



Fintech and the Retirement Savings System



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Executive Summary

This report provides a sampling of new financial technologies (fintech) and their applications related to retirement savings systems affecting participants, plan sponsors and service providers. This Executive Summary provides a brief overview of the contents of the report.

We first discuss issues directly relevant to pension participants and the decisions they need to make. We then discuss issues relevant to plan sponsors and service providers. Each section also includes references about the fintech area discussed which can be found in the References section.

The sections about participants look at how fintech can offer personalization that enhances how participants interact with pension plans. These trends may be particularly relevant because more people are working with computers from home due to the COVID-19 pandemic, and because telework will likely continue at an increased level after the pandemic has ended. The fintech we discuss includes:

- More engaging communication with pension participants using artificial intelligence;
- Greater motivation for participants to learn about pensions using gamification;
- Some approaches to overcome obstacles to informed investment direction using robo-advisers;
- New methods for a participant to better track pensions from former employers using dashboards; and
- A novel way to spread risk in the payout phase of pensions using tontines.

The sections about plan sponsors and service providers look at how fintech can offer better protection of pension data and accountability of advisors. As COVID-19 changes behaviors, people are using online transactions more often and reducing in-person banking. Financial technologies can offer improvements in monitoring pensions. This includes:

- More secure and streamlined participant access to data using facial recognition;
- Better insight for defined benefit pension plan investment advisors and investing using artificial intelligence;
- Increased security of online access to transactions and records for pension plans, service providers, regulators, and participants using blockchain recordkeeping;
- Simpler and cheaper plan administration as demonstrated in the Netherlands using blockchain accounting;
- Less effort and cost to maintain and upgrade information systems using cloud computing; and
- A new approach to protect defined benefit data moving from a plan sponsor to an insurer using blockchain technology for pension risk transfers in the UK.

The final section presents a few concluding comments on the direct and indirect ways that fintech affects the retirement savings system.

Section 1: Introduction

Financial technologies (fintech) can solve problems with Retirement Savings Systems for participants, plan sponsors and service providers. At the same time there can be downsides of fintech. In this paper, we look at the solutions and downsides that are particularly relevant to middle-income individuals with pensions. In our discussion, we include defined benefit and defined contribution plans, as well as Individual Retirement Accounts (IRAs). We note that IRAs include more total dollars than employer sponsored defined contribution plans. IRAs include retirement savings rolled over when workers change employers and when plan sponsors terminate plans. We examine current and potential future uses of fintech. Our focus is on the United States, but our project is international in scope.

Throughout our discussions, we refer to *retirement savings plans* and *pension plans* interchangeably. In our definition, both terms include defined benefit and defined contribution plans, including IRAs. We focus on issues related to pensions as they affect participants (those currently working and those in retirement); we do not discuss other issues, such as the effects of fintech on the employment of pension service providers.

Financial services for pension plans are going through a period of change, with a rapid acceleration of the development and deployment of new financial technologies, in part due to workplace changes caused by COVID-19. Pension plans face a number of governance challenges that fintech could address, such as deciding on an investment strategy, selecting and monitoring asset managers, overseeing communications with participants, and ensuring that plan records are accurate.

It is not possible to know which new fintech developments will succeed and which will not. Nonetheless, it is clear that (broadly speaking) fintech has the potential to revolutionize the ways in which pensions are provided and administered.

The definition of *fintech* and what it includes is not agreed upon. In this report, fintech includes artificial intelligence (AI) and computer algorithms, which are sometimes called *robos* or *bots*, short for *robots*. Artificial intelligence could play a larger role in the future in financial decisions, including those related to technical and fundamental analysis of financial market investments. These developments are being facilitated by increased computing power, reductions in the cost of data storage, increased data availability, and improvements in human-to-machine interfaces, such as voice communications with computers.

COVID-19 will doubtlessly have long-lasting effects on the way people interact. Many people have become more comfortable with remote work and with remote interactions with service providers. As a result, the pandemic may change the way that pension information is communicated and could increasingly make fintech-based interactions, such as obtaining financial advice from robo-advisers, and remote conversations with plan representatives and notaries, more preferable than in person interactions.

Section 2: Participants

The sections in this part of the report focus on ways that fintech can directly help plan participants, starting with communications.

2.1 FINTECH AND PENSION PLAN COMMUNICATIONS

2.1.1 INTRODUCTION

Fintech can be used to improve communications with plan participants. During the COVID-19 pandemic, many people began working remotely and therefore using a diverse array of communication methods. Fintech offers promising technologies to help pension participants communicate with plan administrators in more engaging ways. The innovations we consider in this section all involve the use of computers and thus assume that workers have access to a computer or smart phone.

2.1.2 PERSONALIZED COMMUNICATIONS

Artificial intelligence (AI) is based on the theory that computer systems can perform tasks that normally require human intelligence. These tasks include visual perception, speech recognition, and decision-making. AI's building blocks—applied mathematics and data science—enable organizations to rapidly analyze large quantities of data. Machine learning is a primary aspect of AI. Statistical analysis of data enables computers and algorithms to gradually “learn,” thus achieving better outcomes over time.

Increasingly, participants' communication with financial service providers is handled automatically by chatbots, which are computer programs that use voice recognition software to carry on a conversation. The chatbot Amelia, used by Swedish Bank SEB, acts as a customer service agent. It can answer simple queries and learn from human agents when it cannot answer certain questions.

Artificial intelligence combined with data about employees can be used by employers to personalize pension communications. One company uses AI to assist investment specialists who advise participants about 401(k) plans. The AI provides insights and analytics about the clients. By analyzing data about their employees, such as age, income, sick leave usage, and family status, pension sponsors can provide more targeted, personalized communications. These communications can encourage employees to participate, provide better advice about pension investments, and encourage employees to increase their contributions.

Pension plans can use personnel data to consider the best methods and timing of communications with employees. The member can select which form of communications—printed material, email or text messages—he or she prefers. By understanding what type of information is important to individuals, and by using technology and data to provide that information, pension plan administrators can improve outcomes.

A survey in the UK found large differences across age groups in the way pension participants prefer to receive information. For example, 60 percent of people age 25 to 34 would be comfortable viewing their pension information with a mobile banking app compared to only 11 percent of those over age 65. However, 61 percent of people age 55 to 64 would find it most convenient to view pension information on the pension provider's website compared to 37 percent of those age 18 to 24 (Burrell 2020).

One robo-adviser used for pension and non-pension clients has found ways to improve targeted communications by using AI to better understand clients. The AI categorizes clients as either actively engaged or not actively engaged. It contacts actively engaged clients during market downturns to encourage them not to sell stocks. During market downturns, such as in early 2020 when COVID-19 caused fear relating to the state of the stock market, 401(k) participants greatly increased trading by selling stocks and moving into bonds (Sullivan 2020). However, informing

non-active clients about market fluctuations can backfire if those clients take inappropriate actions, such as selling during a downturn (Egan 2017). During upturns, however, it could be desirable to contact all participants and encourage them to rebalance their portfolios if they are in plans where that is not done automatically.

2.1.3 GAMIFICATION TO EDUCATE WORKERS ABOUT PENSIONS

Gamification uses computer games to educate workers about pensions. This approach might not be suitable for some workers, but for others it can make otherwise complex material interactive and engaging. Gaming principles, such as competition, status, recognition, challenges, and fun, can motivate people to perform certain actions, such as enrolling in and contributing to pensions.

