share price was \$10, while in the other six months, the share price was \$20. Then, six times, the person bought 10 shares, and for the other six months, the individual acquired five shares. Thus,  $90 (= 5 \times 6 + 10 \times 6 = 30 + 60)$  shares were purchased, where the average price per share was \$13.33 [=

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<sup>155</sup> Allie Grace Garnett, Micro-Investing: Your Gateway to Financial Empowerment?, *Britannica Money* (n.d.), available at <https://www.britannica.com/money/volatility-etfs-explained>.

<sup>156</sup> *Id.*

<sup>157</sup> *Id.*

<sup>158</sup> *Id.*

<sup>159</sup> Dan Rosenberg, What Is Dollar Cost Averaging?, *Britannica Money* (n.d.), available at <https://www.britannica.com/money/dollar-cost-averaging>.

<sup>160</sup> *Id.*



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$(5*20*6 + 10*10*6) \div 90 = (600 + 600) \div 90$ . This example oversimplifies the dollar cost-averaging strategy, but it does illustrate the point.

### *Types of Micro-Investing Strategies*

With micro-investing, there are various investment types, including stocks, bonds, ETFs and real estate investment trusts (REITs).<sup>161</sup> Other ways to diversify the micro-investing strategy include:<sup>162</sup>

- **By market cap**, where one purchases shares of small-cap, mid-cap, or large-cap firms;
- **By sector**, where one can concentrate their investments in various market sectors, such as technology or healthcare;
- **By geography**, where one can invest domestically or internationally;
- **By strategy**, where one invests in different micro-investing platforms, including robo-advisers;
- **By employing one's values**, where the values one holds can determine where one invests.

### *Steps to Be Taken When Micro-Investing*

The following six steps need to be considered when micro-investing, including:<sup>163</sup>

- **Deliberate on investment goals** – Define one's investing objectives and goals;
- **Research micro-investing apps** – Select the micro-investing app(s) that reflect one's investing objectives and goals;
- **Select a platform** – Choose the micro-investing app and install the software, where an account is created, identifying information is provided, and funding source (e.g., bank account) is stated;
- **Specify investment preferences** – Use the micro-investment app to make investment choices and establish automated investing if wanted;
- **Begin micro-investing** – Invest the desired amount periodically; and
- **Monitor and adjust as needed** – Although micro-investing may be automated, one is responsible for monitoring one's investments to make key adjustments as needed.

### *Partial List of Micro-Investing Apps*

The following is a partial list of micro-investing apps, including:<sup>164</sup>

- **Acorns** – This platform uses automated roundups in \$5 increments;
- **Betterment** – This platform is a robo-adviser that employs automated investing without a minimum balance. An account can be opened for as little as \$10;
- **Charles Schwab** – This traditional company supports fractional share investing via *Schwab Stock Slices*, where one investment slice is \$5;
- **Fidelity** – One can obtain fractional shares for as little as \$1 by investing in *FidelityGo*, the platform's robo-adviser, beginning with \$10; or
- **Robinhood** – This company's retail brokerage app pioneered commission-free trading while also supporting fractional share investing with investments as small as \$1.

### *Bottom Line*

Any financial innovation that ensures that investing is accessible to more people helps everyone. One need only select the investment path, align one's financial objectives and goals by defining one's financial priorities, and then investigate fund prospectuses and company fundamentals.<sup>165</sup> Over time, micro-investing can yield significant financial gains.

### **Can Using a Micro-Investment App Be a Long-Term Investment Strategy?**

Can using a micro-investment app be a long-term investment strategy? The answer depends on the amount of money invested periodically, the average rate of return, and the period when the investments are made. The key to success in micro-investing is what is known as the *Rule of 72*. Under the Rule of 72, when 72 is divided by an interest rate, the quotient is the number of periods it takes for money to double. For example, suppose one invests in a one-time investment of \$1,200 annually and supposes that the annual rate of return is 18 percent. If 72 is divided by 18, it takes 4 years for the money to double. Here is a table demonstrating the results of a single \$1,200 investment at 18 percent over 40 years.

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<sup>161</sup> Allie Grace Garnett, *supra*, note 135.

<sup>162</sup> *Id.*

<sup>163</sup> *Id.*

<sup>164</sup> *Id.*

<sup>165</sup> *Id.*

<b>Period</b>	<b>Investment Result</b>
0 years	\$1,200
4 years	\$2,400
8 years	\$4,800
12 years	\$9,600
16 years	\$19,200
20 years	\$38,400
24 years	\$76,800
28 years	\$153,600
32 years	\$307,200
36 years	\$614,400
40 years	\$1,228,800

Please note that a single \$1,200 investment at 18 percent annually yields \$1,228,800 at the end of 40 years.

