



The Future of the Securities Value Chain

A SIX White Paper



Foreword

The SIX Board of Directors has mandated the BU Innovation & Digital to develop future scenarios to increase the future readiness of SIX by sharpening its understanding of what the relevant future may look like. This white paper is one of the by-products of I&D's efforts to develop such scenarios.

The publication of this white paper serves several goals: to underscore the cultural shift going on at SIX, to elicit feedback from a broader audience, to serve as a basis for starting conversations with various external stakeholders, to suggest possible avenues for joint innovation with start-ups and established players (open innovation), and to communicate to prospective employees the types of innovation initiatives/projects that may be taking place at SIX in the years to come.

We believe that explicitly thinking in terms of a plurality of futures (scenarios) is important as it pushes us to think about the conditions under which alternative futures may occur. This improves our understanding of what we believe to be the most-likely future by making our implicit assumptions explicit – and therefore helps us to review

our beliefs about the future. Scenarios also facilitate the explanation of complex developments and technologies (eg, distributed ledger technologies, DLTs) to non-experts by describing what consequences can be expected under which conditions, by describing how various new development/technologies may interact, and by embedding these descriptions within a familiar context.

We understand this white paper as a stepping stone in a never-ending journey toward achieving a better understanding of possible futures. We therefore inherently understand it as a work in progress rather than an end-product, capturing our current views but ready to be updated as new information comes along.

We hope you will enjoy reading it, and look forward to constructive discussions.

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1 Introduction

Our world is changing. This white paper aims to assess the potential impact of the many complex and concurrent developments we are currently witnessing on the securities value chain. It does so by describing the future in terms of possible scenarios. The insights have been gained from workshops, in-person interviews and secondary sources (articles, books, reports, blogs and white papers). Importantly, all scenarios make an implicit underlying assumption: **there will still be entities in the future wanting to issue financial products and investors wanting to buy those financial products.** We do not deal with the alternative scenario in which this is no longer the case (and the securities value chain would become redundant) because we believe this to be a very low-probability scenario because the reasons for issuing financial products (external financing, hedging, liquidity provision, speculation, capital gains etc.) will continue to be relevant, as will the reasons for investing/trading in them (capital gains, hedging, societal impact, speculation etc.). Lastly, we cannot understand the securities value chain without understanding its broader context and we therefore **extend the thinking to financial products independently of whether they qualify as securities.**¹

This introduction starts by explaining the societal relevance of the securities value chain. This is followed by an overview of some of the factors we considered, a short description of the relevant future scenarios we identified, and a set of strategic implications for FMI providers. Finally, it provides our rationale for adopting a scenarios-based approach and gives some pointers on how the scenarios were selected.

The remainder of this white paper is then organized as follows. Chapter 2 lists the future scenarios we view as most relevant, and then describes each of these various scenarios. Chapter 3 provides a high-level description of the main elements, functions, and concepts of the securities ecosystem. And Chapter 4 provides a description/explanation of the visualizations depicting the first two scenarios.

Societal Relevance of the Securities Value Chain

The securities (or “capital markets”) value chain plays a central role in **sustainable development** in at least three ways. First, it is fundamental for economic development and job creation by facilitating the flow of private and public capital from capital owners to businesses and entrepreneurs in need of external financing (**efficient capital allocation**). In so doing it furthers **economic inclusiveness**, on the one hand by facilitating access to capital, and on the other hand by allowing participation in the gains in capital. Secondly, it provides access to **liquidity** for commercial enterprises and individuals (e.g. loans). Thirdly, it helps reduce financial risk (**risk reduction**) by offering a broad universe of investment possibilities to diversify risk, by insuring against adverse future price development (e.g. options), and by eliminating exposure to future price uncertainty (e.g. futures). The member states of the United Nations pointed out the relevance of the securities value chain for achieving the **United Nations sustainable development goals** by agreeing on the necessity of both private and public sources of financing.²

¹ Please refer to the chapter “Securities value chain overview” on page 54 for more details about legal qualification as a “security”.

² United Nations Addis Ababa Action Agenda of the Third International Conference on Financing for Development (Addis Ababa Action Agenda), A/RES/69/313, adopted on 27 July 2015.

Factors: Catalysts, Drivers, Developments, Trends

The following table depicts factors that were considered for the development of the future scenarios – factors with the greatest impact (“key factors”) are marked in bold.

| Social/Cultural | Technological | Economic | Environmental | Political* |
|--|--|--|--|--|
| <ul style="list-style-type: none"> – Demographics (aging population) – Do-it-yourself mentality – Entrepreneurship – Digital natives – Immediacy – Instant gratification – 24/7 availability – UX expectations – Peer validation – One-stop shops – Mobility – Omni channel – Social media – Social sharing – One percent movement (occupy movement) – Transparency – Sustainability | <ul style="list-style-type: none"> – Software – Internetization – Ubiquitous connectivity – Sensors/Big Data – Advanced analytics – Machine learning/deep learning – Artificial intelligence – Automation and robotics – Cloud technology – Additive manufacturing (3D printing) – Energy storage – Quantum computing – (Permissioned and permissionless) distributed ledger technologies (DLTs) – (Industrial) Internet of Things (IoTs) | <ul style="list-style-type: none"> – E-business – Digital marketplaces – Platform-based ecosystems – Disintermediation – Gig economy (contractors) – Externalization/outsourcing – Intangible economy (dematerialization/virtualization) – Data-based economy – Digital business model – Economic growth – Unemployment – Borderless industries – Unbundling – Digital representation of rights – Big tech companies – Fintech companies – Financial crises – South-east shift of economic center of gravity – Digital talent scarcity (war for talent) – Cyber-criminality | <ul style="list-style-type: none"> – Global warming – Post-oil electricity – Renewable energy – Decentralized energy production/smart grid | <ul style="list-style-type: none"> – Unlevelled laws/regulations – Big-tech criticism (“tech-lash”) – Data ownership/protection – Fear of too powerful companies – Anti-competition concerns – Systemic relevance (too big to fail) – National security concerns – Anti-globalization (protectionism/trade war) – Openness – Global stability – Global power struggle/redistribution – Digital warfare – Government trust – Surveillance – Censorship – Universal basic income |

* Includes legal and regulatory factors and international relations.

Summary of the Scenarios

These (key) factors suggest that the securities value chain is likely to experience substantial changes over the next 5 to 10 years – perhaps more than it has seen over the past 20 years.

On the surface, our most-likely and second most-likely scenarios might appear as simply describing the status quo since permissionless distributed ledgers are not dominant, permissioned distributed ledgers only may become dominant, and the main roles/functions within the securities value chain persist. A closer look, however, reveals that these scenarios exhibit quite substantial (though perhaps subtle) changes below the surface. For instance, the shift of primary markets towards direct-access digital platforms (allowing direct connectivity between issuers and investors) is a far cry from the status quo with its many intermediaries. The explosion in the number and diversity of digitized assets is in stark contrast to the status quo. The extent of big tech companies' presence in the securities value chain is also not comparable to the status quo. The same is the case for the extent to which automation and advanced analytics permeate every aspect of the security value chain – although these trends are clearly apparent in the status quo, their deployment at scale is far from certain.³ Finally, although we are not very bullish on permissionless distributed ledgers becoming dominant, we nonetheless believe that they may leave a permanent mark in the securities value chain: they raise people's expectations regarding the scope/price of automation, they fuel people's imagination of what can be represented digitally (digitized assets), they exhibit specific use cases even in a world in which they do not become dominant, and the business model underlying virtually all crypto issuing venues in the mid-2010s (ie, "open-issuing marketplace")⁴ may contribute to such a business model becoming dominant in the primary market.

Most-Likely Scenario

Listed investment classes have remained most popular as they are still viewed as an indicator of quality by investors. **Direct-access, platform-based primary markets have become dominant and disrupted (disintermediated) traditional broker/middleman** functions for listed financial products. The world has experienced an **explosion in the number and diversity of digitized assets**. **Global tech companies have set up issuing venues** (primary markets) to support activity in their ecosystems. **New technologies have been widely adopted** throughout the securities value chains (e.g. automation, AI, advanced analytics, Big Data, cloud computing). It is not **clear whether permissioned distributed ledgers will become dominant** and replace (permissioned) central ledgers as the IT infrastructure for the securities value chain. **Permissionless DLT and crypto assets have not become dominant**, but **crypto assets have retained some popularity as investment assets** due to their potential for diversification. **Cyber-risks have significantly increased** as cyber-attacks have become increasingly sophisticated and **quantum computing** may have become reality.

Second Most-Likely Scenario

"Listing" is no longer viewed as an indicator of quality by many investors, and **non-listed financial investment classes have become highly popular** as a result. Open-issuing marketplaces have displaced listing venues as the dominant issuing venues because investors have been overserved in terms of protection and underserved in terms of choice on listing venues. **Open-issuing marketplaces** take the form of **direct-access platforms** and allow the issuing of any kind of financial product, with third parties offering services through these platforms. These direct-access platforms have **strongly disrupted (disintermediated) traditional broker/middleman** functions for any type of financial products (e.g. equity, bonds, loans, insurance).

³ See for instance our low-likelihood, high-impact scenario "Extreme reduction of digital exposure".

⁴ For the definition, see Exhibit 1: Open-issuing marketplace on page 38.

Low and Medium-Likelihood Scenarios

New players, exhibiting new business models and/or relying on new technologies, have been able to establish themselves thanks to **legally unlevel playing fields** tilting (deliberately or by omission) in their favor.

Extreme fear of overly powerful digital platform companies has led to government action (heavy regulation, classification, breaking up), resulting in the **low profitability of platform businesses**. Content is king, and content is provided by third parties via platforms.

Extreme consolidation of FMI providers (issuing venues, trading facilities, CCPs, CSDs).

Low-Likelihood, High-Impact Scenarios

Issuers, investors, and corporations have actively weighed the costs and benefits of digitalization, and have **significantly reduced their digital exposure**. FMI providers have added human elements to their value chains, have disconnected/isolated certain system from the internet, and have only selectively automated their processes. The digital representation of rights to real-world assets (**digitized assets**) has only taken place very selectively.

Widespread protectionism, an unfriendly domestic business environment, a lack of domestic venture capital, and an **eastward shift of economic growth** have seriously hampered FMI providers' prospects in smaller Western countries.

Loss of trust in governments may lead people to put their trust in a code (for lack of an alternative) and thus lead to the **broad adoption of permissionless distributed ledgers** (e.g. Bitcoin/Ethereum blockchains) as the framework for digital interpersonal dealings. Issuing venues take the form of **crypto issuing venues**, the process of issuing takes the form of **initial coin offerings** (ICOs), and financial assets take the form of **crypto assets**.



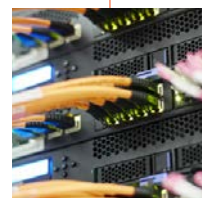
1900



2000



2025



Strategic Implications

It is widely accepted that concentration/focus is the foundation of any successful strategy ("The essence of strategy is choosing what not to do" (Michael Porter)). Each player has to prioritize and select for themselves which specific role(s) they want to play in the future based, among other things, on their established competitive advantages, core competencies, achievability, available pool of capital, expected returns on investment, willingness to take risks, and expected future competitive advantage. Different players will therefore identify/pursue different **future strategic role(s)** and will thus differ in terms of their roadmap of necessary measures and in terms of opportunity spaces.

Below we provide a non-exhaustive list of **high-level measures** (each requires further specification by the players) that players may implement to be successful in the future. We distinguish between two types of measures: **future-proof measures** (or "no-regret moves"), which describe high-level measures that are appropriate responses to any given relevant future scenario, and **future-ready measures**, which describe high-level measures that should be undertaken in order to have a shot at playing a relevant role in some specific alternative future scenarios.

Future-robust Measures

- Expand into **new financial asset classes** and diversify into **digital assets more generally** (i.e. digital representation of real-world tangible/intangible assets) by operating flexible/DIY-capable issuing venues (**maker platform**), lending/trading facilities (**exchange platform**), and clearing/settlement/custody infrastructure for any type of digital asset. May include: IoT devices, hitherto non-bankable assets or crypto-asset-backed digital assets
- Lead the shift toward **digital platforms (electronification)** in primary and secondary markets and provide **direct access/connectivity** to issuers and investors (direct/disintermediated connectivity)
- Adopt an **open platform approach** to develop an ecosystem of third-party content/service providers by acting as an **ecosystem orchestrator**
- Build an **ecosystem for young/early-stage firms** (i.e. extend the securities value chain)
- **Monetize data** through data mining (uncovering unmet customer needs) and advanced analytics
- Develop **unique value-added services** around platforms (e.g. FI provider, outsourcing banks' back-office functions)
- Implement advances in **automation/robotics, advanced analytics, and cloud computing** at scale
- Heavily invest in **cyber-security** by adopting an active cyber-security strategy and ensuring **quantum-readiness**
- Become an **innovation powerhouse** by establishing thought leadership, by fostering a culture of innovation (tolerance of failure), by winning the war for talent, by investing in employee development, and by allocating necessary resources
- Work pro-actively with governments to ensure an appropriate legal/regulatory framework (**smart laws/regulations**)
- Design an **operating model** for fast execution (agility and speed) and for self-disruption (cannibalization)
- Ensure strong **M&A** and **post-merger integration** capabilities

Future-ready Measures

- Engage with **permissioned distributed ledgers** to ensure readiness for a possible evolution from (permissioned) central ledgers by setting up CoEs, by joining industry consortia, and by deploying **permissioned distributed-ledger-ready IT infrastructure** which can easily be switched from central to distributed ledger
- Operate an **open-issuing platform**, with **initial coin offerings (ICOs)** as one possible issuing means, with dedicated **P2P/P2B/B2B lending** environments, and with a specialized **young firm investment** environment (e.g. lead investor model); operate a **trading facility** and **custody services** for the products issued thereon
- Devise processes and deploy IT infrastructure enabling critical systems to be readily taken offline without interrupting the business and allowing **analog/human elements** to be readily included
- Develop an action plan for a world running on **permissionless distributed ledgers**
- Derive **early-detection signals** and scout/monitor the environment
- Develop strong **scouting/monitoring** capability to quickly spot new developments (incl. of business model innovations, new technologies, social/cultural developments) inside and outside the financial sector
- Set up a **corporate venture fund** to ensure deep tech access and to strengthen the surrounding ecosystem

Approach: Scenarios-Based Thinking

We adopt a scenarios-based approach because we believe that capturing the plurality of possible futures **increases the likelihood of concentrating/focusing on the right things today** and also increases the likelihood of being prepared/ready for the improbable – or of consciously/deliberately deciding not to prepare for it. We develop future scenarios with a **horizon of 5–10 years**.