Gamification does not necessarily involve a traditional game format. Many people who do not consider themselves to be gamers have encountered gamification techniques, such as being motivated to walk farther to reach a Fitbit goal or moving up levels on retail or airline loyalty programs.

A game format can communicate the effect of delaying pension contributions or saving different amounts on future account balances. Gamification can be used to teach people the basics of investing in pensions, such as the value of diversifying investments.

A UK bank introduced an online computer game called Pension Jungle to encourage its employees during pension enrollment to actively choose the level of their pension contributions. Participants pick an avatar, which is a visual figure representing the player, and provide information about their finances. They learn about the company's pension plan as they navigate a river. To avoid the rocks and crocodiles, participants need to correctly answer questions about the company's pension plan. An electronic genie guides participants.

In the United States, a benefits consulting firm has created pension plan games for its clients. Also, one software company is partnering with pension recordkeepers to bring financial education to participants (Tannenbaum 2018). A mutual fund company that manages pensions offers the game Boom or Bust to teach participants about pensions and saving for retirement. That game uses two avatars, one for the player's present self and one for their future self, in order to help the player understand the effects of current pension choices on his or her financial future.

In these ways, fintech can be used to provide better and more engaging targeted communications. It can be used to educate participants and to encourage better choices.

2.2 MAKING INVESTMENT DECISIONS—ROBO-ADVISERS AND PENSIONS

2.2.1 INTRODUCTION

Computer algorithms are increasingly used to automate investing functions. These algorithms are sometimes called robos or bots, which are terms that are short for robots. This section focuses on robo-advice designed to help pension participants in defined contribution plans, including IRAs, manage pension investments.

2.2.2 ROBO-ADVISERS

Robo-advisers are online services that use computer algorithms to provide investment advice and manage customers' investment portfolios. The client typically fills out a questionnaire that asks about his or her attitude toward risk, age and expected retirement date, and other investments. Robo-advisers use quantifiable factors, such as account balance, income, tax situation, investment goals, and risk tolerance, to analyze each client's financial status and to provide portfolio recommendations tailored to that client's needs. Typically, these programs do not provide advice relating to decumulation, which involves withdrawing money from the pension account in retirement.

Robo-advice comes in different forms. The advice provided to pension participants might be part of a program that manages their other financial market assets, or it could be focused solely on the pension plan investments. It might be part of a program that considers other financial goals, such as college savings, or it could be focused on assistance with making pension investments. It might be part of a program that addresses financial wellness, including debt and insurance, or it might be more narrowly focused. It could be a stand-alone program, or it might involve a human investment adviser in a hybrid format. Robo-advice can directly interact with the pension participant or it can assist a financial adviser as he or she advises clients (Fisch, Labouré, and Turner 2019).

Robo-advisers interact with clients online to gather client information and to inexpensively manage the clients' investments. An investor creates an account online by responding to various questions. Using that information, the robo-adviser uses algorithms to offer investment selections deemed appropriate for each client. Selections typically include low-cost mutual funds and exchange traded funds (ETFs). Sometimes mutual fund companies only offer their own funds. Robo-advisers invest the client's portfolio in accordance with the recommended asset allocation, which can typically be modified by the client. They manage the client's portfolio on an ongoing basis, providing services that include automatic rebalancing to maintain the desired asset allocation, and reinvesting dividends and interest payments to manage cash flow. They can help clients keep savings on track to meet retirement goals.

Within the financial advice industry, fintech's impact is evident. Robo-advice is generally cheaper and more accessible than human advice, making it especially useful for defined contribution plans that often present participants with numerous financial choices about managing relatively small accumulated savings. According to the UK government's chief scientific adviser, fintech companies can increase the availability of financial advice to previously underserved populations. This is due to "lower cost structures, greater customer reach or superior ability to monitor or score risk" (OECD 2017). Robo-advisers were estimated to manage \$440 billion in assets worldwide as of June 30, 2019 (Backend Benchmarking 2019).

Because workers are responsible for financial decisions relating to their defined contribution plans, it has become increasingly important to provide them with affordable, trustworthy financial advice. In the U.S., the Pension Protection Act of 2006 authorized pension providers to use computer-generated advice for pension participants. Since computers are good at both routine and complex tasks, robo-advisers can make it easier for pension participants to manage investments. For years, human advisers have used computer programs to help them provide advice. Robo-advisers have made those types of computer programs available to pension participants and other investors.

Traditionally, financial advice has only been available to people with substantial wealth. Many people were excluded from access to financial advice because of minimum investment requirements and because of the cost of the advice. Today, robo-advisers make financial advice available to nearly everyone with any level of wealth. This particularly benefits middle- and lower-income pension participants who otherwise would not have access to affordable financial advice. Robo-advisers can provide increasingly personalized advice as they gather more information about clients.

Recently, fintech is being used to assess investor risk tolerance. This trend, which is driven by increasingly sophisticated software, is helping robo-advisers do a better job of determining the risk tolerance of clients and then making sure that their portfolios are consistent with that risk tolerance. Software developments could soon integrate portfolio rebalancing with assessments of risk tolerance (Kitces 2020).

Robo-advisers have an advantage over target date funds; namely, the ability to help clients pick investments that are aligned with their risk tolerances, not just their ages (Fisch and Turner 2018). Breen (2019) speculates that eventually robo-advisers could replace target date funds, even though target date funds are often the default for people who are auto-enrolled in a 401(k) plan. In the future, funds managed by robo-advisers could be offered as the default funds for pension participants. This change could reduce fees and result in more personalized advice.

Target date funds tend to have fees of around fifty basis points. By comparison, one financial service provider has offered robo-advisor managed funds designed for 401(k) plans with total fees of twenty basis points (Breen 2019).

Relatively new companies and more established financial services companies are using robo-advisor technology to serve pension plan sponsors and participants who traditionally relied on human advisers. Some robo-advisers provide the option of a hybrid model that involves a robo-advisor and a human adviser (Friedberg 2018).

The new robos primarily help small and midsize employers, which tend to have lower-wage employees than larger companies. Many believe this market has been neglected and overcharged (Iacurci 2018).

One robo-advisor provides every plan participant with fiduciary investment advice and a professionally managed account. In addition to handling compliance, recordkeeping, and custodial work, the robo-advisor assists with investment selection, and evaluation and monitoring of service providers for employers, which are basic services for most 401(k) advisers (Iacurci 2018).

Human financial advisers in the U.S. generally charge fees of around 1 percent of assets under management, with clients having larger portfolios often paying lower fees (Ludwig 2017). By contrast, robo-advisers typically charge fees ranging from 0 to 50 basis points. In both cases, additional fees are charged for the underlying investments. One robo-advisor, for example, initially charged fifteen basis points for accounts with more than \$100,000 and thirty-five basis points for the smallest accounts, but it has since been charging twenty-five basis points for all accounts. (For accounts that exceed \$2 million, fees are capped). Deschenes and Hammond (2019) summarize studies indicating that users of robo-advisers might do better than people who use human financial advisers, mainly because of the lower fees.

In addition, human advisers might require clients to have minimum investable assets of \$100,000 or more, whereas robo-advisers are willing to help customers with much lower balances. One robo-advisor, for example, requires a minimum balance of only \$500, and at least one requires no minimum balance. Accordingly, robo-advisers might offer an opportunity to democratize finance and disrupt the wealth management sector through low-cost, accessible business models (Braunstein and Labouré 2018).