Suppose that one makes a \$100 investment every month at an 18 percent annual interest rate (or 1.5 percent monthly) over 40 years (or 480 months). Instead of using the Rule of 72, one has to calculate the future value of an annuity-immediate, where a payment is made at the end of a period.<sup>166</sup> The formula for the future value of an annuity-immediate is:<sup>167</sup>

$$FV = P * [(1 + r)^n - 1] / r$$

where FV is the future value of the annuity-immediate, P is the periodic payment, r is the interest rate per period, and n is the number of periods. In this instance, P = \$100, r = 1.5 percent, and n = 480. After substituting these values into the equation above, it turns out that the future value of the annuity-immediate equals \$8,821,908.38.<sup>168</sup> If only \$1 is invested per month, the future value of the annuity-immediate is \$88,219.08.<sup>169</sup> It was assumed that the payment was made at each month's end. If the payment is made at the beginning of a period, the future value is multiplied by (1 + r), and the future value is called an annuity due.

What can be seen from this calculation is that the use of a micro-investment app can indeed be a long-term investment strategy. However, the more money one invests per period, the rate of return, and the number of periods all make a difference. Because of the time value of money, the more money one invests at the beginning of the total investment time frame, the greater the future value of the annuity-immediate.<sup>170</sup>

**Can Using a Micro-Investment App Be a Viable Strategy for Retirement Planning?**

Can using a micro-investment app be a viable strategy for retirement planning? The sample calculations above also indicate that employing a micro-investment app is a viable retirement planning strategy. Even so, there is one caveat that one should remember. The sample calculations above do not take inflation into account. In other words, \$8.82 million at the end of 40 years has less purchasing power than \$8.82 million at the beginning of the 40 years. If the average inflation rate is significant, say 5 percent or more annually, it may not be possible to retire on \$8.82 million at the end of 40 years. If the inflation rate is dramatic and hyperinflation or near hyperinflation occurs, \$8.82 million will be insufficient to retire on. The inflation rate is a sabot that can destroy almost any retirement planning strategy.

Another issue with micro-investing is that individuals may not become aware of the strategy until later in life, say when they are 40 or older. Then, it is difficult to take advantage of the time value of money because so little remains before retirement. Secondary schools and universities rarely teach the time value of money principles to most of their students. Without the knowledge of the time value of money, the fact that micro-investing is a viable investment strategy is lost in translation. A quality financial education is imperative to take advantage of micro-investing.

**Micro-Investment Conclusion**

In conclusion, micro-investing is a viable strategy provided that the amount saved per period is not minuscule (i.e., \$1 per month), the rate of return is significant over an extended time, and the period is quite long (e.g., 40 years). Even so, if inflation rears its ugly head in the specified period or hyperinflation occurs, all bets are off, and only substantial amounts of investing will result in effective retirement planning. It is a risk that comes with the planting of seeds.

<sup>166</sup> Julia Kagan, Immediate Payment Annuity: What It Is and How It Works, *Investopedia* (Sep. 25, 2024), available at <https://www.investopedia.com/terms/i/immediatepaymentannuity.asp>.

<sup>167</sup> *Id.*

<sup>168</sup> Future Value of Annuity Calculator, *Calculator Soup* (n.d.), available at <https://www.calculatorsoup.com/calculators/financial/future-value-annuity-calculator.php>.

<sup>169</sup> *Id.*

<sup>170</sup> Julia Kagan, *supra*, note 166.

### CONCLUSION

In conclusion, this article discussed FinTech, self-regulating entities, autonomous finance, self-sovereign identity, and micro-investment. Each seems to support the other because they move society toward greater individual independence and self-sufficiency. It is almost as if individuals are evolving into sovereign beings, not creatures dependent on large centralized organizations for their existence. People are taking control of their lives. No longer is the state or government the center of societal focus. These four financial tools contribute to a different political paradigm where the individual rather than the collective is supreme. It is likely a treacherous road to travel, but if these comments have any weight, then society and its missteps seem to be cautiously moving ever forward. It is an evolutionary transformation that cannot be stopped except possibly by a cataclysmic event. Given that what remains is relatively stable, individualism is the wave of the future, not the telltale signs of a bygone era.

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