The reasons underlying this belief are as follows. Firstly, by relying on scenarios as the lens through which we see the future, we **reduce complexity while still providing a differentiated view of future possible variability**. Secondly, by inciting people to think hard about alternative scenarios and conditions under which these scenarios could occur, we make implicit assumptions regarding one's beliefs about the future explicit, and thus **increase transparency and objectivity**. Thirdly, by describing possible future worlds, we can explain complex and possibly interacting social, technological, economic, environmental, and political developments more easily to non-experts by showing how they may play out, and in so doing **aid the understanding of new developments** (i.e. bring order to the chaos). Fourthly, and on a related note, by reducing complexity while not falling into superficiality, increasing transparency and objectivity, and by spreading understanding of new developments, we hope to contribute to better-**informed decision-making**.

A manageable number of scenarios must be selected in order for the approach to meet the aforementioned objectives. We have selected 6–10 scenarios based on what we believe **best captures the future variability of the system being analyzed**. At times, more extreme scenarios are chosen because they cover several less

extreme scenarios in one scenario (therefore the thinking that each of these less extreme scenarios would elicit with a single scenario). Also, we **do not require that scenarios be mutually exclusive** because that would prevent us from building alternative scenarios with a single core message that are easy to understand and rely on. Finally, a scenario may only qualify as relevant if players would not have time to react if it were to occur.

We distinguish between **four types of scenarios**: the most-likely scenario (“expectation scenario”), the medium-likelihood scenarios, the low and medium-likelihood scenarios, and the low-likelihood, high-impact scenarios.

We flesh out the scenarios in some detail to increase the likelihood that they are internally consistent by facilitating the observation of possible inconsistencies. Each scenario is written in the present perfect tense to help readers immerse themselves by conveying the feeling that the scenario has actually occurred. The most-likely scenario is fleshed out in a lot of detail, while the other scenarios are only fleshed out insofar as they diverge from the most-likely scenario. This approach prevents duplication and allows us to readily see the key characteristics/distinctions of alternative scenarios – but requires the alternative scenarios to be read together with the most-likely scenario.

Early detection signals are identified for each scenario. Observation of such signals indicates that it is necessary to update the probabilities of the relevant scenarios occurring. Specifically, the observation of a signal pertaining to some scenario implies that the probability of that scenario occurring has increased – and hence that the probabilities of the alternative scenarios have reduced.

2 Relevant Future Scenarios

Most-Likely Scenario ("expectation scenario")

- Listed investment classes remain dominant amid disintermediation and explosion of digitized assets **12**
-

Medium-Likelihood Scenario

- Non-listed investment classes and open-issuing marketplaces become dominant **33**
-

Low and Medium-Likelihood Scenarios

- Sustained legally unlevel playing fields for incumbents **39**
 - Extreme fear of overly powerful digital platform companies **40**
 - Extreme consolidation of FMI providers **43**
-

Low-Likelihood, High-impact Scenarios

- Low attractiveness of Switzerland **45**
 - Extreme reduction of digital exposure **47**
 - Untrusted governments **50**
-

Listed Investment Classes Remain Dominant Amid Disintermediation and Explosion of Digitized Assets



Description of visualization on page 58

Likelihood of occurrence: Most likely

Brief description: Investors have continued to view “listing” as an indicator of quality and have mainly invested in such financial products. As such, **listed financial products have remained the dominant investment class** and **listing venues have remained the dominant issuing venues**.

The direct costs of “listing” and of “being listed” have fallen sharply. **Mature firms of all sizes have therefore**

issued their financial products on listing venues, while (young/early-stage) firms and individuals have continued to issue their financial products as non-listed products.

Issuers and investors have been able to directly connect/interact with each other to sell/buy listed financial products, giving them greater choice and comparability/transparency than ever before while avoiding unnecessary intermediation costs. Primary markets (issuing venues) and secondary markets (trading facilities) have

shifted onto **digital platforms offering direct access/connectivity to issuers and investors** driven, most notably, by issuers' and investors' preference for transparency and counter-party choice as well as by technological advances (eg, internetization, mobile devices, AI). These direct-access platforms have **disrupted (disintermediated) traditional broker/middleman functions for listed financial products**. The services previously offered by these intermediaries have been offered by third-parties via the platforms (e.g. issuer rating, underwriting, book-building, advisory, market-making).

Competition among listing venues has intensified and moved into the young/early-stage firm space.

Listing venues have competed by building ecosystems to help these firms grow, while hoping to be better positioned for their "listing" once these firms reach maturity and significant size.

Competition faced by trading facilities for trading in listed products has increasingly played out in primary markets among listing and non-listing issuing venues

because direct-access, platform-based issuing venues can readily set up a digital platform-based secondary market since investors are already digitally connected to their platform. Importantly, non-listing issuing venues have also become competitors in the secondary market because they can submit the products already issued on their platform to a listing venue (for the product to become listed, known as "direct listing") while already operating a secondary market for these products and therefore benefiting from a first-mover advantage in the form of network effects.

Global tech companies have set up issuing venues to support activity in their ecosystems. They have also **become important retail investor-focused investing gateways** by leveraging their global client bases, their analytics-as-a-service infrastructure, and proprietary data of their retail customers. **Fintech startups** did not have the much-touted disruptive effect.

Governments have aimed to provide a technology-neutral legal environment, and have actively intervened in the market in order to ensure jurisdictional authority over certain FMI providers due to systemic risk and national security concerns (critical national infrastructure), which most notably has **prevented extreme consolidation**. Public-availability regulations have **slashed**

profits from (non-low latency) delayed market/trading data to zero.

It is unclear whether t-instant settlement will become dominant; if it does, then it would reduce, but not eliminate, the scope of CCPs. It is also **unclear whether permissioned distributed ledgers will become dominant** and replace (permissioned) central ledgers as the IT infrastructure for the securities value chain. If so, then the role of CSDs will disappear since the distributed ledger will itself amount to the "end custodian". CSDs may pivot into gatekeeping of the ledger and maintaining the code. Throughout the securities value chain, processes have become **highly automated** (RPA, AI), functions/services have been enhanced with **advanced analytics** (Big Data, AI), and **cloud computing** has been widely deployed. **Cyber-risks** have significantly increased as cyber-attacks have become increasingly sophisticated. **Quantum computing** may have become a reality.

Non-listed products have become popular for tailored investment products and for personal interest projects. Investments in young/early-stage firms have returned to being the preserve of specialized investors.

Permissionless distributed ledgers, including initial coin offerings (ICOs), have not disrupted financial markets. A small but steady demand for **crypto assets** has persisted mainly for diversification purposes.

The world has experienced an **explosion in the number and diversity of digitized assets** (i.e. the digital representation of rights to tangible/intangible real-world assets), which has facilitated the trading, financing, sharing, lending, collateralization, and pricing of assets.

Strategic implications: Winning incumbent FMI providers have successfully increased **scale**, ensured **cost-effectiveness**, and led the digital transformation through the securities value chain. Specifically, winners have built **digital platforms (electronification)** in both primary and secondary markets that provide **direct access/connectivity** to issuers and investors by leveraging their existing connectivity to issuers and investors. They have successfully adopted an **extensive ecosystem** strategy by **building ecosystems for young/early-stage firms** (eg, incubator, accelerator, mentorship, network, specialists, IP advisors, APIs, sandboxes, venture funds) and by adopting an **open platform approach** to

build an ecosystem of third-party content/service providers around their own platforms (by acting as **ecosystem orchestrators**). They have more generally adopted an **open innovation mindset** and have in particular not excluded global tech companies and fintech startups as possible partners.

Winning incumbent FMI providers have realized that the **relevant market they are in is the one for digitized assets** (i.e. they have realized that issuing and trading financial products amounts to a subset thereof) and that **disruption may come from anywhere in that market** because the underlying infrastructure is identical for all types of digitized assets. Winners have doubled down on extending their services to provide/facilitate investors access to **new financial asset classes** (e.g. crypto asset-backed assets, insurance-backed assets) and on venturing beyond their traditional business into **digital assets more generally** by leveraging their know-how and expertise in the financial product space to operate **flexible/DIY-capable issuing venues (maker platform), lending/trading facilities (exchange platform), and clearing/settlement/custody infrastructure** for any type of digitized asset.

Winners have developed **unique value-added services around the platforms** (e.g. by becoming a financial information provider, by outsourcing banks' middle/back-office activities) to counter the loss in profitability from selling market/trading data and from operating such platforms more generally.

Winning incumbent FMI providers have recognized that **global tech companies are new competitors**. Winners have pro-actively sought **strategic partnerships** by cultivating their primary market (ie, helping them connect the financial products issued within their ecosystems to investors) and by cultivating their secondary market. Winners have also focused in particular on **financial products and/or customer segments for which global tech companies' unique data did not give them a competitive advantage**.

Winners have successfully streamlined processes by increasing speed/agility while eliminating waste (**end-to-end process optimization**). They (platform operators) have established efficient data management throughout their organizations (i.e. absence of silos), have analyzed their data in real time to uncover/predict

unmet customer needs (**data mining**), and have offered tailored solutions to the needs identified in this way. They have been quick to adopt advances in **automation and robotics** and **advanced analytics** at scale based on mature technologies, while experimenting with immature technologies (to ensure absorptive capacity), and have taken advantage of advances in **cloud computing**.

Winners have switched from a passive to an **active cyber-security strategy** (measures have included IT infrastructure preparedness, training, awareness-raising, cyber war rooms to coordinate intelligence and response, battle testing systems with white-hat hackers, AI-based detection systems) and have especially ensured **quantum-readiness**. Finally, winners (especially CSDs) have been well prepared for a possible IT-infrastructure revolution from central ledgers toward permissioned distributed ledgers (**permissioned DLT**) by showing willingness for self-disruption (i.e. by pro-actively positioning themselves for a possible post-central ledger world) through establishing centers of excellence (CoE), through joining industry working groups/consortia and joint ventures, and through deploying **distributed ledger-ready IT infrastructure** that can easily be switched from central to distributed ledger.

Finally, winners have pro-actively engaged with governments to jointly develop an **appropriate legal framework** governing these digital assets.

Key Players

Issuers (of Financial Products)

Entrepreneurship has spread widely. The number of new start-ups per year has steadily increased, most notably driven by the drastic reduction of barriers of entry for entrepreneurship (i.e. for setting up a start-up),⁵ and by the strong entrepreneurial mindset of millennials and younger generations.⁶

The existence of a universal basic income would likely further contribute to a rise of entrepreneurship by reducing its downside risk through offering a safety net.

It is unclear whether the overall need for external financing will reduce. On the one hand, the overall number of commercial undertakings may increase (see previous paragraph). But on the other hand, each individual commercial undertaking may on average become significantly less capital-intensive.⁷ The overall effect on external financing needs is thus unclear at this stage.

If the overall external financing needs reduce, then capital raising-based issuing (i.e. the issuing of equity-type/debt-type financial products) reduces as a share of all issued financial products.

Mature firms of all sizes have issued their financial products on listing venues.

Mature firms of all sizes have become able to issue their financial products on listing venues because of substantial reductions (due to digitalization and automation)⁸ in the direct costs of “listing”⁹ and of “being listed”.¹⁰ Mature firms have issued their financial products on listing venues because listed financial products have remained most popular with investors.¹¹

Firms which had already issued a listed financial product have issued all of their other financial products (e.g. equity, bonds, loans, insurance, structured products) on listing venues as well because of the low marginal cost of doing so.¹²

Other (young/early-stage) firms and individuals have continued to issue their financial products as non-listed products. All other issuers have continued to issue non-listed financial products because they do not fulfill some of the listing criteria,¹³ and/or because the costs of “listing” and of “being listed” are still too high in relation to the smaller volumes being issued.

⁵ The costs of setting up a start-up have plummeted from USD 5m in 2000 to USD 5k in 2011; see CB Insights, 2018, Future of Fintech: Gradually, then suddenly (20 June 2018).

In the old days, ventures consisted of railways or manufacturers and thus needed pots of capital to set up the necessary buildings, plants or equipment. Many new ventures, however, take the form of e-businesses requiring much less physical infrastructure, little geographic bricks-and-mortar presence, and less human capital than in the past. Automation has also further reduced the need for human capital. Improved connectivity (higher bandwidth, lower latency), availability of free open-source code, and the possibility to lease computing power and storage (cloud computing) have all substantially reduced infrastructure costs. Many new ideas have also remained intangible and do not need physical factories, and even when they do, globalization has allowed them to be manufactured in low-wage countries. We would also note that large sums of capital are not even necessary for scaling as the marginal cost of intangible goods (software, ideas) is close to zero: they can be copied at almost zero cost since they require no factories or warehouses. Finally, even the development of new drugs, which used to cost up to USD 2b per drug, has become much less capital intensive because a universal control group has readily become available (see “Project Baseline”, for example) and because of substantial advances in genome editing tools (such as CRISPR-Cas). To be sure, there are still lots of asset-heavy commercial undertakings around which continue to require pots of capital.

⁶ Surveys suggest that millennials could be the “most entrepreneurial generation ever”. See e.g. James O’ Brien, 2014, Why Millennials could Be The Most Entrepreneurial Generation Ever, American Express (20 August 2014).

⁷ See footnote 5.

⁸ Most notably because accountants, auditors, and lawyers are likely to be highly replaced by machines; see WEF, 2018, The Future of Jobs Report. See also Sections “Automation and robotics” and “Advanced analytics” later.