2.2.3 ARTIFICIAL INTELLIGENCE AND ROBO-ADVISERS

Artificial intelligence (AI) is improving robo-advisers. Improving recommendations is one of the uses of AI. A step in providing more useful recommendations involves incorporating data from a wider range of sources than has been used historically. One company has a machine-learning product that reviews a person's tax returns, credit reports, and bank-account information to provide customized financial-planning advice (Pah 2019).

While robo-advisers usually carry out the advice they provide, in other cases that must be done by the participant. In either case, the participant can override the advice of the robo-advisor. Because participants are subject to behavioral biases, they may not follow good advice provided by robo-advisers. Recognizing this issue, some robo-advisers use a hybrid model that includes human advisers to help clients deal with their biases (Davenport and Guscza 2016).

2.2.4 WHO IS EXCLUDED?

New fintech such as robo-advisers could aggravate financial exclusion for people who are not comfortable using digital communications. Lack of digital and financial literacy among some populations might slow the development of robo-advice, making digital marginalization an issue. People who distrust the technology, rural residents with poor internet connections, and people who lack access to a computer or smart phone might be excluded. Older people who are uncomfortable with the technology might also be excluded from the benefits of fintech.

Robo-advisers could make financial education and financial literacy less important in the future. A basic level of financial literacy will always be a valuable skill, but attaining more advanced financial literacy might not be necessary because people will have inexpensive access to financial advice.

In upstate New York, Older Adults Technology Services (OATS) borrowed an idea from New York City to see if it would work in a rural area where half of older adults experienced social isolation. The nonprofit partnered with the state to set up centers to teach computer skills, bringing older adult students to them. The students took to the training and formed a community of peers. Some became trainers themselves. Nine hundred took the course of which 83 percent reported a higher quality of life after the training and of which 77 percent said they felt more confident living independently (Campbell 2019).

2.3 KEEPING TRACK OF PENSIONS

2.3.1 INTRODUCTION

Lost pensions are a problem affecting people with small pensions who change jobs. Sometimes workers cannot locate a pension from a former employer, perhaps because the employer has gone out of business or has been bought out. In addition, lost pensioners occur when an employer cannot communicate with a former employee concerning a pension, generally because the employee has moved and has not notified the pension provider of their new address.

The U.S., the UK, and other countries share a policy concern for workers who have lost pensions from previous employers. To address this concern, the UK is working on a pensions dashboard so that workers can keep track of all of their pension accounts in one place. For the U.S., a recent paper described below has outlined the advantages and hurdles involved in the creation of a pension dashboard.

2.3.2 UK AND US PENSION DASHBOARDS

The UK government, using British terminology of *pensions*, has made a commitment to support Pensions Dashboards created by the pension industry. The dashboard would enable everyone to view details of all their pensions in one location. The government has indicated that every pension provider will eventually move to this way of sharing data with participants. For many people, keeping track of various pension accounts is a significant barrier to effective financial management. Pensions Dashboards will enable people to view an online snapshot of their pensions via the portal of their choice.

The Pensions Dashboard Prototype Project was launched in September 2016 by the UK government. The project group ran a selection process to identify which firms would build the prototype. Selected firms were assigned to five project areas:

- Pensions Dashboard User Interface: how people interact with the dashboard;
- Pensions Finder Services: how the system retrieves information about individual pension accounts;
- Identity Providers: identity and personal data verification (discussed in the section on cybersecurity);
- Integration Service Providers: providing additional connections that some pension firms will need to share data with the dashboard;
- Matching/Data Quality Analysis: overcoming the challenges of finding every pension in every system.

The pension dashboards will also provide more transparent information about pension costs. One of the key issues, which is attracting attention from UK regulators and policymakers, is to improve transparency, including a full and clear disclosure of all investment costs charged by asset and fund managers for their services. Historically, service

providers have not been motivated to transparently report and communicate costs and fees to trustees, pension plan representatives, and participants.

Pension dashboards might help participants better understand their likely financial condition in retirement by looking at their current situation. This knowledge will help them decide if they need financial advice and perhaps motivate them to increase pension contributions. A goal is to encourage participants to take a proactive role in managing their retirement plans, stay in touch with their savings efforts, get a sense of their overall readiness for retirement, and feel empowered to make decisions about their finances.

Pension dashboards will include most defined benefit plans, most defined contribution plans, and the UK social security program. All of the pension dashboards will work the same way and the data they provide will be secure. Functions will include:

- Collecting the person's details and checking identity;
- Getting approval from the person to securely share that information;
- Searching millions of pension plans to find all of each person's pensions;
- Displaying all of the details about their pensions in the same place.

It will usually take a few seconds to track down all of a person's pensions, but the amount of time will depend on where their pensions are. For some people, it could take a few days. Pension dashboards will give people contact details for the pensions they find.

Eventually, each person will be able to choose which pension dashboard to use. Dashboards could be offered by banks, employers, and advice services.

A Pensions Dashboard Project Group is making sure that all elements of the dashboard will link together safely and smoothly. This group is also recommending the standards that all dashboards and pension plans will have to meet for sharing information. Pension dashboard apps will be available that can be downloaded to a smart phone.

In order to find all pensions, the Pensions Dashboards program in the UK will need to access the financial details of about eighty million pension accounts. Pension dashboards will not store data; rather, they will search and find data after an inquiry is made via the dashboard. In the future, every company that works with the Pensions Dashboards program will have to meet certain data and security standards. The UK dashboard program has encountered significant delays and complications, with the current timeline targeting full implementation in 2023, as of this writing.

A paper published in October 2020 from the Brookings Institution (John et al. 2020) discusses the potential creation of a retirement dashboard in the U.S. The advantages of such a dashboard in the U.S. are similar to those in other countries including helping savers manage preparation for retirement. The authors propose an online registry enabling workers to track their retirement accounts and benefits. The proposed dashboard may also offer services for lost account management, future income projections and advice. Obstacles to implementing such a dashboard include specific U.S. retirement system characteristics including its size and complexity compared to other countries, potential industry opposition, cybersecurity and overall cost. In terms of advancing the concept, the authors suggest the establishment of a feasibility task force with learnings from other countries helping to guide its assessment.

2.3.3 ISRAELI PENSION DASHBOARD

Israel provides a pension dashboard that helps many Israelis who previously had difficulty tracing retirement savings when they changed employers.

Known in Hebrew as the *Mislaka Hapensionit*, this dashboard receives information from all pension funds and insurance companies. It is operated by a private company that is regulated and supervised by the Ministry of Treasury. It is the center for information about long-term savings and insurance for every Israeli.

Israel's Finance Ministry contracted a private company to build this dashboard, which any saver in Israel can use to learn about savings products. The tool is supervised by the Capital Market, Saving, and Insurance Authority of the Ministry of Finance. It receives information from all the companies and authorities that manage long-term savings. Any saver can receive a report, which is sent by email and shows the amount of money accumulated in each retirement savings vehicle. An additional tool is called *Har Hakesef*, which means "the money mountain." It accumulates information from banks, pension funds, and insurance companies, and allows individuals to locate forgotten accounts.

Other countries providing some form of pension dashboard include Australia, Belgium, Denmark, the Netherlands, and Sweden. In some of these countries, the dashboard is a repository of information about pension accounts. In other countries, the dashboard functions as a search engine for information held in other places. Dashboards allow participants to see projections of their pension accounts and pension income in retirement.

2.4 THE PAYOUT PHASE

2.4.1 INTRODUCTION

We thus far have discussed issues related to participating in a pension, contributing to a pension, choosing investments for a pension, and keeping track of pensions from previous employers. The decumulation phase poses major problems for many defined contribution participants because they need to determine a payout schedule for an unknown number of remaining years. All that is further complicated by financial market risk affecting the size of their account balances. Fintech might be able to help. A number of existing approaches address the payout phase, plus others are on the short-term horizon. For example, robo-advisers could, in the future, develop financial drawdown strategies for participants. For the purposes of this report, this section focuses on a particular fintech application that uses a decumulation product called a *tontine*.

