sciendo

The International Review of Financial Consumers
Volume.9 Issue.2 (December 2024), 1-18
https://doi.org/10.2478/irfc-2024-0005

Three Waves of FinTech Innovations and Their Implications for Financial Frauds and Anomalies

Man Cho*

A B S T R A C T

The main objectives of this study are two-fold: first, to survey the technological innovations adopted in the financial service sector during the last three decades, commonly termed as FinTech, by categorizing them into three waves; and, to elaborate their implications for combating financial frauds and abusive intermediation practices. To that end, the paper also documents a sample of real-world cases observed in Korea and other countries which demonstrate the fraudulent and problematic practices in trading financial products that harm the welfare of financial consumers. Given these discussions, the paper elaborates three sets of remedies to deal with the anomalies, i.e., combating the financial fraudsters, overseeing the abusive intermediaries, and nudging financial consumers to make sound decisions.

Keywords: FinTech, Financial frauds and abuses, Financial consumer protection, Nudging

I. Introduction

In November 2022, a star technology was born: ChatGPT, whose impacts are permeating to virtually all sectors of economy in many countries. As a type of Generative-AI, this neural net-based AI system achieved a phenomenal 500 million subscriptions around the globe before its one-year anniversary, faster than any other pervasive technological breakthrough ever introduced. In a broader context, pundits argue that data-trainable AI algorithms, broadly termed as the machine learning, should now be regarded as a new General Purpose Technology (GPT)[1] along with the milestone GPTs introduced during the last half century (e.g., the invention of microprocessor in 1969, the initiation and commercialization of the World Wide Web in the 1990s, and the development and pervasive use of smartphones since 2007). Working as a complement to each other, these GPTs are increasingly impacting the ways that goods and services are designed, produced, and delivered to consumers.

The financial service sector is no exception in that those tech-driven alternative modes of intermediation, commonly termed as FinTech, are spreading into its major segments of lending, funding, insurance, and payment. At the core of such innovations, there exist three enabling technologies: the internet and mobile platforms, vast amounts of structured and unstructured data crawled from online platforms, and AI algorithms acting as analytics to process and find patterns from those data. These platform-data-AI driven services are leading to welfare gains of various types, e.g., a more efficient intermediation process with lower transaction cost, a more accurate credit evaluation, an expanded financial inclusion for marginal consumers, and more automated internal and external processes for financial

* Emeritus Professor, KDI School of Public Policy and Management

[1] GPT refers to those innovative technologies that have abrupt, pervasive, and discrete effects on economic systems (i.e., a game changer). The literature argues that GPT tends to combine with complementary technologies and to increase its social and economic impact in a discrete fashion (Bresnahan & Trajtenberg, 1995; Helpman & Trajtenberg, 1998;Teece, 2018).

© 2024 Author(s). This is an open access article licensed under the Creative Commons Attribution-NonCommercial-NoDerivs License (http://creativecommons.org/licenses/by-nc-nd/3.0/).

intermediaries. However, there is no free lunch in that those innovative technologies are also creating welfare losses, such as the heightened vulnerability to cyber thefts and crimes (hacking, phishing, smishing, pharming, and so on) as well as the rising incidences of excessive leverage and risk-taking by financial consumers. Given this as a backdrop, the current study aims to achieve a two-fold objective: to survey the technological innovations adopted in the financial service sector during the last three decades, commonly termed as FinTech, by categorizing them into three waves; and, to elaborate their implications to combating financial frauds and abusive intermediation practices.

As a side effect of the FinTech innovations, financial frauds that utilize private consumer information are on the rise globally. For instance, voice phishing cases are increasing in Korea in recent years, with high incidence in virtually all age cohorts (Park, 2024), more than 10% of adults in the U.S. fall victim to fraud each year (Anderson ,2019), and online gambling by youth is reportedly rising in a number of countries, which also leads to a chronic gambling problem for many (Packin, 2023). At the core of this trend is identity theft through hacking and other means, which serves as an enabling mechanism for financial fraudsters to efficiently target and harm consumers.

Another form of the social cost documented in the literature is the distortion in consumers' borrowing and consumption decisions, particularly among low-income and other marginal consumer cohorts. That is, while consumers enjoy a faster, lower-cost, and more convenient financial intermediation thanks to the FinTech innovations, the platform-based lending services often induce a high leverage, hence an over-spending at the cost of saving for the future. It is shown that two particular types of online lending platforms have such effect: namely BNPL (Buy-Now-Pay-Later) - e-commerce combined with online lending (Di Maggio et al., 2022; Guttman-Kenney et al., 2023; Bian et al., 2023; deHaan et al., 2024), and peer-to-peer (P2P) lending (Chava & Paradkar, 2018; DiMaggio & Yao, 2021). For investment decisions, internet and mobile platform-based intermediation is also shown to induce herd behavior among consumers, pushing them to high-risk assets such as cryptocurrencies and to high-frequency trading (Barber et al., 2022). In addition, there are cases of fraudulent products sold to financial consumers, such as a Ponzi-like Private Equity Fund (PEF) and Variable Annuity Life Insurance (VALI) with embedded exploitive conditions.

As policy remedies, three sets of suggestions are made. First, in order to combat the large, well-resourced, and international organizations behind many fraudulent financial transactions, a concerted effort among financial institutions, regulators, and law enforcement authorities of multiple countries is warranted to combat the fraudsters. For that, multilateral organizations such as OECD, G20, and the World Bank can play a supportive role. On the part of financial intermediaries, they can enhance their middle- and back-office functions to detect illegal or fraudulent transactions in a more efficient and accurate fashion through automation and utilization of data and machine learning algorithms. Regulators can also constrain intermediaries by requiring a regular monitoring for fraudulent transactions, for which the SAR (Suspected Activity Report) requirement by CFPB in the U.S. can serve as a benchmark. Finally, it will be fruitful if the international research community (e.g., the IAFICO network) collaborates on collecting and sharing real-world cases of financial frauds happening in different countries, to compile a comprehensive and representative sample of fraud cases which can serve as a base for future research in this vein.

Second, dealing with abusive financial intermediaries (e.g., predatory mortgage lenders, fraudulent crypto-asset exchanges, and sellers of fraudulent investment or insurance products) calls for tight regulatory oversight, possibly through a tech-based solution such as SupTech (SupervisionTechnology). However, imposing a restrictive control in this context should be done with a balancing act of promoting the FinTech innovations, for which the regulatory sandbox, initiated in the UK

financial service sector in 2016 and being popularized and adopted in over 40 countries in variant forms, can be utilized.

Third, to nudge financial consumers to make a more sound decision on financial products, an education or counseling program to that end will be useful, but only if it properly targets specific consumer cohorts (in terms of lifecycle, extent of financial literacy, and so on), if it provides meaningful help for consumers at the time of decision making, and if it is tailored to remedy specific behavioral problems such as over-consumption, over-borrowing, or excessive risk-taking, as argued by Cho (2025). In the context of avoiding an incomplete sale in trading financial products, a ChatGPT-like LLM (Large Language Model) can work as a useful support system for both service providers and financial consumers. To that point, Brynjolfsson et al. (2023) offers interesting empirical evidence showing that such a system can increase both productivity of consumer-support staff at a call center as well as customer satisfaction, which can also be considered in the context of dealing with the issue of incomplete sales in the financial markets.