⁹ The costs of “listing” include: several years of consolidated financial statements according to international accounting standards (e.g. IFRS); confirmation (due diligence) by auditors and lawyers; proper corporate governance (e.g. executive board, possibly a board of director).

¹⁰ The costs of “being listed” include: production of financial statements according to international accounting standards (e.g. IFRS); confirmation by auditors and lawyers; periodic financial reporting; corporate-governance restrictions; endless disclosures (e.g. ad hoc publicity of price-related information, management transactions); ceaseless spotlight.

These requirements reportedly used to cost SMEs up to CHF 1m per year. In a survey, 67% of CFOs estimated that they spend USD 1-1.9m annually; see PWC, 2017, Considering an IPO to fuel your company’s future? Insights into the costs of going public and being public (November 2017).

¹¹ See “Investors” section on page 16.

¹² Once a company has issued one type of listed financial product (e.g. listed shares), the marginal cost of issuing additional listed financial products has become very small as most listing requirements are identical across financial products (they are related to the issuer rather than to the financial product, see footnote 10) and as technology has automated the generation of issuing prospectuses – thus making “listing” even more economical for smaller-volume issuing (e.g. loans or insurance).

¹³ Most notably, the requirement of “several years of consolidated financial statements” which young firms cannot fulfill.

Investors

Retail investment has increased substantially in absolute terms. A much larger portion of the population has assumed ownership of financial products. Drivers of this development include the spread of financial literacy (due to the democratization of access and information, AI-based learning tools/bots, or perhaps even reduced working hours), analytical capabilities brought about by digitalization (e.g. the internet, cloud computing), readily-available tax implications, and novel pricing models reducing the costs of trading (e.g. in the form of free-but-pay-with-data models adopted by global tech companies, subscription-based models such as those offered by the start-ups eToro or Robinhood). The aging of the population has also led to a loss of trust in pension funds' ability to meet their future obligations, leading to ever more people saving and investing to meet their future needs. Finally, reduced wealth prospects from labor (gig economy) have driven people into the investment arena with the hope of capturing some of the wealth created by the economy – investment has become something of a national pastime.

Institutional investment has remained dominant, retail investment has only increased slightly in relative terms. Although retail investors now make up a larger portion of total investments, institutional investors remain the dominant source of capital.¹⁴

Assets under Management (AuM) have shifted eastward, but have not fully left Switzerland. Although Assets under Custody (AuC) have largely stayed in Switzerland (due to its stable political environment and neutrality), individual investors and global investment firms have shifted part of their AuM to financial hubs closer to the fast-growing regions. However, a substantial part of AuM has remained in western countries for risk-management purposes (lower volatility, and global portfolio diversification).¹⁵

It is, however, unclear how substantial the eastward shift of AuM will be. Indeed, it is unclear how developing economies will be affected by a reduction of global supply chains as countries will be prompted to re-onshore production due to advances in automation and 3D-printing (not to mention possibly growing nationalistic/protectionist sentiments at home). Also, it is unclear whether western countries will shift their electronics supply chains back home for fear of tampering with the devices on which critical national infrastructure runs (cyber-attack concerns).¹⁶

24/7 availability, connectivity, mobile, peer ratings and validation (social), virtual reality, voice interface, and omni-channel have become widely expected by (retail and institutional) investors. Influenced by their experiences with global tech companies in other areas of life, investors have come to expect the same quality of user experience in the trading area.¹⁷ The arrival of global tech companies in the trading space has further strengthened this imperative as they have brought their non-compromising approach to end products with them. Importantly, institutional investors have also exhibited such preferences because they have become run/operated by digital natives, who expect the same flexibility/services in their professional life as in their personal life.

Sustainable investment products have become substantially more popular. Younger generations have been more social and environmentally conscious, which has translated into an increasing demand for sustainable/ethical/SRI/value-driven/impact/ESG solutions in the investment sphere.¹⁸ The popularity of such solutions has especially increased as the transfer of wealth to these younger generations has taken off.

¹⁴ HNWI have continued to indirectly invest (via actively-managed funds, wealth managers, etc.) due to their limited time to develop the skills necessary to manage their wealth.

¹⁵ Remember that investors face a trade-off between "expected return" and "risk".

¹⁶ Besides crippling critical infrastructure, risks include theft of high-value corporate secrets (intellectual property, for example) or access to sensitive government networks.

¹⁷ Mobile: A survey of 400 professional traders (institutional investors) found that over 60% expect to use a mobile trading app in 2018, up from 30% a year ago; see Financial Times, 2018, Bond trading: technology finally disrupts a \$50tn market (9 May 2018).

¹⁸ See e.g. US Trust, 2014, Annual survey of high-net worth and ultra-high-net-worth Americans, page 12, "Four in 10 [wealthy US millennials] agree that investing is a way to express their social, political and environmental values" and page 13, "75% of [wealthy] Millennials ... consider the social and environmental impact of the companies they invest in to be an important part of investment decision-making"; Bloomberg, 2018, Sustainable investing grows on pensions, millennials.

Listed financial products have remained most popular with investors because of a perception of quality.

Retail and institutional investors' growing interest in non-listed financial products during the 2000s and 2010s¹⁹ did not continue and listed financial products have remained most popular.

The rise was driven by both the demand and the supply side of capital. On both sides, it was driven by internetization (internet-based digital platforms) facilitating access to capital for non-listed issuers. On the demand side it was driven by the credit crisis/crunch during the mortgage crisis in 2007 and by the ensuing increase in capital requirements for banks reducing credit even further, leading many smaller borrowers (retail and SMEs) to look beyond traditional channels (i.e. beyond banks) for borrowing; and by the absent legal/regulatory framework of and the vast supply of capital available in novel technology-based financial product issuing forms (see below). On the supply side it was driven by the low-interest environment which made (institutional) investors look for yield beyond traditional investment classes, by the debt-heavy business model of private-equity firms/funds (which are themselves typically non-listed) benefiting from the low-interest environment and facilitating (indirect) investment in non-listed financial products, by a diversification rationale, by a fear of missing out as ever more non-listed companies reached valuations in the billions, and by the advent of novel technology-based

financial product issuing forms (namely, "initial coin offerings", ICOs) promising rapid and large gains.

This rise was however only temporary as institutional and retail investors strongly reverted to listed financial products because "listing" has continued to be widely recognized as an indicator of quality²⁰, because most of the young/early-stage firms financed in this way went bust,²¹ because interest rates recovered to their long-term average levels, because many non-listed firms failed as a result of their heavy debt burden brought about by their private-equity owners (i.e. private-equity firms/funds)²² thus reducing their attractiveness to co-investors and indirect investors, and because non-listed investment classes failed to develop a liquid secondary market. An additional financial crisis rooted in non-listed financial products (in 2007 the culprits were non-listed asset-backed financial products, namely, financial products built on top of collateralized loans) could spread broader doubt in non-listed financial products, could cause regulators to restrict certain institutional investors (e.g. pension funds and insurance providers) from investing in non-listed investment classes based on an investor-protection rationale, and/or could cause regulators to increase the legal requirements certain non-listed financial products and their issuers must fulfill based on a systemic-risk rationale (e.g. by linking such requirements to their qualification as a security).²³ Finally, regulators may also be prompted to engage in such regulations out

¹⁹ McKinsey, 2017, Equity investments in non-listed companies (November 2017), page 8, reports that pension funds and sovereign wealth funds have increased the share of their portfolios invested in non-listed equities from 4% in 2000 to 8.5% in 2017. BlackRock, 2016, The New Prominence of Private Assets (June 2016), page 3, reports that pension funds have increased the share of their portfolios invested in alternative assets (which strictly includes all non-listed financial products) from 6% in 1996 to 25% in 2015.

Note that the (18% to 45%) decrease in the number of listed companies on western exchanges between 2000 and mid-2010 does not readily imply a demise of listed equity as an asset class since the reduction may be due to listed companies acquiring each other and/or due to listed companies acquiring (non-listed) young/early-stage firms before their listing. Supporting this view is the fact that the overall market capitalization of listed equity has more than doubled over the same period; furthermore, global PE's AuM stood at USD 5-7t in 2017, which was dwarfed by US listed equity alone standing at USD 28t. See e.g. Patrick Förg, 2018, Put Numbers in Context, SIX Presentation at the 17th SECA Conference (4 July 2018).

²⁰ Even though listing requirements only amount to formal checks (i.e. not a check of the issuer's business case or strategy), "listing" is widely perceived as an indicator of the quality of the issuer. Indeed, journalists and professional investors alike have repeatedly criticized listing venues (i.e. exchanges) for past listings having experienced dramatic share price losses as well as forthcoming listings by expressing skepticism of the issuer's business case; see e.g. Ivo Ruch, 2018, Direktplatzierung: Müssen Börsengänge in der Schweiz strenger reguliert werden?, Cash (9 August 2018), citing the listings at the Swiss Stock Exchange of SIX in 2018 of Wisekey, Asmallworld and Blackstone Resources which lost 75%, 66%, and 30% respectively in less than 6 months since their listing.

²¹ Open issuing marketplaces, on which these non-listed financial products were mainly issued, have arguably been subject to "adverse selection" if borrowers only turn to these marketplaces if they cannot get financing through other means, leading to open-issuing marketplaces exhibiting lower-quality borrowers.

²² Private-equity firms/funds typically load the companies they purchase with lots of debt in what is known as a "leveraged buyout" (LBO). The claims that private-equity firms/funds were shifting from "financial engineering" to "value creation" have not realized. It has, for example, been argued that the company Toys "R" Us would not have filed for bankruptcy had it not been for its heavy debt burden brought about by the consortium of private-equity firm that purchased it; see e.g. Bryce Covert, 2018, The Demise of Toys "R" Us Is a Warning, The Atlantic (July/August Issue).

²³ At the extreme, issuers of certain non-listed financial products may be required to fulfill the same requirements as issuers of listed financial products. History suggests that regulations have a strong impact on the relative attractiveness of listed and non-listed financial products. Indeed, the rise of non-listed markets in the US can arguably be traced back to their deregulation in the "National Securities Market Improvement Act" of 1996, which facilitated the issuing of non-listed financial products; see Michael Ewens, Michael Ewens, 2018, The Deregulation of the Private Equity Markets and the Decline in IPOs (14 September 2018). Available at SSRN.

of a fear that the disappearance of listed financial products would lead to the dominance of private markets (private issuing venues) from which the average investor is excluded – thus intensifying inequality.²⁴

Non-listed products have remained popular for tailored investment products and for personal interest projects. Tailored/bespoke financial products are typically non-listed because the listing costs are disproportional to the issued volume. The demand for tailored products has significantly increased because (retail and institutional) investors have become more sophisticated, transparency/comparability has increased, access has been facilitated (digital platforms), and fees have significantly reduced, enabling smaller ticket sizes (automation).

Also, non-listed investment classes have, most notably, remained popular with retail investors for initiatives that do not primarily pursue a commercial purpose such as social, cultural, community-oriented projects, social entrepreneurship projects, special projects by mature listed firms, or crypto-based projects. Investment in these initiatives is therefore primarily driven by personal interest – commercial aspects only matter secondarily for these investors. Debt-based and reward-based funding is the dominant financing form.

Non-listed investment products more generally (incl. investments in young/early-stage firms) have returned being the preserve of specialized investors. Non-listed and non-tailored investment products have returned being the preserve of specialized investment firms (eg, venture-capital firms/funds, private-equity firms/funds) – with non-specialized investors mostly investing indirectly via specialized firms/funds which are themselves listed (e.g. Blackstone Group, KKR, Partners Group).

External financing of young firms (i.e. start-ups and early-stage firms) has, in particular, reverted to being mainly the domain of specialized firms and of banks, friends, and family for loans. Listing has remained the

most popular “exit option” for these specialized investors when these firms reach sufficient scale and/or maturity.

Small but steady demand for crypto assets. Permissionless distributed ledgers have not become the dominant IT infrastructure (please also refer to the discussion on “permissionless distributed ledgers” later under “IT infrastructure”).

Crypto assets have experienced a loss in popularity among investors primarily because it became clear that permissionless distributed ledgers would not dominate the world.²⁵ As such, the high valuations of crypto assets²⁶ turned out to be a bubble driven by irrational/herd behavior, by a fear of missing out,²⁷ and by a desire to take risks combined with the restrictions imposed by accredited-investor regulations.²⁸

They have, however, retained some popularity as investment assets by both retail and institutional investors due to their potential for diversification, due to their high volatility promising rapid/high returns, and due to governments around the world having clarified the regulatory framework. Furthermore, they have also retained their popularity with a small group of investors who mistrust governments and therefore prefer to invest in projects based on a permissionless distributed ledger. Regulators have at times forbidden investment in certain crypto assets. Most importantly, regulators have intervened when a certain crypto asset primarily served an illegal purpose (e.g. financing of illegal activities, means of payment for illegal activities).

Issuing Venues (Primary Market)

The issuing of financial products has shifted onto digital platforms (“electronification”) offering direct access/connectivity. Issuing has continued to shift onto digital issuing platforms offering direct access to issuers and investors, enabling issuers and investors to directly connect/interact with each other. This has given issuers and investors greater comparability of counterparties (transparency/competition). It has therefore given them

²⁴ See also footnote 123 and the text preceding it.

²⁵ See the discussion in the Section “IT infrastructure” on page 28.

²⁶ The total market capitalization of crypto assets reached almost USD 800b in January 2018.

²⁷ Everybody seemed to know someone who bought crypto-assets for a few cents, put in a few thousand dollars and became quite rich.

²⁸ Accredited investor regulations in many countries prevented retail investors from taking risks elsewhere than in the crypto-asset space.

the choice of whether to rely on an intermediary (freedom to choose),²⁹ thus avoiding the costs of potentially unnecessary intermediation (transaction costs),³⁰ the potential monopolistic/oligopolistic rents charged by intermediaries (perception of inherent conflict of interest/biasedness),³¹ and the opacity of intermediaries' pricing (price-formation opacity).