2.4.2 BLOCKCHAIN TONTINES

A tontine is a particular type of investment pool in which a group of investors invest. When a member of the pool dies, that person loses his or her claim to the pool; therefore, the pool benefits the longer-lived members at the expense of the shorter-lived members. Like a defined contribution plan, it has no unfunded liability because benefit payments are based on the available assets.

It is a rarely used option for retirement benefits in the U.S. The SECURE Act of 2019, however, may have facilitated the development of tontines for U.S. pensions because the law does not require insurance for a lifetime income guarantee (Toth 2020).

A tontine is an investment pool managed in an actuarially fair way, according to a plan for distributing payouts to investors. Tontines and ordinary investments have two key differences. First, tontine investments are generally irrevocable. Second, account balances are generally not transferred to a member's beneficiaries upon death; instead, remaining assets are divided among the pool's surviving participants. These extra returns are referred to as "mortality credits." In this way, tontines allow members to collect lifetime income by collectively self-pooling longevity risk among themselves. This obviates the need for, and cost of, reserve funds to back a guarantee. Tontines can deliver lifetime income similar to annuities and pensions. They can also, however, be structured to provide benefits to surviving spouses.

Importantly, a tontine can never be underfunded because no explicit financial promises or guarantees are made. The benefits it pays adjust up or down in a continually self-correcting manner based on the plan's mortality and financial market experience, ensuring that the present value of a tontine's payouts never exceeds the present value of its assets.

To be successful, tontine providers must establish the trust of participants, sponsors, and regulators. This is where [blockchain technology](#) can come into play. Blockchain technology promotes security and transparency by providing an immutable and public log (financial ledger) of all contributions, payout distributions, fees, and expense payments. This transparency allows regulators and analysts to audit its operations and status at any time. Blockchain technology is discussed further in section 3.4.

One company working to establish tontines ([Tontine Trust](#) 2020) is based in Gibraltar. This company's mission is to create secure, low cost, highly transparent lifetime income solutions via tontines invested passively in a highly diversified set of exchange traded funds (ETFs). The firm utilizes blockchain technology with pseudonymous immutable ledgers and biometric authentication, providing full transparency of every transaction and with privacy protection. Its authentication approach uses cellphone technology and 3D facial maps to confirm identities based on a live person rather than a photograph. This issue is discussed further in the section on cybersecurity.

Technology now presents an opportunity to build efficient new ways to protect old-age consumption, which is a primary goal of pension systems. This innovation holds the potential to disrupt the benefits-payments industry. Defined contribution plan sponsors might find tontines attractive because they presumably are a relatively low-cost lifetime income solution for plan participants without the need for reserve funds. The plan sponsor is freed from the potential fiduciary liability that comes with selecting a guarantor because no guarantee is provided. Tontine plan sponsors bear no investment risk, no longevity risk, and no underfunding risk.

Section 3: Plan Sponsors and Service Providers

The following sections focus on issues relevant to pension plan sponsors and others who provide services to pension participants.

3.1 PROTECTING PENSIONS AND PENSIONERS AGAINST CYBERCRIME

3.1.1 INTRODUCTION

Cybercrime can be viewed as a negative application of fintech. This section discusses cyberattacks and types of defenses against them.

Plan fiduciaries need to monitor cybersecurity with the same intensity as they monitor recordkeeping fees and fund performance. Although plan sponsors generally delegate cybersecurity responsibility to recordkeepers, they have a fiduciary duty to ensure that recordkeepers maintain a cybersecurity program, and that the recordkeepers have systems and procedures to protect against cybersecurity breaches and verify participant identities (Geller 2020).

3.1.2 CYBERATTACKS

Pension plans hold large amounts of personal data and assets, which can make them targets for cyberattacks (The Pensions Regulator 2018). Cyberattacks can involve stealing personal information or assets in a participant's account. Theft of participant money through fraudulent online transfers is one cybersecurity concern (Clark and Edwards-Franklin 2019).

As an example of theft of personnel data, in 2015, the U.S. Office of Personnel Management (OPM) discovered that the personnel data of 4.2 million current and former federal government employees had been stolen. The stolen data included names, birth dates, home addresses, and Social Security numbers (OPM 2019) thus placing many people at risk of identity theft. It also included fingerprints, which is concerning because participants can change passwords, but fingerprints are immutable (Peterson 2015).

Pension plans should have incident response plans to deal with cyberattacks and enable the swift and safe resumption of operations. These plans should take into account the diverse types of cyberattacks, which include accidental, staff-related, hacking, malware, ransomware, phishing, and coordinated DDOS (distributed denial of service) attacks. A distributed denial-of-service attack is a malicious attempt to disrupt the normal internet traffic of a targeted server, service, or network by overwhelming the target with a flood of traffic. Plans need to ensure that all third-party suppliers have sufficient controls in place to protect member data and plan assets. Critical systems and data should be regularly backed up. This should include, if appropriate, one or more offline backups to protect data from a cyber incident.

In the case of untargeted attacks, attackers indiscriminately target as many devices, services, or users as possible. They do not care who the victim is. They simply assume that a widespread attack will exploit vulnerabilities in some computers or services. In comparison, targeted attacks single out an organization because the attacker has a specific interest in the business or has been paid to target it. Establishing the groundwork and finding the best route to target an organization's system or users can take months. Targeted attacks are often more damaging than untargeted ones because they are specifically tailored to impact a particular system, process, or group of individuals.

Participants can be highly vulnerable to cyberattacks. They make mistakes, such as choosing an easily guessed password or leaving laptops and mobile phones unattended. Restrictions on minimum password length and complexity are designed to protect passwords. Service provider staff when they are particularly busy or distracted are at risk of being fooled into giving away passwords, installing malware, or divulging information to an attacker

(such as the names and roles of people within an organization and their schedules). These details can help attackers to effectively implement their attacks.

In 2019, hackers stole \$4.2 million from the Oklahoma Law Enforcement Retirement System. The fund has since recovered some of the money (Vizcaino 2019). This case highlights the important role of plan fiduciaries. They must ensure that plan service providers include information about their cybersecurity policies and procedures as part of their request for proposals (Saxon 2018). If a plan fiduciary has been impacted by a successful cyberattack, and if the fiduciary has not taken sufficient precautions against such an attack, that person may be subject to enforcement actions under the Employee Retirement Income Security Act (ERISA) or under state laws.

3.1.3 CYBER-DEFENSES

Fortunately, effective and affordable strategies can help protect pension participants and pension plans from common types of cyberattacks. Participants can use two-step authentication when logging in to accounts. With two-step authentication, participants sign in with their account names and passwords. Then, by email or text message, they receive a single-use code that must be entered to complete the sign-in process. Text messages may be more secure because they are limited to a single device.

Other types of cybersecurity defenses include boundary firewalls and internet gateways. Organizations can also use network perimeter defenses, such as web proxies, web filtering, and content checking. Firewall policies can be developed to detect and block executable downloads and to block access to known malicious domains.