The rest of the manuscript consists of the following sections: surveying the three waves of the FinTech innovations (Section II); discussing trends in financial frauds and sampling the real-world cases (Section III); suggesting three sets of policy remedies (Section IV); and making concluding remarks (Section V).

II. Three Waves of FinTech Innovations

The ICT-enabled alternative financial services, often termed as 'digital finance' or FinTech (Financial Technology), are broad and diverse in their scope. At the core of such services, however, there exist three underlying technological elements: (1) an online (internet or mobile) platform, (2) alternative data, and (3) artificial intelligence (in particular, those data-trainable algorithms known as machine learning). With this as a backdrop, this section surveys three waves of DPA-driven services in the financial markets by focusing on their welfare implications – the first wave of platform-based business processes, the second wave of alternative data-based changes, and the third wave of AI-driven financial services. While the first two have a relatively longer history, the third is still in its early stage, but its impact is expected to accelerate in coming years given the rapid advancement of Gen-AI technologies.

A. The First Wave of Online Platform Driven Financial Innovations

The inception of the internet in the early 1990s was truly a milestone event that dramatically changed the way the economic system operated, a phenomenon often termed as "new economy" (as elaborated by Agrawal et al., 2017). In essence, this new technology not only connects economic agents to form various online networks, but also lowers the price of doing certain activities, e.g., communication, data sharing and search. In the viewpoint of typical financial intermediation, the commercialization of the internet deeply influenced front-office functions (e.g., client management and service delivery) via development of various B2B and B2C systems, as well as middle- and back-office functions (e.g., risk management, transaction support, regulatory compliance, and other operational supports) through development of diverse online systems for internal communication and data sharing. This platform-based financial intermediation was further accelerated with the introduction of the smartphone around 2007.

The technology also brought about alternative forms of service provider in both sides of financial intermediation: that is, in the borrowing side (for those with liquidity deficit), P2P (Peer-to-Peer) lending of various types (e.g., Market Place Lending, and Balance Sheet Lending); and, in the investment side (for those with liquidity surplus), equity-crowdfunding for various asset classes (e.g., for real or financial asset investment projects). Unlike traditional intermediaries, these platform-based service providers attempt to directly link a large number of borrowers and investors without a traditional financial institution involved. ZOPA

(Zone Of Possible Agreement), one of the earliest platform lenders in the UK (launched in 2005) is a good example, which provides online services processing loan applications, making underwriting (or accept-reject) decisions, and posting desirable lending rates to be charged (reference rates plus risk spreads) to match loan applications with willing investors.[2]

As elaborated by a number of studies, these platform-based alternative services tend to be more efficient than the traditional branch-based financial services, with lower transaction costs and faster and more convenient service delivery (IMF, 2017; Buchak et al., 2017; Fuster et al., 2018; Frost et al., 2019 Jagtiani & Lemieux, 2019; OECD, 2019). As a case in point, Fuster et al. (2018), who utilize a large loan-level data set, show that the FinTech mortgage lenders in the U.S. - those online service providers who adopt a complete online processing of loan application, credit evaluation, and funding - reduce the transaction costs by 20 percent or more (compared to the traditional mortgage lending process), lower the ex post (or post-origination) delinquency rate, and respond to changes in housing demand and monetary policy in a more elastic fashion. As such, the platform-based services can pose a 'catfish effect' to the existing intermediaries, i.e., forcing them to be more efficient in their internal and external processes as well (as elaborated by Philipone, 2016). However, there are certain social costs that come along with this efficiency gain, which will be discussed later in this section.

The inception of the smartphone popularized another form of alternative financial intermediation - mobile phone-based payment and settlement services (e.g., ApplePay, AliPay, SamsungPay, M-Pesa, and many other similar products adopted worldwide). The advancement of these service providers posed a competition to the traditional means of settlement (those with cash and credit cards); And, in the developing world, it also worked as a means of extending financial inclusion to unbanked or underbanked populations, with M-Pesa in Kenya being a good example (Jack & Suri, 2014; Beck et al., 2018). In addition, mobile payment services are now working as an inlet for collecting and utilizing consumer data in a large quantity (by BigTechs in particular), which are used for various analytical purposes such as consumer segmentation, customer-tailored product development, and data-driven risk management practices (CitiGroup, 2018).

In the realm of these platform-based financial services, one can categorize three main types of service provider: (1) SmallTechs (i.e., start-ups or SMEs), (2) BigTechs and their affiliates (e.g., those servicers who are subsidiaries of Google, Apple, Amazon, Alibaba, Tencent, and others), and (3) existing financial intermediaries who offer platform-based services. The recent trend observed, however, indicates that the first group (SmallTechs) is losing ground. For example, ZOPA, who began its operation as a SmallTech, acquired the full banking license in 2020 and converted itself to a traditional bank in the UK. In Korea as well, although there are several hundred FinTech firms that are operating right now, the three 'internet-only' banks affiliated with the BigTechs (KakaoBank, K-Bank, and TossBank) are the dominant players in the sector in terms of asset and employment bases.

B. The Second Wave of Alternative Data Driven Innovations

The next wave of financial innovation involves the utilization of alternative (usually non-financial) data, whose main impact is in reducing information asymmetry between business counterparties. For a long while in finance literature, the intermediation process was characterized by the phenomenon of credit

[2] Some of the renowned examples of Crowdfunding and P2P lending servicers include Prosper (US, 2005), ZOPA (UK, 2005), Lending Club (US, 2006), iZhongchou (China, 2014, Alibaba), and QQ Gongyi (China, 2014, Tencent). In general, P2P lending refers to an on-line lending method that makes loans to both household and business borrowers (a subset of crowdfunding), Market place lending (MPL): An on-line investment method that enables investors to purchase lending products, and Direct (or balance sheet) lending. On the other hand, Crowdfunding represents an on-line funding method that raises capital from a large number of unidentified investors, both for investment (e.g., consumer & SME loans) and for non-investment (e.g., rewards/donations).

rationing caused by the asymmetry between transaction counterparts in terms of the other party's (e.g., loan applicants') credit worthiness (Stiglitz & Weiss, 1981; de Meza & Webb, 1987; Waller & Lewarne, 1994). To deal with this issue, the intermediaries implemented underwriting criteria, based on which a post-origination likelihood of credit event (e.g., default or delinquency) caused by a particular loan applicant is assessed based on before-origination data on his or her behavior (e.g., past credit history and other 'hard variables' such as income, wealth, credit card utilization). However, thanks to the online platforms, alternative consumer data (on 'soft variables' such as digital footprints, online shopping patterns, and so on) are now being collected and utilized in the evaluation of creditworthiness, and a number of studies empirically demonstrate that credit evaluation model accuracy is enhanced when combining those soft variables with the conventional credit risk indicators (Iyer et al., 2016; Puri et al., 2017; Berg et al., 2020,; Kim et al., 2023).

To illustrate, Kim et al. (2023) reports a substantial enhancement of credit score statistics in the case of 'thin filers' in Korea if three types of alternative data– online shopping data, telecommunication service data, and mobile payment data - are added to the traditional credit scoring model. Equally important is the fact that the alternative data-driven credit scoring system exhibits a relatively low correlation with the traditional scoring system. The result implies that the use of alternative data can work as a mechanism to extend financial inclusion for thin filers to fulfill their borrowing needs.