This shift was most notably driven by the following developments: the increasing digital connectivity of participants (internet connectivity); increasing digital connectivity between participants (internet networks/platforms); increasing willingness to transfer value on the internet (trust in modern technology);³² reduction of onboarding on and connectivity costs to platforms (easy onboarding/light connectivity)³³; automated/algorithmic book-building (automation)³⁴; automated issuing document generation fulfilling legal requirements (automation); automated real-time securitization (automation); robo-advisory services for customized investment recommendations help investors not become overwhelmed by the investment universe (automation/advanced analytics); sophisticated pricing and portfolio-building (risk-return-evaluation) toolkits for investors (advanced analytics/AI).

Notable first movers included Lending Club (launched in 2006), Ipreo (acquired by Blackstone and Goldman Sachs in 2014), Leonteq's Constructor (launched in 2008), Vontobel's Deritrade (launched in 2012), Alibaba's Zhao Cai Bao platform (launched in 2014), the start-up Firstwire (launched in 2015), the start-up Loanbox (launched in 2016), and Vontobel's Cosmofunding (launched in 2018).

Despite the aforementioned advantages of direct-access platforms, the shift was not instantaneous because the deep personal relationships between intermediaries and institutional investors (the largest pool of capital) meant that the latter had a tendency to resist fully relying on direct-access platforms. The shift, however, accelerated once digital natives (unburdened by personal relationships, and used to direct-connectivity platforms) achieved critical mass and/or took over top management functions at institutional investors.³⁵

Direct-access platforms have disrupted (disintermediated) traditional broker/middleman functions in the issuing space. All services that used to be offered by intermediaries/brokers have continued to be offered by third-parties via the platform or by the platform operator itself.³⁶ Third parties have for example offered services such as the generation of issuing documents, issuer

²⁹ Historically, this choice did not exist. Take corporate bonds, for example: corporations used to have to engage the help of an intermediary (typically an investment bank's DCM function) which then contacts its network, typically via phone or e-mail, to find investors (referred to as "book-building"); although the corporation is the actual issuer, there is no direct contact between the corporation (issuer) and investors.

Take loans: the party requesting the loan (borrower) used to have to engage the help of an intermediary (typically a bank) which may then issue securities (possibly through a SPV) for a portfolio of loans to investors. After the financial crisis of 2008, the most (in)famous example is perhaps the "mortgage-backed security".

Take insurance: similarly to loans, the party requesting the insurance (insurance taker) used to have to engage the help of an intermediary (typically an insurance company) which may then issue securities (possibly through a SPV) for a portfolio of insurances to investors (referred to as "insurance-linked securities"). The most famous example is perhaps the "catastrophe bond".

Note that in the last two examples, the intermediary itself issues a financial product. For this reason, this intermediary is not simply a broker and is instead referred to as "originator".

³⁰ Issuing debt in the amount of 100m can yield fees of up to 500k for the intermediary.

³¹ Indeed, an intermediary always has to reconcile two opposing interests: the issuer's interest in a low interest rate, and the investor's interest in a high interest rate.

Empirical evidence indeed suggests that intermediaries may have a conflict of interest as there is evidence of quid pro quo behavior between intermediaries and investors: Tim Jenkinson, Howard Jones, Felix Suntheim, 2018, Quid Pro Quo? What Factors Influence IPO Allocations to Investors? Journal of Finance 73(5), 2303-2341, who find that intermediaries favor high revenue-generating investors when allocating newly issued shares during an IPO.

³² This includes making payments as well as investing over the internet.

³³ Light connectivity was clearly driven by the digitalization of primary markets, but also by the digitalization of KYC and by a possible eID.

³⁴ For more context on these automated processes see the discussions on "Automation and robotics" and "Advanced analytics" later.

³⁵ UBS, 2017, Crowd Capital Raising, UBS Group Innovation White Paper (June 2017), page 4, reports that already by 2015 over 80% of capital on P2P lending platforms (i.e. direct-access platforms) came from institutional investors.

Between 2005 and 2018, Prosper Marketplace reportedly connected issuers and investors of debt-based products in the amount of almost USD 11b. Between 2006 and 2018, Lending Club reportedly connected debt-based products in the amount of almost USD 40b. Between 2010 and 2018, Funding Circle reportedly connected debt-based products (for SMEs) in the amount of almost USD 6.5b. Between the fall of 2016 and summer 2018, [word missing?] reportedly connected debt-based products (limited to public-sector-debt at that time) in the amount of CHF 6b.

³⁶ As such, ECM and DCM functions have appeared as third parties around these platforms rather than as intermediaries as in the past.

rating, issuer risk assessment, underwriting, distribution/book-building, issuing advisory services regarding market conditions, securitization (acting as originator, fund, SPV), or liquidity-provider/market-maker in the secondary market. At the risk of repeating ourselves: although the services may be the same, the difference is that issuers and investors now have the choice of relying on them, which is why those providing these services are properly referred to as “third parties” rather than “intermediaries/brokers”. Third parties have typically specialized in some of these services, leading to an unbundling of the services previously offered by a single intermediary/broker. Services that have become commodities (i.e. non-differentiating), have become directly offered by the operator of the digital issuing platform rather than by third parties.

To be sure, these third parties have de facto continued to amount to intermediaries for non-standardized/fungible and/or complex financial products. Indeed, many (non-specialized) investors did not want to hold such financial products because of their anticipated low secondary-market liquidity, because of their risk exposure, and/or because of the difficulty to price them. In this context, third parties provided standardization/fungibility through securitization, which increased secondary-market liquidity, and allowed the spreading of risk exposure (partitioning/fractionalization),³⁷ and through decomposing complex products into simpler standardized/fungible financial products. The number of products necessitating such intermediation has, however, significantly reduced as investors’ pricing and portfolio-building toolkits have become increasingly sophisticated,³⁸ and as issuers have been able to factionalize/partition individual financial products themselves.³⁹

Finally, we have observed that third parties may continue to constitute intermediaries for risk scoring: issuers may not want to share some information (such as accounting data) with the public and instead opt to rely

on a trusted intermediary to rate them based on this private information (in combination with publicly-available information). If publicly-available information on issuers does not capture this private information, then trusted rating agencies may therefore de facto amount to intermediaries in this ecosystem.

Listing venues have remained dominant. Since listed financial products have remained most popular amongst investors, listing venues have remained dominant in the primary market.

The competition faced by listing venues has intensified (because of existing and new players). Competition among existing rivals has intensified as listing venues have even more aggressively approached listing candidates outside of their home markets.

Competition has also intensified due to new competitors. The shift toward digital platforms with direct access (see above) has allowed new players to establish listing venues by facilitating the building of substantial networks of issuers and investors thanks to easy onboarding and light connectivity. Furthermore, big tech companies have set up issuing venues (see the section on “Big/global tech companies” below).

Competition among listing venues has mainly focused on ecosystem-building for young/early-stage firms. Issuing venues have been competing by establishing relationships with young/early-stage firms with the goal of gaining their issuing (e.g. IPO or direct listing) further down the road. Young firms have been approached at an ever earlier stage. Most issuing venues have set up their own all-inclusive ecosystem to help these firms grow/scale. These ecosystems most notably include an incubator, accelerator, mentorship, network, specialists, IP advisors, APIs, sandboxes, cloud infrastructure, distribution channels for services/products, networks of venture funds, credit/loans.

³⁷ Specifically, third parties acted as originators: buying the financial products of the original issuers, combining them into portfolios/funds, and then themselves issuing (standardized/fungible) financial products linked to these portfolios/funds back onto the platform.

Note that securitization may also reduce maturity if the financial products issued by third parties have lower maturity than the pooled ones – namely, if third parties engage in maturity transformation.

³⁸ We may expect non-standardization/fungibility to no longer lead to lower liquidity since advanced algorithms automatically consider all financial products in the investment universe so that there is a latent demand for all types of financial products.

³⁹ Either directly, by automating the entire generation of issuing documents, or indirectly, by relying on an intermediary SPV that allows real-time single-financial-product securitization.

Closed multi-issuer venues (closed issuing venues) have become dominant for tailored⁴⁰ investment products. Take for instance structured products, which have historically been issued via each issuer's own issuing venue (ie, a type of closed issuing venues). Closed multi-issuer digital platforms have become the dominant venues for issuing tailored structured products driven by a margin-pressured buy side (investors) seeking increased comparability and transparency. Notable early movers were the platform Contineo, Leonteq's Constructor, Vontobel's Deritrade platform, or Swissquote's Swiss Dots platform.

Open issuing marketplaces have mostly disappeared, but retained some popularity for personal-interest projects with retail investors. Although open-issuing marketplaces were popular for some time with retail and institutional investors, they have mostly turned their back on non-listed investment classes (see above) and thus on open-issuing marketplaces. Open issuing marketplaces have remained popular with a small set of investors investing out of personal interest (e., in the form of P2P lending).

Crypto issuing venues (initial coin offerings, ICOs) have remained a small subcategory of open-issuing marketplaces.⁴¹ There has only been low, residual demand among investors for crypto assets (see above) and therefore for crypto issuing venues.

The issuing of crypto assets has only continued to exist as a subcategory of open-issuing marketplaces. Early initiatives aimed at building crypto listing venues never achieved a significant market share and ultimately disappeared as crypto assets lost popularity.

Trading Facilities (Secondary Market)

Trading has continued to shift onto digital platforms ("electronification"). Trading has continued to shift onto

digital trading platforms (also known as "electronification of trading") following the path of equity markets.⁴² This shift was most notably driven by the data advantage of digital platforms in helping parties discover suitable counterparties (efficiency/transparency), by best-execution regulation and trade-reporting regulation (see below) which are easier to fulfil on digital platforms, and by the digitalization of primary markets (see above). Early movers in the corporate bonds space were MarketAxess and TradeWeb.

Trading facilities have increased direct/sponsored access.⁴³ The sell side (market-makers) has continued to access trading facilities directly. But trading facilities have also increasingly offered direct/sponsored access to the buy side (retail and institutional investors).

High-frequency investors (a type of automated algorithmic trading) requiring ultra-low latency have always required direct/sponsored access (such as co-location in a trading facility's data centers). But large investors more generally have also increasingly demanded direct access to trading facilities. This development was most notably driven by the rise of digital platforms as trading facilities (electronification) facilitating direct access (connectivity), by the lower cost of running an in-house brokerage/trading arm due to technological advances (advanced analytics/automation), and by a perception that market prices move whenever they talk to their brokers (perception of conflict of interest).

Retail investors and smaller institutional investors have generally continued to rely on brokers to provide them with intermediated (one-stop) access to multiple trading facilities without having to directly connect to each of these and without having to set up their own brokerage/trading arm. Retail investors' preference was also driven by their having been accustomed to one-stop shops in other aspects of life (think: Amazon).

⁴⁰ Tailored to the specific needs of an investor.

⁴¹ Recall that "crypto issuing venues can theoretically" be a subcategory of any of the three types of issuing venues (open-issuing marketplaces, listing venues, closed issuing venues); see the definitions in the "Securities value chain overview" section (page 54).

⁴² Remember that in 2017, most corporate-debt trading was still conducted by voice over the phone. Between 2010 and 2014, the average daily trading volumes of fixed income reportedly rose on aggregate by about 40 percent on digital platforms. See Bank of International Settlement, 2016, Hanging up the phone – Electronic trading in fixed income markets and its implications, page 84.

⁴³ "Direct access" and "sponsored access" are de facto the same, except that with "sponsored access" the investor is not a member/participant of the trading facility and enters the order with another participant's ID (known as a "sponsoring participant") – because the investor completely bypasses the sponsoring participant's electronic trading systems, we do not refer to the sponsoring participant as a broker.

Competition faced by trading facilities for trading in listed products has intensified. Two sources can be identified. Firstly, the digitalization of secondary markets has made it easier for investors to switch between trading facilities (lower switching costs) and has made it easier to set up a secondary market (reduced entry barriers). Secondly, increased competition in the primary market has spilled over into the secondary market because of the digitalization of both markets (see next paragraph).

Competition faced by trading facilities for trading in listed products has increasingly played out in primary markets, among listed and non-listed issuing venues. The shift toward platform-based trading facilities first led to competition focusing on market data, co-location and high-speed connectivity.⁴⁴ Since then, the competition for trading volume has increasingly played out in the primary-market arena.

The increased competition among listing venues (see previous section) has readily spilled over to trading facilities due to the digitalization of primary and secondary markets. Indeed, digital-platform-based listing venues can readily offer a digital-platform-based secondary market since investors are already digitally connected to the platform. This allows the listing venue to benefit from a first-mover advantage because trading in the secondary market will first launch on their affiliated trading facility (creating network effects and therewith increasing the likelihood that trading remains there).

Importantly, the shift toward digital platforms in primary markets has also made non-listing issuing venues a source of competition for listing venues' trading facilities. Indeed, a product issued on a non-listing issuing venue can be submitted to a listing venue in the future to become a listed product (known as "direct listing"). This soon-to-be-listed product can, however, already be traded on the non-listing issuing venue's affiliated trading facility, which therefore benefits from the aforementioned first-mover advantage as well.

The share of multilateral trading has increased, but bilateral trading has persisted. Traditionally bilaterally-traded (fungible) products have increasingly been traded in a multilateral way because investors and brokers facing increased margin pressure have to price faster and more accurately, and because the shift toward digital platforms has also facilitated (and therefore encouraged) a shift towards multilateral trading.

Institutional investors, especially algorithmic traders, have remained the dominant source of trading volume. Trading volumes have continued to be driven by institutional investors – specifically by algorithmic traders – even though the share of trading volume due to retail investors has risen slightly.

LIT markets' share of the trading volume has significantly increased. LIT markets have gained a much larger share of the trading volume as regulators have continued to pursue efficient price formation through the rapid and complete dissemination of information by increasing market transparency – i.e. both pre-trade and post-trade, real-time public availability of the order book, trades, and volume (please also refer to the discussion on "Laws and regulations" below).

MiFID II led to systematic internalisers ramping up their businesses. Regulators have, however, since then reduced the attractiveness of systematic internalisers.