Listed below are some of the defensive measures organizations use to protect against cyberattacks:

- *Malware protection*: establishing and maintaining malware defenses to detect and respond to known attack code;
- *Patch management*: patching known vulnerabilities with the latest software versions to prevent attacks that exploit software bugs;
- *White-listing and execution control*: preventing unknown software from running or installing itself;
- *Secure configurations*: restricting the functionality of every device, operating system, and application to the minimum needed for business to function;
- *Password policy*: ensuring that an appropriate password policy is in place and followed;
- *User access control*: limiting normal users' execution permissions and enforcing the principle of least privilege (National Cyber Security Centre 2016).

Cloud-based systems arguably offer higher levels of security than on-site infrastructure (Arslanian and Fischer 2019).

A cybersecurity platform might use AI to sift through millions of pieces of data to pinpoint cybersecurity threats. Yet, if left on its own, that same AI application could be prone to detect many false positives. Human security experts could intervene to assess the outliers, giving the machine the opportunity to better learn how to identify security threats based on the human oversight (Waytz 2019).

Cybersecurity firms tend not to reveal their capabilities because that information could help cyber criminals. Similarly, pension recordkeepers have incentives to reveal only limited information about their cyber defenses to prevent hackers from adapting their methods and avoiding detection. For this reason, recordkeepers often respond with only limited information about cyberattacks. The Data Security Oversight Board of Spark Institute has developed standards to help recordkeepers communicate about the capabilities of their cybersecurity systems to plan sponsors and others (Rouse et al. 2019).

Cybersecurity is a serious issue for plan sponsors and participants, one that requires the participation of both to prevent successful cyberattacks.

3.2 ARTIFICIAL INTELLIGENCE AND DEFINED BENEFIT PENSION INVESTING

3.2.1 INTRODUCTION

Defined benefit investing differs considerably from defined contribution investing. It is investing to fund liabilities, while defined contribution investing doesn't have that issue. Defined benefit plans have professional asset managers, and they use complex investment strategies, while defined contribution investing is often managed by the participant.

3.2.2 ARTIFICIAL INTELLIGENCE FOR DEFINED BENEFIT INVESTING

Artificial intelligence technologies enable defined benefit pension plans to incorporate broader and less-structured data sets into the analysis of potential investments. Pension funds can use AI to help them beat the market with active investment strategies. For example, one equity fund uses machine learning to time and weight its investments (Arslanian and Fischer 2019). Additionally, active defined benefit portfolio managers can use algorithmic investment trading programs, sometimes called *algo bots*. AI can be used to help investment managers evaluate a wider range of data, and to evaluate new data more quickly. Algorithmic programs allow investment managers to automatically track economic indicators and automatically adjust portfolios in response (Hicks 2019).

Artificial intelligence draws insights from evaluating large amounts of data. The insights are not based on any theory but are entirely empirically based. While often they are useful, that is not always the case for the relationships they find which can be random correlations. For that reason, it is advisable to have a hybrid approach where AI results are reviewed by human experts.

3.2.3 USE OF ARTIFICIAL INTELLIGENCE TO SELECT AND TRACK FUND MANAGERS

Sasaki et al. (2018) report on how Japan's Government Pension Investment Fund (GPIF) is using AI to select and track pension fund portfolio managers. They write: "The proper selection and monitoring of fund managers is one of the most important tasks for the Government Pension Investment Fund (GPIF). Its current approach, which depends on the track records and qualitative explanation of candidates and commissioned fund managers, can be significantly improved with the use of artificial intelligence (AI). This would lead to better management of GPIF's assets, which amount to over 150 trillion yen."

For assessing the financial prospects of a company or other investments, pension funds can use AI to analyze market sentiment related to stocks, bonds, commodities, countries, currencies, and cryptocurrencies. To do this, AI tools evaluate content expressed on blogs, stock message sites, and social media platforms (Donaldson 2019).

3.3 FINTECH FOR PENSION RECORDKEEPERS

3.3.1 INTRODUCTION

Blockchain technology is a type of accounting technology that can be used for facilitating and recording financial transactions. Accounting firms are building blockchain software solutions to facilitate auditing, taxation, and general accounting. The Accounting Blockchain Coalition has launched a risk assessment tool that provides accountants, auditors, CFOs, and others with guidance to evaluate digital assets and blockchain technology. The tool can be employed by businesses that use or might use blockchain technology (Pollock 2019).

3.3.2 BLOCKCHAIN ACCOUNTING TECHNOLOGY FOR RECORDKEEPERS

Blockchain technology will likely be implemented in the future to help pension recordkeepers. From a cybersecurity perspective, blockchain is more secure than current procedures used for pension recordkeeping (Iacurci 2019) due

to its decentralized structure. All data is updated simultaneously on each provider's platform. Therefore, hackers would need to break into each system *simultaneously* in order to modify the data or to access underlying accounts. Blockchain could also improve the sharing of data between recordkeepers, asset managers, plan sponsors, and participants, thereby reducing plan administrative costs.

Smart contracts also may improve the management of pension funds. A smart contract is a self-executing contract with the terms of the agreement between buyer and seller being directly written into the computer program. The program code and the agreements it contains exist across a distributed, decentralized blockchain network. The code controls the execution of transactions (Frankenfield 2019). ASURE, a German pension fund company, uses Ethereum Blockchain for recording pension contributions.

Blockchain could substantially reduce the price of 401(k) recordkeeping services by eliminating layers of human intervention. It could make asset rollovers from one 401(k) plan to another 401(k) or to an individual retirement account (IRA) a seamless operation, as opposed to the convoluted process that currently exists (Iacurci 2019).

Blockchain, as a distributed ledger technology, can fundamentally transform systems for authenticating securities transactions and tracking securities ownership. With each accounting record held on numerous computer systems, securities transactions can be executed and settled via the blockchain. Information about the transactions would then be distributed to the ledger and stored (October Three 2019).

Post-trade settlements are an important, and relatively slow, aspect of securities trading. Historically, settlements have involved intermediaries. Currently, this process takes an average of two days. Custodians, depositories, brokers, and clearinghouses facilitate securities transactions. If blockchain technology were used, the centralized ledger, traditionally maintained by the clearinghouse, would instead be a distributed ledger. Both parties involved in transactions would need to authenticate this ledger. The biggest hurdle to establishing such a system is not the technology but reaching an agreement between different institutions in the industry with competing interests (Rubini 2019).

Use of new blockchain technology in securities and pension transactions will bring significant changes to custody and 401(k) recordkeeping, dealing with lost participants, managing small account balances, and moving money across employers during job changes (October Three 2019).

One new blockchain service aims to create the largest smart contract pension fund infrastructure. It offers a transparent smart contract blockchain that aims to eliminate deficiencies in pension fund infrastructure. "The system designed for pension funds is massively flawed and full of deficits that can create a major crisis in the future. We are aiming to make a more sustainable economic future by using the power of blockchain and tokenization," said the company's spokesperson. The goal is to put users in the driving seat and eliminate dependency on third parties, making the system more transparent and reducing fees (Reuters 2018).

The venture is building a blockchain platform that allows users to effectively build and manage retirement portfolios. It provides a decentralized pension marketplace that gives users access to a variety of pension products. Users will be able to track fund performance and view their portfolios at any time.

For all these reasons, blockchain accounting technology is promising. It is already being used for many functions related to pensions.

3.4 BLOCKCHAIN FOR PENSION PLAN ADMINISTRATORS

3.4.1 INTRODUCTION

Blockchain may prove to be useful for pension plan administrators. This section explores ways that might happen.