Another data-driven innovation to be examined in this study is the market for cryptocurrencies (or crypto-assets for investment, to be more exact). Taking Bitcoin as an example, its price movement demonstrates three dramatic boom-busts during the last ten years or so, probably the most volatile asset price dynamics ever recorded historically[3]. The growth of this asset is in a sense surprising, given that the generation and distribution of the coin among the network participants (called 'nodes') essentially relies on puzzle-solving, as sketched by Nakamoto (2008)[4]. Nonetheless, the markets for Bitcoin and other crypto-assets are now huge and growing; In Korea only, there are roughly seven million investors, 35 percent of the total population, who are mostly in their 20-40s. Furthermore, many of them are levered investors who rely on borrowing, making them more vulnerable to downturns of the market.

The underlying data technology to crypto-asset transactions (i.e., Distributed Ledger Technology, DLT, or blockchain) is deemed as a potentially important innovation in the viewpoint of financial intermediation. Some pundits argue that DLT, often termed as 'DeFi' (Decentralized Finance), offers a different and potentially welfare-enhancing architecture where record keeping is completely decentralized, access to the service is anonymous and unrestricted, and the system enables trading diverse and new financial assets (e.g., stable-coins, smart-contracts, NFT – Non-Fungible Token, and so on) (Makarov & Schoar, 2022). However, given the recent incidences of fraud and abuse observed from the sector (e.g., the Terra-Luna debacle, and the FTX's inside trading of its own coin and the criminal sentences to its executives), the net social welfare outcome from the DeFi-like alternative intermediation model remains to be seen.

C. The Third Wave of AI-driven Financial Innovations

We are currently witnessing another wave of tech-driven innovations caused by the GenAI systems such as ChatGPT. In fact, this third wave is an outcome of a series of continued breakthroughs in the AI algorithms that are

[3] Cho (2023) documents that, between March 2020 to April 2021, the Bitcoin price increased 696 percent in total (in real price), followed by a 41 percent drop in the subsequent three months; and, between July and November 2021. it boomed again with a steep growth of 73.9 percent, again followed by a decline of 70.7 percent as of November 2022.

[4] In particular, the process of mining, the process of validating new transactions and of rewarding the first successful one with the coin, utilizes a hash function called as 'SHA256' with 'SHA' standing for Security Hash Algorithm. And the miners are supposed to find a solution that satisfies the quiz based on the function, hopefully faster than others.

capable of self-improvement through Big-Data-based training[5], which led to a dramatic enhancement in several human-like capabilities as summarized in Table 1 (see below). Namely, (1) face or object recognition (enabled by the neural net algorithms trained with ImageNet and other internet-crawled large data sets); (2) gaming (enabled by similar AI systems, AlphaGo and AlphaZero, trained with past game records along with its own simulations); and, (3) language recognition (by the GenAI systems such as ChatGPT and BERT, trained on vast numbers of documents downloaded from the internet).

In the financial market, AI-enabled business systems have already been in place, with Robo-Advisor (RA) and RegTech (Regulatory Technology) being good examples. RA is an on-line financial advisory service for asset management with no or minimum human involvement[6], and it offers a more efficient process of the investment consultancy. That is, its development usually requires a high initial fixed cost, but, once being developed and becoming operational, the marginal cost in serving one additional customer is virtually zero. As such, it is transforming the investment consultation service from one that serves a small number of highly endowed individuals to one that offers the service to a large number of consumers with small or moderate wealth, i.e., 'democratizing' the service. The outcomes of this transformation, as documented in the literature, include a reduced advisory fee, a lower (or no) minimum account balance, among others (compared to a human-based advisory service) (Lee, 2021). Nonetheless, there are several regulatory requirements that an RA system is supposed to fulfill: its operator should fulfill the fiduciary duty, i.e., the legal and ethical obligation for financial intermediaries to act in the best interests of their clients and to put the interests of clients above their own; the recommendations should be suitable and appropriate to the users (consumers); and the underlying algorithm should reflect the generally-accepted financial theories (such as the Modern Portfolio Theory (MPT) and Capital Asset Pricing Model (CAPM).

RegTech, on the other hand, is a BD·ML-driven service whose main task involves providing an efficient (usually automated) internal process for regulatory compliance, detection of illegal or fraudulent transactions (e.g., Anti-Money Laundering (AML) and Anti-Terrorist Funding (ATF), and other business processes by utilizing various structured and unstructured data along with a ML algorithm. The market for RegTech surged between 2014 to 2018, when large amounts of fine were levied on several global banks for their illegal transactions in sanctioned countries (e.g., $8.9b to BNP Paribas, and $1.9b to HSBC)[7]. In more recent years, however, the RegTech service is evolving into one that offers a more comprehensive and enterprise-wide risk management tool for financial intermediaries.

Given these existing applications of AI in the financial service sector, the recent advancement of GenAI is expected to accelerate BD·ML innovations in two main directions. Firstly, its capabilities of collecting vast amount of information and knowledge, of converting them to an easy-to-understand summary, and of interacting with users through a prompt-response mechanism with more tailored answers (all in an essentially real-time fashion) will enable a dramatic efficiency gain in some of the intermediaries' functions. For example, typical front-office functions such as sales, marketing, and customer support, as well as middle- or back-office functions like credit evaluation, product development, risk

[5] DeMauro et al. (2018) defines BigData as an information asset with five main characteristics - Volume (a large magnitude with multiple terabytes and petabytes), Velocity (the speed at which data are generated, analyzed, and acted upon at virtually the same time), Variety (various types of structured, semi-structured, and unstructured data), Analytics (available methods to process and analyze the data with the three Vs), and Value (extracted information or insight that can create economic and social value).

[6] Typical steps performed by RA: (1) Assessing the risk appetite of clients; (2) Categorizing investable assets (or opportunity sets); (3) Determining matching portfolio(s); (4) Executing the ordering; (5) Rebalancing the portfolio. The system should comply with several principles, e.g., suitability principles, fiduciary duty, and avoidance of incomplete sales.

[7] Early examples of RegTech include Ayasdi (2008, US), RedOwl Analytics (2011, US), Elliptic (2013, UK), Compliance Advantage (2014, UK), Saude (2014, UK).

management, fraud detection, and regulatory compliance are all potential targets of such efficiency gain through instituting a ChatGPT-like GenAI service (OECD, 2021).

Secondly, applying a BD·ML-based data analytic (such as regression tree, random forest, and ensemble) can produce enhanced predictive power compared to the traditional statistical regression models of various types (Breiman, 2001; Varian, 2014; Mullainathan & Spiess, 2017). The former, essentially an inductive analysis to find underlying data patterns (rather than a deductive analysis to test a hypothesis), relies on iterative estimations and sample separations to find the best functional form of the right-hand side variables (explanatory or x variables) in explaining the left-hand-side variable (explained or y variables). More specifically, the objective is to find the smallest prediction error, MSE, in the function $\text{Loss} = \text{Bias}(\hat{\beta}) + \text{MSE}(\hat{\varepsilon}'\hat{\varepsilon})$, without much concern for the first term, Bias. The implication is that, when one faces a simple y variable to explain (e.g., whether or not a borrower was delinquent in his loan obligation) but a myriad of possible explanatory variables along with interactions among them (all possible factors that can help explain why someone was delinquent), and when testing a particular hypothesis is not a main analytical objective, then a BD·ML-based data analysis is likely to produce better predictive power.