Profits from delayed price/trading data have fallen to zero. Governments have required trading facilities to make their pre-trade and post-trade data (bid/ask, executed trades, volume, etc.) freely available in machine readable form at an ever lower latency and for an increasing number of financial instruments. They have also established entities to consolidate this data. The European Union's Markets in Financial Instruments Directive II' (EU-MiFID II), which entered into force in 2018, already required such free public availability/transparency within 15 minutes for certain financial instruments. Only very low-latency data is still profitable.

⁴⁴ Indeed, exchanges first faced competition for equity trading volume from alternative platform-based trading facilities in the 2000s, and they focused on these functionalities.

Clearing Houses

Regulators have continued to increase the scope of mandatory CCPs. Regulators have continued to extend the mandatory usage of CCPs for an increasing number of types of assets and trades, and have significantly increased CCPs' clearing volume as a result. The European Market Infrastructure Regulation (EMIR), for example, introduced mandatory CCP clearing for certain classes of derivative contracts.

It is not clear whether t-instant settlement becomes dominant; if it does, then the role of CCPs reduces. It is unclear whether increasing numbers of investors/traders will request t-instant settlement and/or whether regulators will mandate it.

A widespread adoption of t-instant settlement would make CCPs redundant except for financial products exhibiting a future obligation for the original issuer and/or the buyer – indeed, in the absence of such a future obligation, there is no settlement risk under t-instant settlement (recall: CCPs' purpose is to provide insurance against settlement risk).⁴⁵

Custodians

It is not clear whether permissioned distributed ledgers become the dominant IT infrastructure; if they do, then the role of CSD disappears. The business of custody will remain, but the role of a CSD may no longer exist depending on what IT infrastructure becomes dominant (please refer to the discussion on “permissioned distributed ledgers vs (permissioned) central ledger” below under “IT infrastructure”).

If a central ledger remains the dominant IT infrastructure underlying financial markets, then the role of CSD in its current form continues to be relevant.

If permissioned distributed ledgers become dominant, then the role of CSD will disappear for digital-only assets because financial products will be registered directly onto a permissioned distributed ledger (which will act as the “end custodian” and therefore disintermediates CSDs). There will be multiple permissioned distributed ledgers acting as financial product registries around the world. We can envision two possible implementations:⁴⁶

- We can expect these different permissioned ledgers to be set up by different consortia of large banks and CSDs because existing institutions are already positioning themselves as key actors for a possible post-central-ledger world⁴⁷ and because existing processes, which rely on existing institutions, are likely to change only slowly. So-called “custodian banks” will therefore most-likely continue to be relevant because they will be directly connected to these permissioned distributed ledgers whereas end customers, smaller banks, and issuers do not have direct access to them – as such, it will lead to decentralization, but not to full disintermediation.⁴⁸ Existing CSDs may position themselves as responsible for the development/maintenance of the distributed-ledger software, as auditors of software developed on top of the ledger (typically referred to as “smart contracts”), as gatekeepers by authorizing participation in the ledger (i.e. in the consensus-formation participation), or as offering custody services for physical assets that are digitally represented on the ledger (i.e. offline vault service).

⁴⁵ *Settlement risk relating to the original issuer.* The buyer of an option contract has the right to sell/buy at a fixed price in the future (put/call option) to/from the original issuer of the option contract (i.e. the seller on the primary market) – since only the original issuer has a future obligation, there is only a settlement risk relating to this original issuer. The same holds for fixed-income instruments where only the original issuer has a future obligation.
Settlement risk relating to the buyer. The buyer of a futures contract (long position) on the primary or secondary market has an obligation to pay a fixed price in the future to the original issuer of the futures contract (i.e. the seller on the primary market) – since the buyer has a future obligation, there is a settlement risk relating to this buyer.

⁴⁶ Both the “European Central Bank” and the “International Securities Services Association” also identify these two possible implementations. Andrea Pinna, Wiebe Ruttenberg, 2016, Distributed ledger technologies in securities post-trading: Revolution or evolution?, ECB Occasional Paper Series No 172 (April 2016), pages 28–31, referring to them as Scenario 1 and Scenarios 2&3 respectively; ISSA, 2018, Distributed Ledger Technology (June 2018), pages 45–46, referring to them as Model 1 and Models 2&3 respectively.

⁴⁷ For instance: the “Utility Settlement Coin” Project includes, among others, Barclays, UBS, Credit Suisse, Deutsche Bank, and HSBC; the “CSD Working Group of DLT” includes Swift and seven CSDs, namely, Dhavi Securities Exchange, Caja de Valores, Depósito Central de Valores, Nasdaq Market Technology, National Settlement Depository, SIX, and Strate.

⁴⁸ This is like going back to the past when, for example in the US, many regional stock exchanges could be found – since the nodes on the permissioned distributed ledger can add/issue new digital assets on it, they are akin to the local stock exchanges. Observing so: Gideon Lichfield, 2018, The problem with ICOs is that they're called ICOs, MIT Technology Review (May/June Issue).

- Another possible (more extreme) implementation could be that both end customers and issuers directly access the permissioned distributed ledger (full disintermediation). In this implementation, existing CSDs could, in addition to the aforementioned roles, also position themselves to act as gatekeeper by authorizing new digital assets to be issued on the ledger (for example through verification of the code and legal compliance).

CSDs have collaborated more closely with each other to improve collateral management. CSDs have collaborated more closely with each other, most notably to enhance cross-border collateral fluidity and in so doing improve collateral management by more easily allowing a party to post securities held at a foreign CSD as collateral (for example, with some CCP clearing house which is not connected to said foreign CSD).

It is not clear whether t-instant settlement becomes dominant; if it does, then settlement volume increases. A widespread adoption of t-instant settlement would increase settlement volume because the parties to a trade cannot net their various trades anymore.

Custodians (including CSDs) have extended their business to crypto assets and other financial products. Custodians have established direct connections to various permissionless distributed ledgers and have thus allowed investors to acquire crypto assets without being directly connected to the permissionless distributed ledgers themselves (custodians thus hold the crypto assets on behalf of these investors).⁴⁹ Furthermore, custodians have offered offline custody services (vault service) for the private keys of investors who want to be directly connected to the permissionless distributed ledgers but are concerned about the security of their private keys (please also refer to the discussion on “per-

missionless distributed ledgers” below under “IT infrastructure”).

Custodians have also extended their custody services to additional non-listed investment classes.

Custodians (including CSDs) have extended their business to digitized assets more generally by leveraging their know-how in the context of financial products. Custodians have extended their traditional business of digitally storing ownership rights to (and thus enabling trading/lending in) financial products to the digital storage of any kind of rights to any kind of real-world assets because such a service exhibits strong economies of scale and because custodians/CSDs are already strongly regulated entities (please also refer to the discussion on “Digitized assets: digital representation of rights to tangible/intangible real-world assets” below.)

Key Themes

Market Structure

Downward margin pressure has remained high for all FMI providers (issuing venues, trading facilities, CCPs and CSDs). Platform operators throughout the securities value chain have experienced continued margin pressure driven by reduced switching costs and by easy connectivity to multiple platforms (digitalization, internetization, and connectivity).⁵⁰ Transaction costs/fees have continued to fall.

Consolidation has continued⁵¹ throughout the securities value chain. Platform businesses tend to exhibit winners-take-it-all dynamics: economies of scale (e.g. operational processes, legal/regulatory compliance) and network effects (e.g. reduced spread through higher liquidity, wider offerings, broader demand). Governments and

⁴⁹ With the advent of second-generation crypto asset trading facilities (i.e. decentralized trading facilities), the crypto asset custody and crypto asset trading facilities can be separated (please also refer to the discussion on second-generation crypto asset trading facilities in the “Untrusted governments” scenario on page 50.)

⁵⁰ Issuers can freely choose the issuing venue since investors are readily connected to multiple ones (possibly via an aggregator), and traders can freely choose the trading facility (securities are admitted to trading on many different trading facilities) and the CCP.

⁵¹ The secondary market (trading facilities) experienced strong consolidation between 2000 and the mid-2010s. Examples of consolidation driven by M&A activities during that time include: Deutsche Börse, Eurex, and Clearstream; London Stock Exchange, London Clearing House, Clearnet SA, and Borsa Italia; NASDAQSE, Iceland SE, Copenhagen SE, Vilnius SE, Stockholm SE, Helsinki SE, and International Securities Exchange; Intercontinental Exchange, International Petroleum Exchange, LIFFE, Bourse de Paris, Amsterdam Stock Exchange, Brussels Stock Exchange, BVLP, and New York Stock Exchange; Chicago Mercantile Exchange, Chicago Board of Trade, and Nymex; Hong Kong Exchanges and Clearing, and London Metal Exchange.

regulators have, however, prevented extreme consolidation by forbidding certain M&As due to anti-competition concerns, systemic risk concerns (higher concentration leads to higher systemic consequences in case of failure), and out of a desire to have jurisdiction over FMI providers (please also refer to the discussion on “Laws and regulations” below.)

Big/Global Tech Companies⁵²

Global tech companies have set up issuing venues (primary markets) to support activity in their ecosystems (i.e. as a means to an end).⁵³ We will use Amazon for illustrative purposes hereinafter. Amazon Lending was launched in 2011 to provide loans to sellers on Amazon’s e-commerce marketplace so that they can develop their operations (it was not an issuing venue when it was launched because third-party investors could not readily access it, only selected partner banks could).⁵⁴ Amazon Consumer Lending (e.g. its own line of credit cards, installment loans option at check-out) provides loans to consumers on Amazon’s e-commerce marketplace to increase their purchasing power (again, it was not an issuing venue when it was launched).⁵⁵ Two factors suggest that Amazon is likely to launch an issuing venue (either itself or jointly with an already-regulated third party): Amazon tends to first develop a new product/service for itself, and it is only when its only and most important customer (itself) is content with it (usually after years of iterations) that it opens it up to third parties (recall that it was the overhaul of its internal capacity for cloud services which later gave rise to the external offering AWS), and an issuing venue (i.e. opening access to any third-party investor) is a natural extension for Amazon’s aforementioned lending services to access a broader supply of capital and to avoid fees by taking out intermediaries (disintermediation).

Social media platforms can be expected to proceed likewise in order to financially support their influencers and content providers. The start-up Patreon already allowed fans to pay small monthly stipends to their favorite artists, podcasters and filmmakers in 2018. Besides e-commerce and social media, big tech companies more generally can also be expected to set up issuing venues. Payment processors (PayPal, Square) and accounting/financial-software providers (Intuit Quickbooks) had already set up lending services for the participants in their ecosystems in the mid-2010s.⁵⁶

Global tech companies’ cloud infrastructure businesses have expanded the scope of their ecosystems to include virtually any economic undertaking. Global tech companies’ push to become the dominant cloud-infrastructure operators has greatly increased the scope of companies they view as part of their ecosystem. They have attracted firms onto their own cloud infrastructure by, among other things, helping them with their financial needs.⁵⁷ They have also attracted investors (e.g. asset/fund managers) onto their own cloud infrastructure by, among other things, providing them with a big-data/advanced analytics environment, by helping them with the distribution of their own shares, and by offering them direct investment access to other firms in the (cloud) ecosystems.

Global tech companies have even set up issuing venues (primary markets) outside of their ecosystems. Although China is arguably not that representative for western economies because its financial sector was much less developed when these tech companies emerged, we nonetheless mention a Chinese big tech company here for the sake of general awareness. Alibaba already started operating an issuing venue (“Zhao Cai Bao” which means “bring wealth”) in 2014 for debt products, structured products, and insurance products.

⁵² Think Alibaba, Amazon, Apple, Baidu, Facebook, Google, Netflix, Tencent.

⁵³ Their issuing venues amount to “closed issuing venues” because only parties that are active in their ecosystems are allowed to issue financial products on them.

⁵⁴ Amazon Lending made loans for over USD 3b to over 20,000 SMEs on its e-commerce platforms between 2011 and June 2017; see Business Wire, 2017, Amazon Loans More Than \$3 Billion to Over 20,000 Small Businesses (8 June 2017). Alibaba, via Ant Financial, also provides loans to sellers on its e-commerce marketplace.

⁵⁵ Alibaba, via Ant Financial, also provides loans to consumers on its e-commerce marketplace (reportedly reaching USD 95b in 2018); see Bloomberg, 2018, Ant Financial Consumer Lending Reaches \$95 Billion (12 March 2018).

⁵⁶ See CB Insights, 2018, How 5 Tech Giants Are Leveraging Data To Reinvent Lending (1 February 2018). For an in-depth analysis of PayPal’s approach see e.g. Daniel Steingruber, Karin Affolter, 2018, PayPal positioniert sich als One-Stop-Shop Lösung im digitalen Handel und konkurrenziert dabei auch Banken, Swisscom e-foresight Think Tank (August 2018).

⁵⁷ Google, for instance, already partnered with Lending Club (an issuing venue) in 2015 to help firms using its services access capital; see Noah Buhayar, 2015, Lending Club Wants to Broaden Its Membership, Bloomberg (23 April 2015).

It then extended its issuing venue to cloud-based hosting by allowing issuers to set up shop directly on the platform (“Caifu Hao” which means “Fortune account”) in 2017.⁵⁸ Furthermore, both Alibaba and Tencent announced in 2018 their intention to focus on providing infrastructure for financial institutions (which has been referred to as “techfin”) rather than financial services per se,⁵⁹ and issuing venues have been key features of these infrastructures.

In 2018, Amazon invested in Capital Float which offers loans to SMBs. Although Capital Float was not an issuing venue at that time (because third-party investors cannot access it), the investment suggests Amazon will go beyond its e-commerce ecosystem in finance.

Global tech companies have become important retail-investor-focused investing gateways to primary and secondary markets. Global tech companies have provided their retail customers with access to third-party issuing venues (primary markets) and to third-party trading facilities (secondary markets) by acting as brokers. They have generally done so as part of their broader retail banking offering. Google has, for example, integrated such a gateway into its “Google Maps” and “Google Lens” (visual search). Users can identify investment opportunities in their immediate geographic environment.

They were able to achieve significant scale in the retail investor space by leveraging their vast base of already-connected users, their analytics-as-a-service infrastructure for retail investors to develop/test their own investment strategies, their vast user data (purchasing habits, comments, sentiments etc.) to make better and tailored financial product recommendations, and their ownership of customer-interfacing hardware and operating systems (e.g. “Alexa buy me 10 shares of XYZ”).