3.4.2 PENSION ADMINISTRATION WITH BLOCKCHAIN IN THE NETHERLANDS

In 2017, APG and PGGM, the managers of the two largest Dutch pension funds, announced that they were testing a blockchain-based system to simplify and reduce the cost of administering pensions. APG and PGGM are asset managers and pension providers for the Dutch civil service plan ABP and the healthcare plan PFZW. The technology being used is an adapted version of the blockchain system underlying the cryptocurrency bitcoin (BasuMallick 2018, Schenker 2019). They two pension managers have now successfully completed a prototype of a blockchain-driven pension administration system.

Further research into this method of pension fund administration is expected to produce a more flexible and transparent administration system with significantly lower costs. The prototype administers a virtual defined benefit plan with ten thousand participants, under arrangements similar to APG’s company pension plan. A virtual employer then fed salary data and information regarding life events, such as a wedding and a divorce, into the system. The next step was to add elements such as administration of benefits and contributions, and subsequently run the entire administration of the APG plan on the blockchain in parallel to its current system.

The prototype was designed to lead to a new kind of pension administration, providing transparency and access for the pension fund, its sponsor, participants, and the government supervisor. Everyone involved would have their own access key and permission to rework the data relevant to them.

Among the benefits of the blockchain is that data don’t have to be passed on and copied between users. “Individual data have been stored several times and in different places, and also in different systems in case somebody has several pensions,” explained the head of APG’s blockchain project. Blockchain technology is designed to be more efficient and to generate fewer errors than existing methods of pension plan administration. “Every adjustment will be stored separately and the history of transactions can’t be changed. As a consequence, it will always be possible to trace errors,” said the innovation manager at PGGM. APG and PGGM said they didn’t know when the technology could take over the real administration, as it was still in its early stages. The transfer of financial value, such as premiums and benefits through the blockchain, however, is still far off. The investment administration could be a promising implementation of blockchain technology (Van Wijk and Preesman 2017).

Each system will have its own mechanism, but the basic infrastructure will share many similarities. For instance, all stakeholders and entities such as consumers, institutions, developer communities, sector advisors, and service providers will join the blockchain as participants, with each being given the ability to execute necessary tasks.

All transactions and assets will be tokenized so as to maintain transparency and an immutable audit trail. Tokenization protects sensitive data by replacing it with an algorithmically generated number (called a token). An individual making a payment for an investment, a pension fund making investment in a security, or a fund being withdrawn can all be authenticated and recorded on the blockchain.

3.5 PURCHASING COMPUTER SERVICES THROUGH CLOUD COMPUTING

3.5.1 INTRODUCTION

This section discusses how pension plans can use cloud computing to reduce costs and simplify the management of information technology. It explains what cloud computing is and the advantages it provides.

3.5.2 WHAT IS CLOUD COMPUTING?

Cloud computing is an enabler for fintech, providing lower cost and faster computing power. It is the delivery of computing services—servers, storage, databases, networking, software, analytics, and intelligence—over the

internet (the cloud) to offer faster innovation, flexible resources, and economies of scale. Users only pay for the cloud services they use, helping to lower their operating costs and scaling their demand to changes in need.

Cloud computing involves a network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer. It provides on-demand availability of computer system resources, especially data storage and computing power, without direct active management by the user.

The rise of cloud computing has been a facilitating factor for artificial intelligence and machine learning. They have been made possible by the increase in computational power, the increase in the amount of available data, and the decrease in the cost of storage.

With a public cloud, all hardware, software, and other supporting infrastructure are owned and managed by the cloud provider. Users access these services and manage their accounts using a web browser.

Cloud computing is a major shift away from the traditional business model for information technology (IT) resources. Cloud computing eliminates the direct expense of buying hardware and software and setting up and running on-site data centers—the servers, the round-the-clock electricity for power and cooling, and the IT experts for managing the infrastructure. Cloud computing services are provided on demand, giving businesses flexibility and reducing pressure on capacity planning. On-site datacenters typically require hardware setup, software patching, and other time-consuming IT management chores. Cloud computing removes the need for many of these tasks. The biggest cloud computing services run on a worldwide network of secure data centers, which are regularly upgraded to the latest generation of fast and efficient computing hardware. This offers greater economies of scale compared to a single corporate data center.

Cloud computing makes data backup, disaster recovery, and business continuity easier and less expensive because data can be stored and backed up at multiple sites on the cloud provider's network. Many cloud providers offer a broad set of policies, technologies, and controls that strengthen cybersecurity, helping to protect data, apps, and infrastructure from potential threats. The investments that cloud providers make in cybersecurity dwarf those of any single pension fund.

3.6 BLOCKCHAIN FOR PENSION RISK TRANSFER

3.6.1 INTRODUCTION

This section discusses the use of blockchain accounting technology for managing pension risk transfers. It begins by discussing what pension risk transfer is and provides an example from the UK.

3.6.2 PENSION RISK TRANSFER

Pension risk transfers occur when a defined benefit plan sponsor sells its plan liabilities to an insurance company. Legal and General, the UK's largest retail life insurer, is launching a blockchain solution for pension risk transfers through Legal and General Reinsurance. The group has more than a trillion pounds (\$1.27 trillion) in assets under management. Legal and General had several separate systems that dealt with pension risk transfer. To manage those systems, they created a blockchain that handles the entire reinsurance process. That includes pricing, claims handling, financial reporting, and collateral. The new system should lower costs. It might redefine how long-term life reinsurance business is sold. "We believe that blockchain is uniquely suited to the long-term nature of annuities business as it allows data and transactions to be signed, recorded, and maintained in a permanent and secure nature over the lifetime of these contracts, which can span over fifty years," said the CEO of Legal and General Reinsurance.

Legal and General Reinsurance only writes pension risk transfer business outside of the U.S. and UK. It has clients in the Netherlands, Ireland, and Canada. It is a specialist reinsurer of pension risk transfer business that provides insurance to direct insurers, who in turn provide insurance to pension plans.

Legal and General considered a number of existing accounting systems but none could deliver the combination of security, flexibility, and auditability of the blockchain. Blockchain provides the ability to exchange and agree upon data between various counterparties, to digitally and cryptographically sign the data, and to ensure that the data is traceable over any period of time, given that it is stored in consecutive blocks in the blockchain. The participants who use the blockchain platform are direct insurers and other reinsurers that Legal and General Reinsurance partners with. Legal and General is exploring extending the system to some of the group's pension plan clients as well (Ledger Insights 2019).

Section 4: Summary and Conclusions

This report examines issues related to the direct and indirect ways that fintech affects pension participants, including pension plan sponsors and pension service providers. In this final section, we summarize a few of the issues previously discussed, and briefly summarize the report.

Generally, fintech enables companies to reduce pension administration costs.

Fintech has a significant opportunity to assist defined contribution participants who cannot afford human wealth managers and advisers. Robo-advisers can aggregate information about individuals (e.g., risk tolerance, investment goals, and spouse's salary) and generate tailored advice more cheaply. In a low-return environment, costs have a large impact on savings outcomes. Robo-advisers considerably reduce the cost of financial advice. Traditional financial advice with a financial adviser generally costs about one hundred basis points a year of assets under management (AUM). This fee compares to about twenty-five basis points and sometimes less for robo-advisers (Fisch et al. 2019).

Fintech also relates to cloud computing. For pension plan managers, cloud computing is not always the lowest cost alternative, but it costs less for some businesses than purchasing their own computing hardware and software. Thus, businesses must determine whether it is less expensive to purchase computer hardware or to rent it through the cloud. Cloud computing allows companies with fluctuating needs for computer services to only pay for what they use. They don't need to purchase excess capacity to cover times of peak need (Cohen 2012, Beasley 2015).