III. Financial Frauds and Abuses: A Side Effect

As a side effect of the FinTech innovations, financial frauds of various kinds are on the rise globally. For example, voice phishing cases reported in Korea are increasing in the recent years (with over 30,000 cases in 2020), particularly among old-age consumers (over 60). However, incidences of voice phishing exist across all age cohorts, with large shares in younger cohorts (in their 30s) as well as in female consumers in their 50s (Park 2024). In the U.S., more than 10% of adults fall victim to fraud each year (Anderson 2019). Both illegal financial transactions (e.g., terrorist funding, money laundering, "darknet" based criminal activities) and financial frauds are global phenomena, whose volume amounts to 3.1 trillion USD and 485 billion USD, respectively (Nasdaq, 2024).

At the core of such large and increasing cases of financial fraud is identity theft through hacking and other means, which, as reported by a number of recent studies, enables financial fraudsters to efficiently target and harm consumers (Bo et al., 2024; Fuster et al., 2022; Armantier et al., 2021; Tang, 2019). As a related concern, consumers' personal information can also be used for the commercial gain of the collectors without their agreement. Using the phrase "surveillance capitalism," Zuboff (2020) warns about such phenomena, stating this trend can exacerbate information asymmetries and tilt market power toward BigTechs, eventually destroying the principle of 'the invisible hand' and greatly increasing monopoly rent for business entities at the cost of consumers' surplus.

As another form of social cost, the literature documents a distortion of consumer decisions, particularly among low-income and other marginal consumer cohorts, caused by the FinTech-driven services. While consumers enjoy faster, lower-cost, and more convenient financial intermediation, some of them end up incurring more debt and over-spending in the short-term at the cost of future saving (Panos & Wilson, 2020; Ahn & Nam, 2022; Yue et al., 2022). FinTech platform-based services such as P2P lending and BNPL[8], which bundle the sale of a product with a subsidized loan, tend to promote such trends, as reported by a series of studies. On the one hand, these products can deliver a positive social effect by expanding financial inclusion for less credit-worthy borrowers. On the other hand, they can lead to over-borrowing and over-spending, as documented by recent studies (Di Maggio et al., 2022; Guttman-Kenney et al., 2023; Bian et al.,

[8] The product surged in popularity in e-commerce around the world, with its volume having increased more than sixfold between 2019-2023 (from USD 50 Billion globally to USD 370 Billion).

2023; deHaan et al. for BNPL, 2024; Chava & Paradkar, 2018; DiMaggio & Yao for P2P lending platforms, 2018).

On the investment side, easy online or mobile execution methods generate herd behavior among financial consumers, pushing them to high-frequency trading and excessive risk-taking by putting their wealth on alternative assets such as cryptocurrencies with an extreme price volatility (Barber et al., 2022). More often than not, those markets are vulnerable to fraudulent intermediation practices. Taking the crypto-asset market in Korea as an example, there was a significant number of delisted coins (e.g., 74 new coin listings but 78 delisted coins in January to June 2022), and also a number of bribery and embezzlement cases reported. Besides crypto-assets, there are conventional investment products, such as PEF (Private Equity Fund) and VALI (Variable Annuity Life Insurance), that are sold to consumers through transaction processes with embedded fraudulent elements.

In order to provide a real-world picture of fraudulent and abusive intermediation practices, the next section discusses three particular categories of welfare-losing cases (as a sample) that damage consumers' wealth and personal lives: (1) Outright frauds or criminal activities; (2) Predatory or high-risk lending products; (3) Predatory or high-risk investment products.

A. Outright Frauds or Criminal Activities

Cyber theft of personal data and financial crimes with that stolen data have been on the rise in recent years. Frequently reported crimes include hacking (particularly targeting financial intermediaries and crypto-asset exchanges), pharming (stealing data from PCs by implanting malignant code), smishing (implanting a code in e-mail or SMS messages to do the same), and voice or messenger phishing (attacking consumers by fraudsters through phone calls or written messages to trick individuals into providing sensitive financial information or performing unauthorized transactions). As to the last type, the reported cases are so many that several movies on the topic have recently released in Korea and the U.S.[9] In those movies as well as in real-world cases, the fraudsters who operate the schemes are large, well-organized (connecting operational points in multiple countries), and highly specialized in targeting and trapping consumers. The methods they employ are also very diverse. A consumer can face serious risk of such crime by simply losing his or her mobile phone.

Some of the fraudsters appear to be quite tech-savvy, as recently reported. For example, it is shown that some voice phishing operators utilize a GenAI system to create more tailored scenarios for individual consumers for a more 'efficient' attack on their vulnerabilities. As reported in news media, the organization called Canadian Kingpin12 developed a specialized GenAI system in 2023, called "WormGPT," and sold its service to voice phishing operators with a mere $75 monthly subscription fee (Seo, 2024). Also, deepfake (deep learning plus 'fake'), a GenAI technique to generate false images or video, is being used by some crime operators. For example, one employee of a large corporation in Hong Kong received a deepfake-generated video in which the company's CFO ordered him to transfer money, and the person followed the order and transferred $26 million USD in total (Seo, 2024).

Regarding hacking, crypto-asset exchanges are shown to be particularly vulnerable, with many reported cases in in Korea and other countries. One famous hacking case was the FTX case. Within 24 hours from its bankruptcy filing in November 2022, $390 million in crypto-assets were lost due to hacking (Seo, 2024). One concern raised about the new technology is the likelihood that hacking crypto-assets and the exchanges would become a lot more possible and easier once quantum computing is used, because breaking into the cryptographies used will become more feasible with this technology.

[9] Those movies include 'Voice' and 'Citizen Deok-Hee' in Korea, and 'The Beekeeper' in the U.S.

B. Predatory or High-risk Lending Products

In general, lending products are less risky and less complicated than investment and insurance products, due in large part to the contractual agreement between consumers and intermediaries (or investors) on loan term, repayment schedule, and other product details. Nonetheless, there were incidences of serious welfare loss on the part of consumers in this sector, to which the online platform based alternative intermediaries contributed. As one example, over three thousand P2P lending platforms (out of about 5,000) in China became either closed or inoperable between 2014-17 as the supervision authorities tightened their oversight on the sector. The incident inflicted a big financial loss by many who participated in the platform-based lending and investment.[10]

As discussed in Section II, online platform-driven financial intermediation generally delivers a more efficient and convenient process for consumers in originating loan products. One such example was the Automatic Underwriting System (AUS) that was popularized in the home mortgage origination and securitization industry in the U.S. from the mid- to late-1990s (e.g., Desktop Underwriter, DU, by Fannie Mae, and a number of similar online B2B and B2C systems adopted by other market intermediaries in the sector). AUS revolutionized the mortgage origination and securitization process by dramatically reducing the processing time for loan applications (in many cases, from about a month to a few minutes).[11] However, the system was also used as a tool for mass-producing the subprime and Alt-A mortgage contracts during the early- to mid-2000s, the epicenter of the global financial crisis that followed.