Early movers can especially be found in China. Tencent, for example, already started offering such investing

access in 2014 on its wealth management app (Licaitong, which is accessible from its messaging app WeChat), offered educational video content regarding wealth management and investing, and even obtained a license to sell mutual funds on WeChat in 2018. Alibaba also started offering such investing access via its wealth management app (Ant Fortune) in 2015.

Global tech companies are likely to ultimately exhibit retail-investor-focused issuing venues and trading facilities. Global tech companies’ large customer base may let them extend their “closed issuing venues”⁶⁰ by operating a retail-investor-focused open-issuing venue on which anyone can issue financial products.

Also, because they are very likely to find counterparties to a trade entered by one of their customers among their remaining customers (i.e. high likelihood of internal matching), they may in addition to providing “investing gateways” decide to operate a retail-investor-focused trading facility so as to avoid sending their trade orders to a third-party trading facility (i.e. so as to avoid incurring the trading fees). Because such a move would involve getting regulated (and would require a license), big tech companies are likely to partner with an already-regulated entity.

Please note that an e-commerce marketplace (e.g. Amazon) for non-financial products is akin to a “primary market” when used to sell/buy “new products” and akin to a “secondary market” when used to sell/buy “used products”.

Open Innovation

FMI providers have adopted an open innovation approach and have viewed global tech companies and fintech start-ups as partners. Global tech companies and fintech start-ups have not had the disruptive effect many predicted. The most successful fintech start-ups provide services that are complementary to existing FMI providers. FMI providers throughout the value chain

⁵⁸ Issuers could now set up shop directly through the app (and could therefore benefit from substantial efficiency gains by building on Alibaba’s IT infrastructure), could directly connect to retail investors, and had access to investor data. Note that only financial institutions (banks, securities firms, mutual funds) were allowed to issue financial products when the platform was launched. Investors could, for example, access the service via Alibaba’s wealth management app (Ant Fortune).

⁵⁹ Their move was arguably driven by regulators’ increasing scrutiny (due to systemic-risk concerns and retail-client protection) putting pressure on margins; see e.g. Economist, 2018, Ant and Tencent: As regulators circle, China’s fintech giants put the emphasis on tech (13 September 2018).

⁶⁰ See footnote 53.

have created additional value for their core services by building on the innovation of external players (i.e. by completely rejecting the “not invented here” stance) through joint ventures and acquisitions.

Free availability of data for non-commercial uses has become widespread. An increasing number of trading facilities have made their trading data freely available for non-commercial uses to foster the establishment of an ecosystem of new services around their platforms by allowing free experimentation with their data. The trading facility IEX already followed this approach in 2017 by offering a “Free Stock API for Realtime and Historical Data”.

Automation and Robotics⁶¹

Automation has substantially increased, and has been driven by the possibilities shown by distributed ledgers. Automation has increased throughout the securities value chain and has substantially reduced costs, increased speed, reduced errors, and permitted faster scaling.

Please note that automation has really taken off since distributed ledger technologies (e.g. Bitcoin or Ethereum blockchains) entered mainstream discussions. DLTs clearly showed the possibilities of automation and therefore pointed out the lack of the same in existing processes relating to financial products (i.e. they raised customer expectations regarding automation).

Repetitive tasks have been automated throughout the securities value chain. Two types of automation are widespread: robotic process automation (RPA) to automate easy, repetitive tasks, and artificial intelligence (AI)⁶² to automate more complex – yet still mostly repetitive – tasks.

- The issuing of financial products now involves virtually no humans, with automated issuing-document generation;⁶³ automated fact-checking of the issuing documentation;⁶⁴ (building on the previous two points) automated real-time fractionalized/partitioned issuing of a single financial product;⁶⁵ automated production and pricing of bespoke/tailored financial products, automated credit-risk assessment and rating of issuers, automated book-building using automated allocation systems and automated underwriting.⁶⁶
- Automated (optimal) trade order execution.⁶⁷
- It has become commonplace for newly issued structured/synthetic products to have been fully packaged by a computer.
- Bilateral trading over the phone is being automatically translated into legal language (semantic and natural-language processing) and then proposed to the parties in the form of a digital written contract.
- Financial products take the form of smart contracts which already embed, and therefore automate, their future cash-flows.

It is not clear whether the automation of non-repetitive tasks will be achieved. It is still unclear whether further advances in AI will be able to automate complex, non-repetitive tasks.

Advanced Analytics⁶⁸

Processes throughout the securities value chain have been enhanced with advanced analytics. Advanced analytics have allowed processes to be improved throughout the securities value chain:

⁶¹ Overall cost reductions in the securities value chain could be as high as 20%, and up to 50% for specific functions/processes. See McKinsey, 2018, A calm surface belies transformation in securities services (March 2018), page 21.

⁶² Note that AI based on machine learning is closely linked to advanced analytics.

⁶³ Most notably the “prospectus requirement” when a financial product that is to be issued qualifies as a “security”.

⁶⁴ This replaces the auditor who would previously check the veracity of some of the facts stated in the issuing documents. Since all information of issuers, including their financials, are available in digital form, fact-checking can readily be automated.

⁶⁵ One possible means: automated real-time securitization (SPV for single financial products) – for example, single-loan real-time securitization.

⁶⁶ Goldman Sachs had reportedly already automated 50 percent of the 120 steps necessary for an underwriter in an IPO in 2017, see Dakin Campbell, 2017, Goldman set out to automate IPOs and it has come far, really fast, Bloomberg (13 June 2017). Please also refer to the discussion under “Advanced analytics”.

⁶⁷ JP Morgan's LOXM is an algorithm that automatically executes trade orders at the best price (most notably: how to execute a large order that cannot be executed at once).

⁶⁸ Leaders of FMI providers have ranked “advanced analytics” as the most important force shaping the near future. See McKinsey, 2018, Fintech Decoded: Capturing the opportunity in capital market infrastructure (March 2018), page 19.

- Issuing: analysis of market conditions to help issuers with the size, structure, and timing of issuing,⁶⁹ credit-risk assessment and rating of issuers derived from ever-increasing publicly-available data,⁷⁰ new data sources to help investors with pricing.
- Trading: sophisticated order types,⁷¹ insider-trading detection, market-liquidity prediction,⁷² market-impact prediction⁷³.
- Investment allocation: sophisticated robo-advisors have allowed tailor-made investment recommendations for the masses and have thus allowed the construction of individualized yet diversified portfolios.⁷⁴
- Risk management at the issuer counterparty level:⁷⁵ analysis of contract terms and related risks, risk model optimization, issuer default rating/credit risk assessment, collateral optimization.
- Risk management at the trading counterparty level:⁷⁵ risk model optimization, counterparty default rating, counterparty default prediction, margin-call prediction, collateral optimization.
- Operational risk (fat-finger protection).
- IT infrastructure: system breakdown prediction.

IT Infrastructure

It is not clear whether permissioned distributed ledgers will replace (permissioned) central ledgers. It is unclear whether permissioned distributed ledgers will replace centralized ledgers as the dominant IT infrastructure of financial markets. It is important to realize that direct-connectivity (p2p) in primary and secondary markets is unrelated to the underlying ledger: direct connectivity only describes a p2p communication channel that allows direct (bilateral or multilateral) inter-

action to trade financial products. Where the ownership of these financial products is ultimately registered is unaffected by this communication channel.

There are three (cumulative) necessary conditions for permissioned distributed ledgers to become dominant:

- *A permissioned distributed DB must be superior to a centralized DB:* if not, then the optimal infrastructure design involves a central ledger with a third-party operating the centralized DB. (Technical assessment in terms of operating costs, cyber-security, throughput, latency etc.)
- *A permissioned distributed ledger must be superior to a central ledger:* if not, then the optimal infrastructure design involves a central ledger operated by a third party.⁷⁶ (assessment of incentives, of ecosystem participants, of business models etc.)
- *A permissioned distributed ledger must fulfil all regulatory requirements:* if not, then a central ledger ought to be used (regulatory assessment).

If central ledgers remain dominant, then ledgers become fully interconnected across network participants and allow embedding code (programmable).

Even if distributed ledgers do not revolutionize the IT infrastructure, they will nonetheless permanently have altered their structure in at least two ways.⁷⁷

Firstly, central ledgers are now being (partially) replicated across all members in the network and with all members allowed to submit entries to the central ledger.⁷⁸ This has replaced the network wherein each member had their own separate internal ledger and has therefore reduced

⁶⁹ See, for example, the startup Overbond.

⁷⁰ Thus precluding – or at least reducing – the need for (non-public) issuer-internal data which issuers are typically reluctant to disclose, as well as for lengthy in-depth (qualitative) interviews with issuers.

⁷¹ This has democratized access to sophisticated order types which used to be restricted to specialized (algorithmic/quant) hedge funds.

⁷² Prediction of liquidity is important e.g. to assess possible costs of forced liquidation of one's holdings, or to assess the safety provided by one's stop-losses.

⁷³ Namely, to predict the effect of one's own trading on market prices.

⁷⁴ This has disrupted the asset management business by disintermediating funds.

⁷⁵ Especially by CCPs.

⁷⁶ This third party may either operate the central ledger as a “centralized DB” or as a “distributed DB” (both are by definition permissioned – with the third-party being the only one with “permission”).

⁷⁷ These are actually the two main benefits identified by one of the finance industry's most prominent permissioned distributed ledger advocates “Digital Asset Holdings”. These two benefits can, however, also be achieved in a central-ledger-based network.

See Digital Asset, 2016, Digital Asset Platform: Non-technical White Paper (December 2016), pages 3 and 4.

⁷⁸ Specifically, the dominant form has become central ledgers with (partial) replication of the ledger across all members in the network, and with all members in the network allowed to submit entries to the ledger (with private/public-key cryptographically-secured signatures). In other words, the dominant form is a *shared centralized ledger* – “shared” in the sense that all members have the right to (partially) access/read/replicate the ledger and submit entries, “centralized” in the sense that a single participant decides which of the submissions gets written into the ledger (single administrator).

reconciliation costs in the network because it is by design always synchronized across all members in the network.⁷⁹

Secondly, central ledgers have gone beyond being mere transaction registries to allowing the embedding of code (often referred to as “programmable” or “smart contracts”). This has, for example, allowed the representation of voting rights or future cash-flows associated with financial products directly into the ledger.⁸⁰

If permissioned distributed ledgers become dominant, then CSDs become obsolete, but issuing venues, trading facilities, and CCPs remain relevant. CSDs would be disrupted because distributed ledgers themselves constitute end custodians (please also refer to the discussion on “Custodians” above.)

Issuing venues (listing venues), trading facilities and CCPs are platforms built on top of these ledgers, and have therefore not readily been rendered obsolete by these distributed ledgers. Indeed, economies of scale/scope and network effects continue to apply.

Permissionless distributed ledgers (including initial coin offerings) have not become dominant, and have therefore not disrupted financial markets. Permissionless distributed ledgers (like Bitcoin and Ethereum blockchains) have not come to dominate the world because they solve a problem that does not exist for most people – they solve the problem of “absence of trusted parties” in a world in which trusted parties (e.g. governments, intermediaries) exist – and therefore bear unnecessary costs.⁸¹ Recall in particular that most investors who owned crypto assets during the 2010s held them in a custody account (i.e. a trusted intermediary) at a crypto trading facility, strongly suggesting that absence of trust is not an issue for most people.

Permissionless distributed ledgers have only become central to the (commercial) dealings of a small minority of the population who mistrust governments: libertarians, people believing in the decreasing relevance of nation states and pushing for a global governance model instead, highly mobile and educated people (“Anywheres”⁸²) feeling overly restricted by a local governance model, people engaging in illegal activities,⁸³ people living in authoritarian countries, or people living in countries imposing capital controls and feeling overly restricted by them. These people have, for instance, relied on permissionless distributed ledgers as a means of payment and a store of value (“crypto currencies”), as a contractual basis (“smart contracts”), and as a basis for issuing financial products (“initial coin offerings”, ICOs).

As mentioned above, the digital assets created on these permissionless distributed ledgers (referred to as “crypto assets”) have, however, gained more widespread popularity as investment assets.

Permissionless distributed ledgers may nonetheless find some specific use cases. Permissionless distributed ledgers may for example allow the replacement of centrally-run social networks (e.g. Steemit, Synereo), centrally-run prediction markets (e.g. Gnosis), centrally-run cloud storage (e.g. Storj) or centrally-run e-commerce platforms (e.g. OpenBazaar).

Importantly, such initiatives may be financed via traditional means and thus may not require the issuing of a new crypto asset.

Cloud computing has increasingly been relied upon. Throughout the securities value chain, providers have moved into the cloud to take advantage of the cost savings (infrastructure costs, set-up costs, maintenance

⁷⁹ In the past, each member in the network had its own distinct/separate (legacy) system for its internal ledger, which had to be reconciled with the internal ledger of the counterparty (e.g. custodian, CSD) because these ledgers did not communicate automatically with each other so that differences could occur.

⁸⁰ For example, Swisscom’s “Swiss C-Share Project” aims to represent a Swiss share on such a ledger (a “Swiss digital share”) enabled with functions allowing automatic dividend payments, share splits, capital increases, or voting-right execution.

⁸¹ We understand the value proposition of “permissionless distributed ledgers” as “allowing a digital ledger in the absence of trusted parties”. For a more extensive discussion, please refer to the “Untrusted governments” scenario.

⁸² The term was coined by David Goodhart, 2017, *The Road to Somewhere: The Populist Revolt and the Future of Politics* (C Hurst & Co Publishers Ltd).

⁸³ It has been reported that approximately 25% of all users and close to 50% of bitcoin transactions are associated with illegal activity. See Foley, Sean, Karlisen, Jonathan R., and Putnins, Talis J., 2018, *Sex, Drugs, and Bitcoin: How Much Illegal Activity Is Financed Through Cryptocurrencies?* (15 January 2018). Available at SSRN.

and upgrade costs etc.), real-time scalability (on-demand), increased cyber-security/resilience, and access to an ever-growing ecosystem around cloud-based services of easy-to-integrate apps and solutions.