Another fintech development is blockchain. This new accounting technology might lead to lower administrative costs for pension plans. It could also lead to lower costs for defined benefit and defined contribution plans by facilitating the provision of benefits through tontines. Blockchain could also reduce costs for insurance companies that do pension risk transfers. As established in many contexts, blockchain cuts costs by removing middlemen.

With AI, robo-advisers can incorporate more information about pension participants, such as information from their tax returns. Increased information enables robo-advisers to provide more personalized advice. They can also improve the personalization of communication with clients. With AI, robo-advisers that serve large defined benefit pension funds can incorporate more information (e.g., analyses of social media statements) about the companies in which they invest.

Pension dashboards are used in Israel and several other countries to help pension participants keep track of multiple accounts with different employers. The UK is in the process of developing a pension dashboard and use of dashboards has been proposed in the U.S. When pension participants change jobs, they often leave behind a pension account. Sometimes workers forget about their pensions from former employers and or have difficulty tracking them down. This is especially true when companies go out of business, move location, change names, or are bought out. A pension dashboard can help these participants find lost pensions.

Thus, fintech holds great promise for reducing costs, increasing security, and improving personalization of services to pension participants.

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References

- 401k Specialist. 2020. "New Platform 'Democratizes' Custom Target Date Funds." Issue 3, p. 42.
- Arslanian, H. and F Fischer. 2019. *The Future of Finance: The Impact of Fintech, AI, and Crypto on Financial Services*. Palgrave.
- Backend Benchmarking. 2019. "The Rise of Digital Advice: A Look Back at Digital Growth." <https://storage.googleapis.com/gcs-wp.theroboreport.com/Gy79gMAxH4pvcx8N/The%20Rise%20of%20Digital%20Advice.pdf>
- BasuMallick, C. 2018. "3 Benefits of Blockchain-Based Pension Solutions and Use-cases." *HR Technologist*, July 27. <https://www.hrtechnologist.com/articles/pension/3-benefits-of-blockchainbased-pension-solutions-and-usecases/>
- Beasley, M. 2015. "Cloud Computing: Not Always the Low-Cost Alternative." *SourcingSpeak*, July 10. <https://www.sourcingspeak.com/cloud-computing-not-always-the-low-cost-alternative-1/>
- Braunstein J. and M. Labouré. 2017. "Democratising Finance: The Digital Wealth Management Revolution." *VoxEU*, November 11: <https://voxeu.org/article/digital-wealth-management-revolution>
- Breen, O. 2019. "The New Class of Robos Lay Siege to 'Antiquated' Target-Date-Funds (TDF) Market." *RIABiz*, Oct. 7. <https://riabiz.com/a/2019/10/8/new-class-of-robos-lay-siege-to-antiquated-target-date-funds-tdf-market-even-defender-of-the-401k-citadel-vanguard-sees-handwriting-on-the-wall>
- Burrell, M. 2020. "Why Pensions and Dashboards, Need to be Open." *AgeWage*, March 2. <https://henrytapper.com/2020/03/02/why-pensions-and-dashboards-need-to-be-open-matt-burrell-blogs/>
- Campbell, S. 2019. "Making Rural Connections." *Stria*, Sept. 9. <https://strianews.com/making-rural-connections/>
- Clark, B. and B. Edwards-Franklin. 2019. "Securing Retirement: 401(k) Plan Cybersecurity." *SHRM*, Aug. 27. <https://www.shrm.org/resourcesandtools/hr-topics/technology/pages/securing-retirement-401k-plan-cybersecurity.aspx>
- Cohen, R. 2012. "Is Cloud Computing Really Cheaper?" *Forbes*, August 3. <https://www.forbes.com/sites/reuencohen/2012/08/03/is-cloud-computing-really-cheaper/#9973527d447c>
- Davenport, T. and J. Guscza. 2016. "Effecting Behavior Change in a World of Automated Financial Advisors." *Deloitte Insights*. June 29. <https://www2.deloitte.com/us/en/insights/topics/analytics/automated-financial-advisors-behavioral-finance.html>
- Deschenes, S.L. and P. B. Hammond. 2019. "Matching FinTech Advice to Participant Needs: Lessons and Challenges." In *The Disruptive Impact of FinTech on Retirement Systems*, edited by J. Agnew and O.S. Mitchell. Oxford: Oxford University Press, pp. 172-189.
- Donaldson, P. 2019. "Exploring AI Trends in Wealth Management." *Refinitiv*, May 16. <https://www.refinitiv.com/perspectives/ai-digitalization/exploring-ai-trends-in-wealth-management/>
- Egan, D. 2017. "Our Evidence-Based Approach to Improving Investor Behavior." *Betterment*, October 12. <https://www.betterment.com/resources/investment-strategy/behavioral-finance-investing-strategy/behavioral-testing>.

Fisch, J.E., M. Labouré, and J.A. Turner. 2019. "The Emergence of the Robo-Adviser." In *The Disruptive Impact of FinTech on Retirement Systems*, edited by J. Agnew and O.S. Mitchell. Oxford: Oxford University Press, pp. 13-37

Fisch, J.E. and J.A. Turner. 2018. "Making a Complex Investment Problem Less Difficult: Robo Target Date Funds." *Journal of Retirement* 5(4): 40-45.

Foster, M. 2017. "Fint6.3 Fuels Pension Pot Mergers." *Financial News*, January 10.
<https://www.fnlonon.com/articles/fintech-fuels-pension-pot-mergers-20170110>

Frankenfield, J. 2019. "What is a Smart Contract?" *Investopedia*, October 8.
<https://www.investopedia.com/terms/s/smart-contracts.asp>

Friedberg, B. 2018. "7 Robo-Advisers with a Human Touch." *U.S. News*, February 21.
<https://money.usnews.com/investing/investing-101/slideshows/7-robo-advisors-with-a-human-touch>

Fullmer, R. 2018. "Fintech's Answer to the Global Retirement Crisis." *Forbes*, January 30.
<https://www.forbes.com/sites/pensionresearchcouncil/2018/01/30/fintechs-answer-to-the-global-retirement-crisis/#6d6e7dd61ff3>

Geller, S.M. 2020. "Cybersecurity Risk Considerations for 401(k) Plans: Mitigating Plan Sponsor Liability." <https://www.cpajournal.com/2020/09/08/cybersecurity-risk-considerations-for-401k-plans/>

Har Hakesef (Hebrew).