In terms of loan attributes, some of the subprime mortgage contracts (e.g., 2-28 or 3-27 Option ARM contracts) entailed quite arcane and high-risk repayment characteristics, which were hard to comprehend by financial consumers at the time of loan origination: to illustrate, a big payment shock after 2-3 years after the artificially-designed low-payment period; a negative amortization of principal (increasing the effective LTV) due to no- or partial-payment of mortgage interest in the initial 2-3 years; and, the extension or refinancing risk at the expiration of the low-payment period (which was exacerbated during the downturn when lenders constrained the underwriting criteria and refused to refinance existing loan contracts).[12] The practice of some subprime lenders was also predatory in that they sold the loans to not financially-savvy borrowers who were incapable of repaying (seniors in many cases), with a primary purpose of having them default on their mortgage obligations (sooner rather than later) so as to liquidate the properties in a booming housing market. However, it should be stressed that financial consumers were also responsible (at least partially) for such a rapid growth of the subprime and Alt-A contracts, because many of them were incentivized to take those loans to increase the expected return to holding home equity, a debt maximization behavior driven by herding into housing investment. But it is worth noting that there are other contributing factors to the subprime mortgage debacle in the U.S., for example, the overly generous underwriting criteria during the boom, and the non-recourse provision for non-performing borrowers in a number of states.[13]

Recent studies also report the gap between short-term vs. long-term consequences of P2P lending for consumers with a liquidity-deficit. Using a large credit bureau data set on the borrowers who use the MPL platforms, Chava and Paradkar (2018) shows that the borrowers use the funds from the platforms mainly to consolidate their credit card debts, and

[10] See Citi-GPS (2018) for more details.

[11] See Cho (2008) for more details as to how AUS was developed and utilized in the residential mortgage fiancé sector in the U.S.

[12] See Gorton (2008) and Cho (2009) for details on loan characteristics of the subprime mortgage contracts along with the embedded risks underlying them.

[13] It is difficult to over-emphasize the importance of proper documentation and its validation as a part of credit evaluation: as shown in the case of the subprime mortgage crisis, the Alt-A mortgages (those mortgage contracts with no or low documentation that are known with various acronyms, e.g., NINA for No Income (documentation) No Asset, SISA for Stated Income and Stated Asset, and NINJA for No Income No Job and Asset) worked as the major source of credit losses in the U.S. mortgage finance industry (Cho 2009).

accordingly their card balances decline by 47% on average right after the funding relative to the previous quarter; their credit card utilization ratios also decrease, and, in consequence, their credit standings assessed in terms of CSS also improves. However, the study documents that the MPL-borrowers tend to incur additional credit card debt from their existing intermediaries, resulting in a higher aggregate indebtedness three quarters after the funding and a significant increase in credit card defaults subsequently. DiMaggio and Yao (2018) reports a similar result, in that while FinTech borrowers' credit outcomes improve right after receiving the funds, they are significantly more likely to be delinquent and exhibit higher indebtedness after several months.

C. Predatory or High-risk Investment Products

From emerging-market countries' point of view, the financial service sector generally grows in parallel with an expansion of economic system, creating a wider set of alternative assets to invest for consumers. Along with this process, however, overly high-risk or predatory investment products are sold, to which both formal intermediaries and unlicensed (often illegal) entities participate. The DPA-driven innovations in the financial markets (as surveyed in Section II) make it easier for such intermediaries to develop and sell those high-risk and fraudulent products in the marketplace.

In particular, a number of the scandalous cases of private equity funds (PEFs) was recently reported and being investigated in Korea. One famous case that drew a lot of public attention was the PEF organized by the firm named the Lime Asset Management (LAM), which mobilized a huge amount of money for a Ponzi investment scheme. LAM was founded in 2015 and recorded a phenomenal growth until 2019, with its total asset under management (AUM) reaching 6 trillion KRW (about $4.6 billion USD). The way that the company mobilized the fund was through the established and well-known financial intermediaries in Korea - three major commercial banks and one security dealer, who contacted their customers and helped open thousands of investment accounts with LAM (4,035 in total). According to media reports the collected funds were allocated to three main investment channels: (1) 173 PEFs created and managed by LAM (about $1 billion USD as of July 2019); (2) one offshore fund in Panama that was mediated by one U.S. firm named International Investment Group (IIG) ($200 million USD); and, one investment project called as "Star Mobility," a personally owned fund by the de factor owner of LAM, Mr. Kim ($46m USD). A surprising aspect of this case is the fact that the owner, Mr. Kim, had no experience in the financial service sector before LAM and used to run a local transportation business. In late 2019, there came news reports on the LAM's illegal money transactions, which led to fund runs and eventually the bankruptcy of the company. Its U.S. business partner, IIG, also became a subject of investigation by the U.S. regulator (SEC), and was later banned from trading. How to allocate the total financial losses from this case (between the intermediaries and the consumers) is still being debated through lawsuits and regulatory arbitration.

Another investment product to note is the variable annuity life insurance (VALI) contract. VALI is a type of annuity that provides periodic payments to consumers for a specified period or for the annuitant's lifetime (hence, suitable to seniors and retirees), with the added feature of variable returns based on the performance of selected investments.[14] Recently, some abusive cases related to the VALI products are reported, as summarized in Table 2 (see below). As seen from the summary, several common issues cut across the cases described: misleading information (providing false or misleading information about the benefits, costs, and features of variable annuities); unsuitable sales (recommending variable annuities that are not appropriate for the client's financial situation or investment goals); churning (excessive trading of variable annuities to generate commissions,

[14] The VALI products involves lots of contract details, in terms of the accumulation of investment, asset classes to select (e.g., stocks, bonds, money market instruments, among others), payment of the return, tax treatment, death benefit, and so on.

often detrimental to the client); and lack of supervision.

Finally, there are ample cases of abusive intermediation in the crypto-asset sector. As an overall issue, unlike its original intent of creating a decentralized and low-cost transaction process with no middleman, the actual transaction process is filled with a diverse group of intermediaries (e.g., exchanges, digital wallets, payment companies, and miners), ending up incurring fairly high transaction costs.[15] And some of the intermediaries are reportedly involved with fraudulent business practices. Chun (2018) documented that the Initial Coin Offering (ICO), initially designed as a means of funding for crypto-related start-ups (e.g., infrastructure and app developers, network operators), in many cases employed a Ponzi scheme to mobilize and using investors' fund illegally (e.g., money laundering, and tax evasion), with 81% of ICOs in the sample being assessed as fraudulent.

Another globally renowned case of fraudulent intermediation in crypto-assets was the failure of FTX in November 2022, one of the three largest cryptocurrency exchanges in the world. In particular, there were the criminal charges against its executives on the illegal uses of investors' money and insider trading of its own coin (FTX Coin) between the company and its affiliate (Alameda Research).[16] It is amazing to see that this young start-up run by executives who are in their 20s could build such a huge asset base through leverage (the total liability of $50 billion as reported by the media) with so little equity (estimated to be about $500m, inferred from its 20% equity sale), which yields a leverage ratio (LR) of over 100 (in comparison, the LR of Lehman Brothers when it failed in 2008 was a little over 30). Yet, according to media reports, the company instituted only a primitive level of internal control (the accounting done by QuickBook), and relied on celebrity marketing by hiring sports and movie stars to attract investors to their exchange.