Cyber-risks

Cyber-risks have significantly increased. The risk of being hacked (data theft, unavailability of service, data manipulation) has constantly increased over the past years as cyber-attacks have become increasingly sophisticated. They have for instance taken the form of DoS/ interruptions of FMI, disappearance of trading orders, and improper execution of trading orders.

Quantum computing may have become a reality and key to cyber-security. If quantum computing becomes a reality then it would render all pre-quantum cryptography useless.

Digitized Assets: Digital Representation of Rights to Tangible/Intangible Real-World Assets⁸⁴

Digitized assets have exponentially increased. The substantial increase in the number and diversity of digital representations of rights to real-world assets was driven by multiple factors: the spread of access over ownership, and the sharing economy more generally, has supported digital representation because such representation enables the easy verification, lending, sharing, auctioning and trading of rights to real-world assets (including one's own). Digital representation improves price discovery (market efficiency), and digital representation of one's own real-world assets provides a complete/consolidated view of one's assets, provides one's true risk profile and exposures, and facilitates the collateralization thereof. The rise to popularity of DLTs (such as the Bitcoin/Ethereum blockchains) has also fueled people's imagina-

tion regarding what can be digitally represented and what can be built on top of such representation. The automation of processes (e.g. automated issuing document generation to fulfil legal requirements) and advances in DB technologies (most notably DLTs) have significantly reduced the production costs of customized/bespoke digital assets and thus made even small ticket sizes economical (fractionalization). A desire to invest directly in assets and a desire to issue assets directly to investors (direct connectivity/disintermediation). Fractionalization allows a diversified portfolio to be held without going through an intermediary (e.g. funds) even on a small budget.⁸⁵ A desire to invest in specific and/or authentic assets (e.g. in one geographic environment, in one's community or home village).⁸⁶ A do-it-yourself preference for digitally representing one's own assets has served as a catalyst for new types and usages (open innovation). The possibility of identifying specific assets in one's immediate geographic environment (via GPS, or visual search). The explosion of IoT devices has necessitated digital representation so that IoT devices can connect to a DB to check a person's rights (see below). And the digitalization of contracts themselves (not least driven by the spread of digital signatures such as eID) has also supported digital representation because such representation allows these contracts to directly refer to some digital rights and therefore enables them to self-execute ("smart contracts").⁸⁷

Because of its abstract nature, some examples of rights that could be digitally represented are mentioned below:

- Various rights to/against a legal person (e.g. a start-up, young/early-stage firm, a mature firm's specific R&D undertaking,⁸⁸ a mature firm's specific business line/unit, or any other type of commercial undertaking)

⁸⁴ Importantly, our definition of "digital representation" is independent from the underlying database – real-world assets can be digitally represented in a central DB, or a distributed DB (eg run as a permissioned distributed ledger). Such rights, most notably, take the form of ownership rights and of access/usage rights.

⁸⁵ For example, instead of going via a diversified real-estate fund, they want to invest directly in the real estate yet be diversified. This requires that the real-estate owner issues themselves digitized assets representing the fractionalized ownership rights to their real estate.

⁸⁶ Although a person could already approach a local business and ask them whether they can buy a stake in the company, we see three limiting factors which "digitized assets" could resolve: a person may not want to talk about money and their wealth by entering into a discussion with the local business about how much they would be interested in investing (such information could also rapidly spread in smaller communities), a person may not want to enter into lengthy contract negotiations regarding the terms and conditions of such an investment, and a person may want the peace of mind knowing that they will be able to exit/resell their investment in the future (i.e. existence of a secondary market).

⁸⁷ Importantly, our definition of "smart contract" is independent from the underlying database – it can run on a central DB or a distributed DB (e.g. run as a permissioned distributed ledger).

⁸⁸ For example, a pharmaceutical company's development of a new drug, or a university's (fundamental) research.

such as ownership rights (equity-type digital assets), rights to future payment (debt-type digital assets), rights to future revenue share, rights to future usage of service/product, right to future priority treatment⁸⁹ etc.⁹⁰

- Ownership rights to precious metals such as gold, silver, or diamonds (“precious-metal-backed digital assets”).⁹¹
- (Fractionalized/partitioned) ownership rights to expensive and/or uniquely identifiable real-world objects such as art, land,⁹² real estate, cars, or luxury goods.
- Access/usage rights to public transportation, a seat at a concert, a seat in a movie theatre,⁹³ a table in a restaurant, a parking space.⁹⁴
- Ownership rights to one’s invoices for accounts-receivable financing (factoring),⁹⁵ to one’s educational certificates⁹⁶, to one’s possessions in an online/multiplayer virtual game (in-game items/currencies),⁹⁷ to one’s possessions more generally (digital inventory).⁹⁸
- Access/usage rights to one’s own possessions such as one’s (anonymized) digital data from internet platforms (e.g. social-media platforms)⁹⁹, one’s parking

space in front of the house,¹⁰⁰ a fraction of one’s future salary, or one’s possessions more generally.¹⁰¹

- Usage rights to spare computing power (edge computing),¹⁰² to spare storage (physical or electronic, including edge devices), to unused transportation vehicles, to surplus energy production (smart grid), to green energy.¹⁰³
- Access rights to one’s own or a third-party building, apartment, room, or car (via connected/IoT doors).
- Future advertising rights such as on a billboard, during intermission at a cinema, during commercial breaks at a sports event, or as product placement in a movie.¹⁰⁴
- (Fractionalized/partitioned) contracts such as mortgage contracts, or insurance contracts.
- Ownership rights to and derivatives based on crypto assets (“crypto-asset-backed digital assets”). Please also refer to the discussion on crypto assets under “Custodians” above.

Internet of Things

The number of connected devices has more than tripled. The number of connected devices has increased from 10 billion in 2010 to over 30 billion in 2020, and has

⁸⁹ Perhaps most notably: Tesla’s pre-order campaigns.

⁹⁰ This bullet point strictly includes (but is not limited to) any investment/financing arrangement that one may associate with “crowd-funding” or “initial coin offerings”.

⁹¹ Britain’s government-owned mint for producing UK coins (“Royal Mint”) has physical gold in its vault and issues digital rights (called “RMG”) to the gold (1RMG=1gr of gold). It partners with CME Group to operate a secondary market. Note that ownership of precious metals was already possible before via ETF securities (e.g. ETF Securities Physical Gold). The difference is that with ETFs, one only indirectly owns the underlying precious metal by directly owning shares in the ETF. To put it differently, RMG is disintermediating ETFs.

⁹² SIX Terravis issues land-ownership rights (thus acting as a land registry). Actually, SIX Terravis is the electronic information portal for land registry data (i.e. land ownership rights) in Switzerland.

⁹³ This would allow one person to order the seats for a group and then transfer them to the other members (for free or in exchange for some money). Or this would allow one member of a group to book the seats, provide the other members’ ID, and have the others receive a message to confirm their purchase.

⁹⁴ This would allow booking a parking space when entering a destination in a web map (e.g. Google Maps or the interface in one’s car). Or it would allow booking a parking space when booking a table at a restaurant (with restaurants perhaps having preferential access or reduced fees to parking spaces around their location).

⁹⁵ This would allow the use of accounts receivable as collateral for a loan.

⁹⁶ This would allow third parties to easily verify the integrity of someone’s educational credentials by allowing educational institutions to digitally represent certificates. The necessity of contacting many different educational institutions is likely to further increase as students increasingly build their own portfolio of classes and (nano-)degrees from different educational institutions around the world.

⁹⁷ This would allow online gamers to exchange items/currencies seamlessly across different games.

⁹⁸ For example, to ensure that one never buys the same thing twice, to ensure compatibility when buying other objects or spare parts, to simply have a full picture of one’s wealth (including liquidity and risk exposure), or to facilitate collateralization.

⁹⁹ This is made possible by the “data-portability requirement” of new data protection regulations.

¹⁰⁰ For example, one may want to lend/share their parking on weekdays because it is never used between 8am and 6pm.

¹⁰¹ For example, to facilitate the lending/sharing of infrequently used objects (e.g. drilling machine, lawnmower, circular saw, party benches, ski equipment, standup paddle, ladder) through a digital inventory, or to facilitate the lending/sharing of possessions within one’s neighborhood or local community.

¹⁰² The start-up Golem aims to do so by enabling participants to issue a usage-right token on their unused computing power and then sell it. Although this start-up operates on the Ethereum blockchain (i.e. a permissionless distributed ledger), it could also be run on a centralized DB.

¹⁰³ For instance, rights to a certain amount of kWh per year from a solar power field or a wind farm.

¹⁰⁴ The start-up NYIAX (launched in 2016) allows issuing advertising rights as digitized assets. It partners with Nasdaq to operate a secondary market.

been rising ever since. Predictive maintenance and software updates have significantly reduced operational costs (by reducing down-time and by allowing almost continuous updates).

Rights to connected devices are stored in digital databases. Ownership of and access rights to connected devices are being digitally stored in databases (i.e. “digital representation of rights”) to which these devices have reading rights allowing them to check the rights of a given person.

Laws and Regulations

Governments have set up legal/regulatory frameworks that are technology-neutral. Governments have actively clarified/updated laws and regulations so as to make them technology neutral – with the goal of leveling the playing field between incumbents and new technology-based companies.

Governments have been concerned with information availability/transparency, market efficiency, anti-competitive practices, systemic risk and jurisdictional authority. Governments have tirelessly pursued efficient price formation in markets through the rapid and complete dissemination of information. They have generally viewed FMI providers as critical national infrastructure. They have furthermore intervened in the free market due to anti-competition concerns, systemic-risk concerns (too-big-to-fail), and out of a desire to have jurisdiction over players that are seen as systemically relevant for their domestic market.

Governments have significantly increased the protection of data subjects and have thus substantially raised compliance costs of data businesses. Governments have, most notably, specified that data ownership lies with the data subjects and enacted laws/regulations requiring data businesses to obtain consent from data subjects for any type of data processing (referred to as an “opt-in regime”), to provide their users with the right to a digital copy of their own data (sometimes referred to as “data portability”), to erase their users’ data upon request (referred to as the “right to be forgotten”), and to give users the choice. The EU was a pioneer in this regard with its “General Data Protection Regulation” (EU-GDPR), which already entered into force in 2018.

Non-Listed Investment Classes and Open-Issuing Marketplaces Become Dominant – Full Disintermediation



Description of visualization on page 58

Likelihood of occurrence: medium

Brief description: The primary market has been disrupted. Specifically, **listed financial products have been disrupted** because many **investors were over-served in terms of protection** (i.e. listing requirements) and therefore underserved in terms of choice. Many investors have stopped viewing “not being listed” (i.e. the “non-fulfilment of listing requirements”) as an exclusion criterion. They either have not taken into account whether a product would fulfil the listing requirements

altogether (e.g. when investing in young/early-stage firms), or have taken into account whether a financial product would fulfil a subset of the listing requirements during their investment portfolio allocation.

Listing venues have been disrupted from below by open-issuing marketplaces which allow the issuing of any type of non-listed financial products. Indeed, over time an ecosystem of reputable/trusted third parties offering rating services for these non-listed financial products (investors could filter along the various rating

types) developed around these open-issuing marketplaces – including a rating category “would fulfill listing requirements” – which pulled the minority of investors who continue to view “listing” as an indicator of quality onto open-issuing marketplaces as well. **Non-listed financial products have therefore become the most popular investment class.**

Closed issuing venues suffered the same fate (as listing venues) since they overserved investors in terms of protections and underserved them in terms of choice to an even greater extent. **All firms and individuals have therefore shifted to issuing all their financial products on open-issuing marketplaces as non-listed financial products.**

Primary markets (issuing venues) and secondary markets (trading facilities) have shifted onto **digital platforms offering direct access/connectivity to issuers and investors** which has **strongly disrupted (disintermediated) traditional broker/middleman functions for any type of financial product** (e.g. equity, bonds, loans, insurance, structured products). The services previously offered by these intermediaries have been offered by third parties via these platforms (e.g. issuer rating, underwriting, book-building, advisory, market-making).

Permissionless distributed ledgers have not become dominant, but they have left a permanent mark in financial services. Although crypto issuing venues, initial coin offerings (ICOs), and crypto assets have not disrupted financial markets, the business model underlying virtually all crypto issuing venues in the mid-2010s – namely, an open-issuing marketplace – has become dominant.

Strategic implications: Winning incumbent FMI providers have been **first-movers** in operating an **open-issuing marketplace (primary market)** which allows the **issuing of non-listed financial products** and which provides **direct access/connectivity to issuers and investors**. They have thus been willing to cannibalize their existing listing businesses. They have adopted a broad **ecosystem strategy (open innovation)** by adopting an **open platform approach** to build an ecosystem of third-party content/service providers around these platforms.

Winners have successfully provided investors **access to investment opportunities in young/early-stage firms** (one type of non-listed financial product) for example by adopting a lead-investor model on their open-issuing marketplaces.

Winners have also been first-movers in setting up a **trading facility (secondary market), CCP and custody services for non-listed financial products.**

Finally, winners have pro-actively engaged with governments to jointly develop an **appropriate legal framework** governing non-listed financial products and services based thereon.

Early-detection signals: Rising popularity of non-listed financial products with institutional investors; development of a liquid secondary market in non-listed financial assets; rising interest in investing in young/early-stage firm; decreased belief that listing acts as an indicator of quality; increased belief in value generation from private equity firms/funds as shareholders; steadily increasing capital supply (including “dry powder”) to private equity firms/funds; prolonged global economic downturn; deep global financial crisis; government push to render non-listed financial products an attractive investment class.