Hamislaka Hepnsionit (Hebrew). <https://www.swiftness.co.il/>

Hicks, C. 2019. "11 Ways Artificial Intelligence is Improving Investing." *U.S. News*, Sept. 16.
<https://money.usnews.com/investing/investing-101/slideshows/ways-artificial-intelligence-is-improving-investing?slide=14>

Iacurci, G. 2018. "401(k) Robo-Revolution is Underway." *Investment News*, March 17.
<https://www.investmentnews.com/401k-robo-revolution-is-underway-73732>

Iacurci, G. 2019. "Blockchain Will Upend the 401(k) Market." *Investment News*, March 23. <https://www.investmentnews.com/blockchain-will-upend-the-401k-market-78749>

Jackson, R. 2018. "Attempting to Reform the Global Pension System with Blockchain." *Hackernoon*, July 30.
<https://hackernoon.com/attempting-to-reform-the-global-pension-system-with-blockchain-21e0ab9b51d9>

John, D et al. 2020. "A Retirement Dashboard for the United States.", *Brookings*. <https://www.brookings.edu/wp-content/uploads/2020/10/Retirement-Security-Project-Dashboards-Oct-2020.pdf>

Kitces, M. 2020. "The Latest in Financial Adviser #FinTech." February 3. https://www.kitces.com/blog/the-latest-in-financial-advisor-fintech-february-2020/?utm_source=Nerd%E2%80%99s+Eye+View+%7C+Kitces.com&utm_campaign=95221fa9db-NEV_MAILCHIMP_LIST&utm_medium=email&utm_term=0_4c81298299-95221fa9db-57149837

Ledger Insights. 2019. "Legal and General Launch Pension Risk Blockchain." <https://www.ledgerinsights.com/pension-blockchain-insurance-legal-and-general/>

- Meserole, C. 2018. "What is Machine Learning?" *Brookings Institution*, October 4. <https://www.brookings.edu/research/what-is-machine-learning/>
- Microsoft. 2020. "Accelerate Your Business with the Power of Data and AI." <https://www.microsoft.com/en-us/itshowcase/data-and-ai>
- Moltzau, A. 2019. "Artificial Intelligence and Pension." *The Startup*, July 17. <https://medium.com/swlh/artificial-intelligence-and-pension-f94c6f4915ee>
- National Cyber Security Centre. 2016. "Common Cyber Attacks: Reducing the Impact." <https://www.ncsc.gov.uk/collection/10-steps-to-cyber-security/introduction-to-cyber-security/common-cyber-attacks-reducing-the-impact>
- October Three. 2019. "Blockchain and Retirement Plan Administration." March 4. <https://www.octoberthree.com/blockchain-and-retirement-plan-administration/>
- Office of Personnel Management. 2019. "Cybersecurity Incidents." <https://www.opm.gov/cybersecurity/cybersecurity-incidents/>
- Organisation for Economic Cooperation and Development (OECD). 2017. "Technology and Pensions: The Potential for FinTech to Transform the Way Pensions Operate and How Governments are Supporting its Development." <http://www.oecd.org/pensions/Technology-and-Pensions-2017.pdf>
- Pah, A. 2019. "Artificial Intelligence Is Improving How Companies Do Business." *KelloggInsight*. July 8. https://insight.kellogg.northwestern.edu/article/artificial-intelligence-is-improving-how-companies-do-business?utm_source=subscriber&utm_medium=email&utm_campaign=boomtrainmailer052019&bt_ee=skGpKgfzmen1UHllvz3NDU%2B24igVIYTSpbtnkFxuFeeEYVoNfyfScVVGfyWUlsjy&bt_ts=1564058310495
- The Pensions Regulator. 2018. "Cyber Security Principles for Pension Schemes." <https://www.thepensionsregulator.gov.uk/en/document-library/regulatory-guidance/cyber-security-principles-the-pensions-regulator>
- Peterson, A. 2015. "OPM Says 5.6 Million Fingerprints Stolen in Cyberattack, Five Times as Many as Previously Thought." *The Washington Post*, September 23. <https://www.washingtonpost.com/news/the-switch/wp/2015/09/23/opm-now-says-more-than-five-million-fingerprints-compromised-in-breaches/>
- Pollock, D. 2019. "Accounting Giants Launch Tool for Assessing Blockchain Risk." *Forbes*, Oct. 22. https://www.forbes.com/sites/darrynpollock/2019/10/22/accounting-giants-launch-tool-for-assessing-blockchain-risk/?utm_source=newsletter&utm_medium=email&utm_campaign=forbes-crypto#4919b96e163e
- Reuters. 2018. "New Blockchain Service Akropolis to Launch Their ICO Program Shortly." *Reuters*, June 16.
- Rouse, T., D.N. Levine, A. Itami and B. Taylor. 2019. "Benefit Plan Cybersecurity Considerations" A Recordkeeper and Plan Perspective." In *The Disruptive Impact of FinTech on Retirement Systems*, edited by J. Agnew and O.S. Mitchell. Oxford: Oxford University Press, pp. 86-103.
- Rubini, A. 2019. *Fintech in a Flash: Financial Technology Made Easy*, Third edition. Boston: Walter de Gruyter, Inc.
- Sasaki, T., H. Koizumi, T. Tajiri, H. Kitano. 2018. "A Study on the Use of Artificial Intelligence within Government Pension Investment Fund's Investment Management Practices." Tokyo, Japan: Government Pension Investment Fund. https://www.gpif.go.jp/en/investment/research_2017_1_en.pdf

- Saxon, S.M. 2018. “Retirement Plans See Rise in Cyberattacks.” *Investment News*, Sept. 1. <https://www.investmentnews.com/article/20180901/free/180909997/retirement-plans-see-rise-in-cyberattacks>
- Schenker, J.L. 2019. “Reinventing Pensions.” *The Innovator*, April 28, 2019. <https://innovator.news/reinventing-pensions-b085b63b52e1>
- Shidler, L. 2018. “How Fidelity Used a Robo Advice Exemption to Stick the Landing as a Fiduciary to 401(k) Participants After the Tumult of the DOL Rule.” *RIABiz*, October 11. <https://riabiz.com/a/2018/10/11/how-fidelity-used-a-robo-advice-exemption-to-stick-the-landing-as-a-fiduciary-to-401k-participants-after-the-tumult-of-the-dol-rule>
- Sullivan, J. 2020. “401k Participants React Poorly in Market Meltdown.” *401k Specialist*, February 28. https://401kspecialistmag.com/401k-participants-react-poorly-in-market-meltdown/?utm_source=401k&utm_medium=email&utm_campaign=401k_enl_02292020_WEEKEND
- Tannenbaum, R. 2018. “App Developers Tap Games to Drive More Savings.” *Pensions & Investments*, August 20. <https://www.pionline.com/article/20180820/ONLINE/180829978/app-developers-tap-games-to-drive-more-savings>
- Tontine Trust. 2020. “Biometric Sign In.” <https://tontine.com/how-it-works>
- Toth, R. 2020. “Tontines and PEP Late Deferrals Are Among the SECURE Act’s Impactful, Infrastructure Oddities.” *The Business of Benefits*, March 12. <https://www.businessofbenefits.com/2020/03/articles/401k-guaranteed-lifetime-income/tontines-and-pep-late-deferrals-are-among-the-secure-acts-impactful-infrastructure-oddities/>
- Van Wijk, M. and L. Preesman. 2017. “APG and PGGM Building Prototype of Blockchain Administration.” *IPE*, October 16. <https://www.ipe.com/countries/netherlands/apg-and-pggm-building-prototype-of-blockchain-administration/10021103.article>
- Vizcaino, M.E. 2019. “Oklahoma Pension Fund Cyber Attack Shows Rising Risk for Munis.” *Bloomberg*, Sept. 13. <https://www.bloomberg.com/news/articles/2019-09-13/oklahoma-pension-fund-cyber-attack-shows-rising-risk-for-munis>
- Waytz, A. 2019. “How to Create a Human-Friendly Workplace in an Age of Automation.” *KelloggInsight*, Oct. 3. https://insight.kellogg.northwestern.edu/article/create-human-friendly-workplace-automation?utm_source=subscriber&utm_medium=email&utm_campaign=boomtrainmailer052019&bt_ee=dTJWxDoYIzEz96u9w%2B%2BobNg7%2Bm%2B%2B%2B79POFzUZd6%2BVTQC%2FCOK9Aez%2Bg8kqCy256xn&bt_ts=1570637556087
- Wealth Wizards. 2019. “The UK’s First On-Line Independent Financial Adviser.” <https://www.wealthwizards.com/>

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