In Korea as well, the market for crypto-assets is high-risk, not just because of the extreme price volatility but because of the fraudulent practices by some intermediaries. As mentioned in Section II, delisting from the exchange is rather frequent, and some cases are a subject of criminal investigation. For example, the coin named PuriEver (PURE) ceased in trading in April 2023, as its operator was found to provide misleading information to consumers (about its major investors, the assessment report, and so on). The CEO of one exchange holding company (the BitSum Holdings) was investigated in May 2023 for taking a large sum of briberies (about $3.8 million USD) from the multiple issuers of 'Kimchi coins' (traded in Korea only). A coin-listing broker is charged for embezzlement by giving briberies (to the executives of the exchanges such as CoinOne) as well as taking a large sum of money from the coin issuers between 2020~23. Last but not least, the major coin exchanges in Korea – BitSum, CoinOne, and GoPax – were investigated in 2023 and found to have been involved with fake transactions of huge amounts with their own money to inflate the market price of Terra-Luna, the infamous case of the fraudulent stable coin traded world-wide.

One important attribute to note about the Korean crypto-asset market is the fact that it consists of two main groups – (small) household investors and the private exchanges (most of whom are not validated by the government) – with not much involvement by institutional investors. In contrast, the US primary (issuance) market is dominated by Venture Capitals (VC), while institutional investors play an increasing role in the secondary (trading) market (Coinbase transaction volume is approximately 64% institutional investors and 36% retail investors). In addition, the US security supervisor (SEC) approved the cryptocurrency-based Exchange-

[15] For more details, refer Cambridge Center for Alternative Finance (CCAF) (2017).

[16] In October 2023, the court found guilty on seven counts, and sentenced 110 years in prison, for the FTX' CEO, Sam Bankman-Fried (31-yrs old), See "the Collapse Of FTX: Insiders Tell All," https://www.youtube.com/watch?v=XqwGt69pDXQ.

Traded Fund (C-ETF) in January 2024, upgrading the asset by encompassing it within the realm of regulatory oversight.

IV. Dealing with Financial Frauds and Abuses

Through regulating the financial markets, we generally aim to achieve three inter-connected objectives: (1) financial stability (i.e., ensuring financial safety and soundness of the intermediaries); (2) financial inclusion (i.e., incrementally expanding financial services, particularly by formal and properly-supervised intermediaries, to marginal consumer groups); and, (3) consumer protection (i.e., instituting a fair and ethical treatment of consumers by financial institutions and their employees). Properly dealing with the fraudulent and abusive practices discussed in Section 5 serves all three policy objectives, in that it will help protect financial consumers, will lead to a safe way to expand financial inclusion, and will eventually help stabilize the financial markets. In the following, some possible remedies to that end will be discussed, grouped into three parts: (1) combating financial fraudsters, (2) dealing with abusive financial intermediaries, and (3) nudging consumers to induce more sound borrowing and investment decisions.

A. Combatting Financial Fraudsters

How to effectively combat the fraudsters in the financial markets? They include the operators of voice phishing along with their collaborators (e.g., the WormGPT service providers), the fraudulent intermediaries in the crypto-asset markets, and the architects of the Ponzi-like investment products. Given the fact that, in many cases, there are large, well-organized, and international organizations behind their operations, combating against them goes beyond the financial service sector and requires a concerted effort among financial institutions (including the FinTech service providers) and their supervisors, as well as law enforcement authorities of multiple countries. Hence, the multilateral organizations such as OECD or G20 can serve as a forum to offer leadership and policy direction for such effort.

Intermediaries can utilize their middle- and back-office functions to detect illegal or fraudulent transactions in a more efficient and accurate fashion. To that end, the RegTech service can be used to automate their internal processes, not only for complying with the KYC (Know Your Customer) and AML (Anti-Money Laundering) related regulatory requirements but also for innovating the processes based on alternative data and machine learning analytics. In addition, regulators can induce the intermediaries to regularly monitor and analyze the extent of fraudulent transactions, similar to the SAR (Suspected Activity Report) requirement by CFPB in the U.S. It would also be a fruitful policy direction to require a measure that solicits consumers' consent when transferring their personal information to a third party, such as the Apple's App Tracking Transparency (ATT) examined by Bo et al. (2024). The study claims that such device is shown to work as a preventive mechanism to deal with lax privacy standards on the part of the intermediaries and, hence, with the financial frauds based on such information.

There should also be an internationally coordinated effort to collect and share real-world cases of financial frauds happened in different countries, which can serve as a larger and more representative sample than the one used in this study. For this, the international research community can play a major role by enabling those interested researchers to utilize such sample in finding patterns and causes of the financial frauds of various sorts, with which one can develop hypotheses to test and can suggest specific policy remedies out of their findings.

B. Dealing with Abusive Financial Intermediaries

There is a long list of abusive practices by financial intermediaries, as discussed in Section 4, which includes the P2P platform operators in China, the executives of FTX, the designers of Terra-Luna and other high-risk crypto-assets, the sellers of the predatory mortgage lending products in the subprime mortgage market, and the sellers of the VALI products with exploitive

embedded clauses. For them, a tight regulatory oversight is required, and the tech-driven solutions such as SupTech (Supervision Technology) can be considered to that end (although not much is documented about its effectiveness by the research community).

One inherent challenge of financial regulation in the FinTech era is to balance two competing goals – instituting a tight oversight to achieve the aforementioned regulatory objectives vs. making sure maximum innovation can happen. In general, FinTech service providers are less rigorously regulated or are subject to a bespoke regulatory regime. But, given the rising incidences of the fraudulent and abusive practices, there should be a new and more stringent regulatory regime that targets those intermediaries who trade high-risk products (e.g., crypto-asset exchanges, equity-Crowdfunding operators, and arcane insurance product sellers).

To promote tech-driven innovations, a country can actively utilize the regulatory sandbox, which was initiated in the UK financial service sector in 2016 and is now popularized in over 40 countries in variant forms (OECD 2023). As a related point, the literature claims that there should be multi-dimensional capabilities in order to link a micro project-level innovation to an organizational outcome. That is, a data·AI driven innovation (e.g., an enhanced predictive power) would result in an enhanced organizational performance only if all three dimensions of capability are in place (termed as BDAC, or BigData Analytics Capability): (1) human dimension (i.e., personnel w/ analytical skills); (2) physical dimension (i.e., IT infrastructure to collect and share BigData); and, (3) governance dimension (i.e., decision-making process to reflect the outcome of data analysis to actual business processes). (Akter et al. (2016), Wamba et al. (2017).

C. Nudging Consumers

Consumers are in general myopic and present time-biased, resulting in too much consumption now and under-saving for future. FinTech services can exacerbate this problem by making it easier to borrow and pay through the platform-based services (e.g., the P2P lending and BNPL). A well-targeted education or counseling program can help nudge consumers to overcome this problem, but only if it delivers a tailored information to specific consumer cohort in the context of avoiding an incomplete sale of certain financial products. Such program should be in-time (i.e., when consumers make decisions on financial products) and interactive with consumers to offer product information in an understandable format.

To that end, a ChatGPT-like LLM (Large Language Model) can be utilized, for which Brynjolfsson et al. (2023) documents a promising empirical result. That is, the study tested the effects of a ChatGPT-based operational support system among about 5,000 customer support employees in a call center, and reported that all indicators of productivity showed a significant improvement after its implementation, more so among low-skilled employees than more experienced ones. The implication is that LLM combined with an institutional knowledge of a particular setting can generate a steep learning curve, both for service providers and for consumers thereof. Such LLM-based interactive program would work as a nudging mechanism, for borrowers to make a more informed and savvy decision as well as investors to move away from a herd behavior.

V. Conclusion

This study attempts to relate the technological innovations adopted in the financial service sector (the three waves of the FinTech innovations) to combating financial frauds and abusive intermediation practices. To that end, the paper documents a small sample of real-world cases of fraudulent and problematic practices observed from different countries, and also elaborates three sets of remedies to deal with the anomalies. Hopefully, this study can contribute to future research effort in this vein in the international research community, to better understand underlying patterns and

causes of financial frauds and to come up with effective policy regimes to deal with them.

As discussed, those frauds and crimes are often backed by the large (often multi-national) crime organizations, and, hence, an effective combat against those crimes goes beyond the financial service sector. Instead, a coordination mechanism (possibly multi-national in nature) should be developed through a cooperation between financial market participants - regulators, intermediaries, and consumers - and crime investigation authorities in a country. On the part of the intermediaries, they can automate their internal processes by utilizing a data·AI technology to efficiently detect and prevent the fraudulent transactions. In addition, the regulators can implement a reporting routine on such transactions as well (e.g., the SAR requirement by CFPB in the U.S.). And there should be a training in the demand-side, to make consumers more cautious and more savvy in responding to the crimes, for which information dissemination on actual cases of financial frauds occurred in different countries and on appropriate responses to those cases would.

One particular concern to be aired in relation to the fast-moving advancement of technology is the potentially detrimental impact of the quantum computing. If and when it enters a full implementation stage, it is expected that the vastly improved computing power will make it much easier to solve highly complicated passwords, which would equip the fraudsters a lethal weapon. That may make any password-based financial transaction vulnerable, particularly those involved with the cryptocurrency transactions. Hence, proper consideration should be given to dealing with this side effect caused by the fast-moving technological advancement.

References

Agrawal, A., Gans, J. & Goldfarb, A. 2017. Prediction machines: The simple economics of Artificial Intelligence. Harvard Business Review Press.

Ahn, S. Y., & Nam, Y. 2022. Does mobile payment use lead to overspending? The moderating role of financial knowledge. Computers in Human Behavior, 134, 107319.

Akter, S., Wamba, S., Gunasekaran, A., Dubey, R. & Childe, S. 2016. How to improve firm performance using big data analytics capability and business strategy alignment?. International Journal of Production Economics 182, 113–131.

Armantier, O., Doerr, S., Frost, J., Fuster, A., & Shue, K. 2021. Whom do consumers trust with their data? US survey evidence. Technical report, Bank for International Settlements.

Anderson, K. B. 2016. Mass-market consumer fraud: who is most susceptible to becoming a victim?. FTC Bureau of Economics, 332.

Barber, B.M., Huang, X., Odean, T., & Schwarz, C. 2022. Attention induced trading and returns: Evidence from Robinhood users. The Journal of Finance, 77(6), 3141-3190.

Beck, T., Pamuk, H., Ramrattan, R., & Uras, B. R. 2018. Payment instruments, finance and development. Journal of Development Economics, 133, 162-186.

Berg, T., V. Burg, A. Gombović, & Puri, M. 2020. On the Rise of FinTechs: Credit Scoring using digital footprints. Review of Financial Studies, 33(7), 2845-2897.

Bian, W., Cong, L. W., & Ji, Y. 2023. The rise of e-wallets and buy-now-pay-later: Payment competition, credit expansion, and consumer behavior. Working Paper.

Bo, B., Pagel, M., Raval, D. & Tang, H. 2024. Consumer surveillance and financial fraud. NBER Working Paper 31692.

Breiman, L. 2001. Statistical Modeling: The Two Cultures. Statistical Science, 16(3) 199–231.

Bresnahan, T., & Trajtenberg, M. 1995. General purpose technology: Engines of growth. Journal of Econometrics 65, 83~108.

Brynjolfsson, E., Li, D. & Raymond, L. 2023. Generative AI at work. NBER Working Paper 31161.

Buchak, G., Matvos, G., Piskorski, T., & Seru, A. 2017. Fintech, regulatory arbitrage, and

the rise of shadow banks. NBER Working Paper 23288.

Cambridge Center for Alternative Finance (CCAF). 2017. Global Cryptocurrency Benchmarking Study. CCAF.

Chava, S., & Paradkar, N. 2018. Winners and losers of marketplace lending: Evidence from borrower credit dynamics. Georgia Tech Working Paper 18-16.

Cho, M.. 2025. A Behavioral-Pattern Driven Framework for Research on Financial Consumer Protection. Working paper.

Cho, M.. 2023. The Risk of Tri-Asset Busting: A Comparison between Korea and the U.S. mimeo. (in Korean)

Cho, M.. 2021. FinTech Megatrends: What Welfare Implications Can We Draw for Financial Consumers?. The International Review of Financial Consumers, 6(2).

Cho, M.. 2009. Managing Mortgage Credit Risk: What Went Wrong with the Subprime and Alt-A Mortgage Markets?. International Real Estate Review 12(3), 295-324. 20.

Cho, M.. 2008. 180 Years' Evolution of the US Mortgage Banking system: Lessons for Emerging Mortgage Markets. International Real Estate Review, 10(1), 171-212.

Citi GPS. 2018. Bank of the Future: The ABCs of Digital Disruption in Finance, CITI (March).

deHaan, E., Kim, J., Lourie, B., & Zhu, C. 2024. Buy now pay (pain?) later. Management Science, 70(8), 5586–5598.

de Meza, D. & Webb, D.C. 1987. Too much investment: A problem of asymmetric information. Quarterly Journal of Economics, 102 (2), 281–292.

De Mauro, A., Greco, M., & Gromaldi, M. 2018. A formal definition of Big Data based on its essential features. Library Review 65(3),122-135.

DiMaggio, M., & Yao, V. 2021. Fintech Borrowers: Lax-Screening or Cream Skimming?. The Review of Financial Studies, 34(10), 4565-4618.

Di Maggio, M., Williams, E., & Katz, J. 2022. Buy now, pay later credit: User characteristics and effects on spending patterns. Working Paper.

Frost, J., Gambacorta, L., Huang, Y., Shin, H.S., & Zbinden, P. 2019. BigTech and the changing structure of financial intermediation. BIS Working Paper No 779.

Fuster, A., Plosser, M., Schnabl, P. & Vickery, J. 2018. The Role of Technology in Mortgage Lending, NBER Working Paper 24500.

Fuster, A., Goldsmith-Pinkham, P., Ramadorai, T. & Walther, A. 2022. Predictably unequal? the effects of machine learning on credit markets. The Journal of Finance 77 (1), 5–47.

Gorton, G. 2008. The Panic of 2007. Presented at the 2008 Kansas City Fed Annual meeting, Jackson Hole, U.S.A..

Guttman-Kenney, B., Firth, C., & Gathergood, J. 2023. Buy now, pay later (bnpl) on your credit card. Journal of Behavioral and Experimental Finance, 37:100788.

Helpman, E., & Trajtenberg, M. 1998. A Time To Slow and A Time to Reap: Growth Based on GPT. in Helpman ed. General Purpose Technologies and Economic Growth, MIT Press, Cambridge, Massachusetts.

International Monetary Fund (IMF). 2017. Fintech and Financial Services: Initial Considerations, IMF Discussion Note.

Iyer, R., Khwaja, A., Luttmer, E. & Shue, K. 2016. Screening peers softly: Inferring the quality of Small borrowers. Management Science 62(6), 1554-1577.

Jack, W., Ray, A., & Suri, T. 2013. Transaction networks: Evidence from mobile money in Kenya. American Economic Review, 103(3), 356-61.

Jagtiani, J., & Lemieux, C. 2019. The roles of alternative data and machine learning in Fintech lending: Evidence from the LendingClub consumer platform. Philadelphia Fed Working Paper.

Kim, Y.I., Shin, S.D., Park, S.J. & Cho, M. 2023. Data Economy and Credit Risk Management: Role of Alternative Data in Korea, Research on Financial Information. 12(2), 1-29. (in Korean)

Lee, S.B. 2021. Current State of Performance of the Robo-Advisor Sector in Korea.

Research Report 21-05, Korea Capital Market Institute. (in Korean)

Makarov, I., & Schoar, A. 2022. Cryptocurrencies and Decentralized Finance (DEFI). NBER Working Paper 30006.

Mullainathan, S., & Spiess, J. 2017. Machine Learning: An Applied Econometric Approach. Journal of Economic Perspectives, 31(2), 87–106.

Nakamoto, S. 2008. Bitcoin: A Peer-to-Peer Electronic Cash System, mimeo.

Nasdaq, 2024 Global Financial Crime Report, https://www.nasdaq.com/global-financial-crime-report;

Organization of Economic Cooperation and Development (OECD). 2019. The Digital Innovation Policy Landscape in 2019. OECD Science, Technology and Innovation Policy Papers, No. 71.

Organization of Economic Cooperation and Development (OECD). 2023. Generative Artificial Intelligence in Finance. OECD Artificial Intelligence Papers, No. 9.

Packin, N. 2022. Financial Inclusion Gone Wrong: Securities and Cryptoassets Trading for Children. Hastings Law Journal, 74, 349.

Panos, G. A., & Wilson, J. O. 2020. Financial literacy and responsible finance in the FinTech era: capabilities and challenges. The European Journal of Finance, 26(4-5), 297-301.

Park, S.J. 2024. Research on Digital Financial Literacy/ Research Report, Korea Insurance Research Institute (in Korean).

Philippon, T. 2016. The FinTech Opportunity/ NBER Working Paper 22476.

Puri, M., Rocholl, J., &Steffen, S. 2017. What do a million observations have to say about loan defaults? Opening the black box of relationships. Journal of Financial Intermediation 31, 1-15.

Seo, B.H. 2024. Current State of Digital Financial Crimes and Its Implications. Presentation material, Korea Institute of Finance. (in Korean)

Stiglitz, J.E., & Weiss, A. 1981. Rationing in markets with imperfect information. American Economic Review,71(3), 393-410.

Tang, H.. 2019. The value of privacy: Evidence from online borrowers. Available at SSRN.

Teece, D. J. 2018. Profiting from innovation in the digital economy: Enabling technologies, standards, and licensing models in the wireless world. Research Policy, 47(8), 1367-1387.

Varian, H. 2014. Big Data: new tricks for econometrics. Journal of Economic Perspectives, 28(2), 3–28.

Waller, C., & Lewarne, S. 1994. An expository model of credit rationing. Journal of Macroeconomics, 16 (3), 539–545.

Wamba, S., Gunasekaran, A., Akter, S., Ren, S., Dubey, R. & Childe,S. 2017. Big data analytics and firm performance: Effects of dynamic capabilities. Journal of Business Research, 70, 356–365.

Yue, P., Korkmaz, A. G., Yin, Z., & Zhou, H. 2022. The rise of digital finance: Financial inclusion or debt trap?. Finance Research Letters, 47, 102604.

Zuboff, S. 2020. The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power. PublicAffairs (March 3).

Received/ *2024.11.26*
Revised/ *2024.12.30*
Accepted/ *2025.02.17*

Table 1. The Enabling Functions of Recent AI Systems

Enabling function	Elements of BDML	Applications
Face•Object Recognition	• From around 2012, R&D and investment↑ (BigTech); GPU use↑ • BD: Use of alternative data↑; Development of "ImageNet" • ML: Human neural net (86b nurons & their network); Deep Learning↑	• Driverless car • X-ray reading, cancer detection, R&D in medical•health sector • SmartX (SmartFarm, SmartFactory …..)
Gaming	• AI based online gaming (e.g., go, chess, curling) • BD: Past play records • ML: Deep Learning + Simulation, (DeepMind Technology)	• AlphaGo (2016), AlphaZero (2017) (for chess, go, shogi; capability of "self-play") • CurlingBot (2018)
Language Recognition (LLM)	• Emergence of LLM (post-2018) • BD: Texts of different languages (GPT3 ~ 500b words from www) • ML: Transformer Architecture (2018), Generative Pre-trained Transformer (GPT) (2020.6)	• BERT (Bidirectional Encoder Representations from Transformers) (Google) • ChatGPT (GPT-3 & GPT-4 by OpenAI); GPT-3 ~ 175b "parameters"
Academic Research, and R&D (Exploratory Science)	• ML based data analyses (for R&D) • BD: R&D targeting BigData (e.g., "All of US" in the US) • ML: Decision tree based data analytics	• Both social & natural science (e.g., "nowcasting") • Analytics: Regression tree, random forest, LASSO, ensemble, bagging ….

Source: the author

Table 2. The fraudulent or abusive cases of the VALI products

Intermediary	Country	Event Year	Description
Lina Tanaka and William Worth	United States	2009	Lina Tanaka, an insurance agent, and William Worth, a former insurance broker, were involved in a scheme where they sold variable annuities to elderly investors and then churned their accounts to generate high commissions. Churning refers to the excessive buying and selling of securities to generate commissions at the client's expense. They targeted senior citizens, convincing them to switch annuities frequently, which incurred high surrender charges and fees, severely depleting their investments.
MetLife	United States	2016	The Financial Industry Regulatory Authority (FINRA) fined MetLife $25 million for misleading customers about the costs and benefits of variable annuities. MetLife made misrepresentations and omissions about replacement variable annuity transactions, leading customers to believe that new annuities were more advantageous when, in reality, they often carried higher costs and less favorable features. This resulted in customers incurring significant fees and charges.
Raymond James Financial	United States	2014	FINRA fined Raymond James Financial $8.25 million for failing to adequately supervise the sales of variable annuities. The company was found to have inadequate systems and procedures in place to ensure that the variable annuity sales were suitable for their clients. This lack of oversight led to instances where customers were sold annuities that did not meet their financial needs or investment objectives.
AXA Equitable Life Insurance Company	United States	2015	AXA Equitable was fined $20 million by FINRA for making misstatements and omissions regarding the fees and potential benefits of variable annuities. They misled investors about the costs of transferring their existing investments into AXA’s variable annuities and the associated benefits, which caused financial harm to many investors who trusted their recommendations.
Waddell & Reed	United States	2005	The National Association of Securities Dealers (NASD), now part of FINRA, fined Waddell & Reed $5 million and ordered restitution of $11 million for failing to supervise the sale of variable annuities. The company allowed brokers to recommend unsuitable annuity exchanges that generated high commissions but resulted in significant financial losses for clients due to surrender charges and other fees.

Data source: ChatGPT 4.0; Revised by the author