Issuers

The (indirect) costs to issuers of being “listed” have continuously increased. While the direct costs of “listing” and of “being listed” have sharply fallen,¹⁰⁵ the indirect costs have increased as companies’ main assets have dramatically shifted from “tangible assets” to “intangible assets”¹⁰⁶. Digital companies’ main assets have become its intellectual property (software), employees, and R&D activities. Disclosure requirements for listed firms of how they are using their capital are therefore quite problematic as this may reveal details of ideas, innovation focus areas, and business plans to rivals.¹⁰⁷

All firms and individuals have moved to issuing all of their financial products on open-issuing marketplaces as non-listed financial products. All firms and individuals have shifted to issuing all of their financial products (e.g. equity, bonds, loans insurance, structured products) on open-issuing marketplaces because of the costs associated with being listed and because non-listed financial products have become most popular with investors.¹⁰⁸

Investors

Non-listed investment classes have become dominant. Non-listed investment classes have experienced a rise in popularity since the start of the 21st century.¹⁰⁹ The drivers for this relentless rise in popularity were as follows: many new HNWIIs (who own a large portion of institutional investors’ capital) are tech entrepreneurs and digital natives, who are less risk-averse and more

tolerant of failures in new ways of doing things, access to information and analytical capabilities has become more widespread (perhaps in combination with reduced working hours), making non-listed products more transparent and therefore more accessible to non-specialized investors, a desire to gamble (“no risk no fun”) with part or entirety of their wealth, a sustained desire to invest in young/early-stage firms (see later) which are non-listed by nature, a sustained desire (e.g. by millennials) to invest sustainably, in authentic/traditional/local assets (which are typically small and hence non-listed),¹¹⁰ lawmakers/regulators have stepped in and created a balanced legal/regulatory environment (including regulatory oversight) for the issuing and trading of non-listed financial products, the investment-universe restrictions of some investors (e.g. in some places pension funds could only invest a certain percentage of their assets in non-listed asset classes, in some countries accredited-investor regulations restricted retail investors from investing in them) have been removed, and the eventual development of a liquid secondary market in non-listed financial products made these assets classes attractive to an even wider audience.

The most notable driver, however, was the decline of “listing” as an indicator of quality for investors, thus allowing issuers to bypass the costs of listing when issuing financial products. Many investors had started to view the various requirements necessary for a listing as uninformative¹¹¹ and/or counterproductive¹¹², and have preferred selecting a combination of criteria themselves depending

¹⁰⁵ See the text surrounding footnote 9.

¹⁰⁶ In 1975, CAPEX was on average 6 times higher than “R&D expenses” – since 2002, “R&D expenses” on average exceeded CAPEX every single year. See Craig Doidge, Kathleen M. Kahle, G. Andrew Karolyi, René M. Stulz, 2018, Eclipse of the Public Corporation or Eclipse of the Public Markets?, *Journal of Applied Corporate Finance* 30(1), 8–16.

¹⁰⁷ Craig Doidge, Kathleen M. Kahle, G. Andrew Karolyi, René M. Stulz, 2018, Eclipse of the Public Corporation or Eclipse of the Public Markets?, *Journal of Applied Corporate Finance* 30(1), 8–16.

¹⁰⁸ See “Investors” section on page 35.

¹⁰⁹ See footnote 19 for data about the rise between 2000 and mid-2010s, and see the text around that footnote for the drivers behind the rise during those years.

¹¹⁰ For example, they may want to invest in their home village’s small bakery, in their favorite restaurant, or in a traditional artisan they discovered during their holidays.

¹¹¹ Most notably, it has been argued that “financial reporting according to standard XYZ requirements” may provide little information about the value of companies in the digital age because they fail to capture the true growth drivers such as intangible assets (recall that R&D is expensed under international accounting standards distorting the view of the assets further), network effects, winner-takes-all/most markets, etc.; see Vijay Govindarajan, Shivaram Rajgopal, and Anup Srivastava, 2018, Why Financial Statements Don’t Work for Digital Companies, *Harvard Business Review* (26 February 2018). Furthermore, digitalization may allow real-time monitoring of growth drivers (as opposed to periodic “financial statements”); for example, the number of purchases from a seller on a digital marketplace, the number of active users and retention rates on a digital platform, the number of customers in a taxi, or the number of cars going in and out of a company’s parking lot (e.g. via pattern recognition algorithms of satellite images). Examples like the Enron scandal have also spread doubt about the informational content of “financial statements”.

¹¹² It has, for example, been argued that “governance requirements” hinder entrepreneurialism and therefore growth/innovation. For instance, placing excessive weight on board independence may come at the cost of the board’s ability to create value because the best possible candidates could potentially be disqualified (especially in niche markets where such a candidate is likely to come from the company’s own ranks) and because outsiders may be less familiar with the critical insights of the business leading to high-level rather than in-depth strategy discussions. See Steffen Meister, Richard Palkhiwala, 2018, Governance Correctness: How public markets have lost entrepreneurial ground to private equity, *Partners Group White Paper*.

on the type of company and sector of activity. Widely-used criteria include: “financial reporting according to standard XYZ”, “due diligence”, “audited”, “credit rating”, “regular reporting”, “ESG standard”, “corporate governance”, “research publications”, “shareholding disclosure”, “management-transaction disclosure”, “ad hoc publicity”, “fulfillment of listing criteria”, “contract-terms analysis and related risks”, “crowd-based quality rating of products/services”¹¹³.

A substantial increase in the popularity of private equity firms/funds (which typically tend to be non-listed entities) could further drive the popularization of non-listed investment classes. The 2010s have experienced a substantial increase in private equity firms/funds taking listed companies private by acquiring all of their listed equity,¹¹⁴ in companies deciding to stay non-listed even as they mature by issuing their equity only to private-equity firms/funds, and in private equity firms/funds selling entire non-listed companies between one another (i.e. “listing” is no longer the most popular “exit option” for these firms/funds).¹¹⁵

Finally, a prolonged global economic downturn or another deep global financial crisis would further strengthen the case for non-listed investment classes becoming dominant. Indeed, in such an environment, investors would have to continue looking for yield beyond traditional investment classes, and borrowers would have to continue looking beyond traditional borrowing channels (i.e. beyond banks) for external financing. As time passes, they would become increasingly comfortable and familiar with non-listed investment classes.

Start-ups and early-stage firms (non-listed investment classes) have become popular with non-specialized investors. Early-stage firms (series B and onwards) have become popular with investors well beyond specialized investment firms (such as venture capital funds and specialized private equity funds). This development was

driven by a fear of missing out as corporations have achieved CHF 1b valuations much faster than ever before¹¹⁶ so that only focusing on mature firms would prevent one from participating in these gains, and by portfolio diversification benefiting from holding different maturities.

Start-ups have been somewhat less popular with non-specialized firms than early-stage firms because of the inherent variability of start-ups’ business plans making financial assessments more difficult and requiring non-standard evaluation methods (e.g. NPV will most likely not suffice). Indeed, before the scaling-up phase, young ventures are very likely to pivot as they go through multiple feedback loops (fail fast) while developing a first “proof of concept” and “minimum viable product”. Nonetheless, many investors have been willing to invest in start-ups for the knowledge that a certain product/service would not have existed without their help.¹¹⁷

Finally, a potential reduction in labor participation (due to automation), perhaps in combination with a universal basic income, would further strengthen the case for the wide popularity of young-firm investments. Indeed, these developments would leave many people with lots of time but little money to invest. They are thus likely to focus on young/early-stage firms because the potential upside is highest and because they have the time to thoroughly understand their businesses.

Issuing Venues (Primary Market)

The issuing of financial products has shifted onto digital platforms (“electronification”) offering direct access. The same rationale as in the most-likely scenario applies.¹¹⁸

Open issuing marketplaces¹¹⁹ have become the dominant issuing venues. Open issuing marketplaces rose in popularity due to the rise in popularity of non-listed financial products (see above).¹²⁰ Eventually, they even displaced

¹¹³ Similar to crowd-ratings of hotels and restaurants found on TripAdvisor.

¹¹⁴ Please note that private equity firms/funds may also take single business units/divisions from listed companies private (rather than the entire company).

¹¹⁵ For data, see e.g. The Economist, 2018, Barbarians grow up: As private-equity firms mature, the way they buy and sell is changing (26 July 2018).

¹¹⁶ For numbers, see John PR Dwyer, The Merging of Public and Private Equity Market (Celent / Oliver Wyman), page 13.

¹¹⁷ Probably driven by an entrepreneurship preference and/or an impact-investment preference.

¹¹⁸ See “Issuing venues (primary market)” section on page 19.

¹¹⁹ For the definition, see Exhibit 1: Open issuing marketplace on page 38.

¹²⁰ Institutional investors were already investing via open-issuing marketplaces in the 2010s; see footnote 19.

listing venues because reputable/trusted third-parties have established themselves in these marketplaces over time (see also below) – and have most notably assessed non-listed financial products according to whether they “would fulfill listing requirements”. Notable early movers in the debt-based space were Loanbox and Firstwire.

Open issuing marketplaces have disrupted closed issuing venues. Closed issuing venues were equally disrupted because operators/owners of such closed issuing venues can act as third-party recommenders¹²¹ in open-issuing marketplaces and because investors can filter financial products according to which products these third-parties recommend.

It is not clear whether private-issuing venues (private markets) will substantially increase their market share at the expense of public-issuing venues (public markets). Private-issuing venues, on which financial products are not issued to the broad public but only to a select set of investors (e.g. institutional investors, HNWIs) may increase in popularity with issuers and investors. Most notably, this may happen if private equity firms/funds substantially increase in popularity¹²² and decide to issue their own shares only privately.

This could prevent the wider public from owning a stake in the economic engines of growth and therefore restrict it from participating in capital gains. This would further intensify inequality as only the wealthy would enjoy these gains.¹²³

An open platform approach (open innovation) has become dominant. An ecosystem strategy allowing third parties to offer additional services in the marketplace (the marketplace only checks and guarantees the identities of the issuers and third-parties) has become the dominant operating model for open-issuing marketplaces.

Third parties have for example come in the form of monitoring, recommendation, rating, and due diligence agencies which evaluate issuers and their financial

products based on various dimensions. Investors can then filter the financial products according to the dimensions that interest them.

The lead investor model has become popular for young/early-stage-firm investments. As non-specialized investors have sought to invest in young/early-stage firms (i.e. start-ups and early-stage firms), open-issuing marketplaces have extended their business from the issuing of financial products by mature firms to the issuing of financial products by young/early-stage firms.

A hybrid investment model in which specialized investment firms invest alongside non-specialized investors has established itself because of the specific know-how needed for investing in young/early-stage firms and because young/early-stage firms’ success depends on much more than simply financial support (know-how, mentorship, network etc.). One popular hybrid model is when specialized investment firms invest first (“lead investor model”) to provide reassurance that experienced professionals have carried out the necessary due diligence since they have their own “skin in the game”. They are then remunerated by other investors piggy-backing on their lead investments. AngelList and Syndicate Room were pioneers in applying this kind of model.

Trading Facilities (Secondary Market)

Exchanges have disappeared, replaced by trading facilities for non-listed investment products. Open-issuing marketplaces’ disruption of the issuing business has led to the downstream disappearance of exchanges (“regulated markets”) as listed products have disappeared. A notable pioneer for running a secondary market for non-listed (equity-type) financial products was Equidate.¹²⁴

FMI Providers

Custodians (including CSDs) and CCPs have refocused their business on non-listed financial products. The rise in the popularity of non-listed investment classes has forced all FMI providers to pivot away from listed investment classes.

¹²¹ Remember that operators/owners of closed issuing venues act as their gatekeepers.

¹²² The 2010s have seen a substantial increase in the popularity of private equity firms/funds; see footnote 115 and the text preceding it.

¹²³ Such concerns have, for instance, been expressed by Jay Clayton, the Securities and Exchange Commission (SEC) Chair, “to the extent companies are eschewing our public markets, the vast majority of Main Street investors will be unable to participate in their growth. The potential lasting effects of such an outcome to the economy and society are, in two words, not good.”; see Jay Clayton, 2017, Remarks at the Economic Club of New York (12 July 2017). Available at: SEC.

¹²⁴ Back in 2014, this secondary market was referred to as a “private secondary market” since non-listed financial products were still referred to as “private market”.

Open-issuing Marketplaces: Definition

We introduce the term “open-issuing marketplaces”.*

| Open-issuing Marketplace | | | |
|---|---|--|--|
| An online digital platform on which non-listed financial products can be issued and which facilitates the raising of capital and investment | | | |
| Capital Raising | | | Other Financial Products |
| Equity-based products | Debt-based products | Reward-based | |
| <ul style="list-style-type: none"> – Ownership share | <ul style="list-style-type: none"> – Consumer loans – Business loans – Real estate loans/mortgages – Student loans – Municipal loans – Etc. | <ul style="list-style-type: none"> – Share of future revenue – Voting rights – Discount on future services – Free access to future services – Priority access to future services** – Acknowledgment in future service*** – Etc. | <ul style="list-style-type: none"> – Derivatives – Futures/forwards – Insurance products – Options – Structured products – Swaps – Account-receivable financing (factoring) – Etc. |

* We prefer this terminology to “crowd capital raising” because it makes it clearer that the crowd is not the only one raising capital. “Crowd capital raising” was coined in UBS, 2017, Crowd Capital Raising, UBS Group Innovation White Paper (June 2017).

** The most famous examples are perhaps Tesla's pre-order campaigns.

*** Musicians may offer to mention capital providers in their next album's release notes.

Open-issuing marketplaces cover what is usually referred to as “P2P platforms”, “P2P lending sites”, “crowdfunding” and “crowd capital raising platforms” – these labels are, however, no longer appropriate because these platforms have been used beyond the crowd: SMEs have relied on them as a source of capital, and institutional investors have relied on them for investing. Open-issuing marketplaces also cover what is referred to as “marketplace lending” and “online capital marketplaces” – these labels are, however, too restrictive because they suggest that only debt-based products or capital-raising products are being issued.

“Open” refers to them being open with respect to who can issue a (non-listed) financial product and what can be issued – namely, they don't impose any restrictions in this regard. They can be thought of as the Amazon, Airbnb, eBay, or Uber of the securities value chain.

NB: The crypto issuing venues of the mid-2010s almost exclusively exhibited this business model by allowing anyone to issue any type of crypto asset.

Sustained Legally Unlevel Playing Fields for Incumbents

Likelihood of occurrence: low-medium

Brief description: New players, exhibiting new business models and/or relying on new technologies, have been able to establish themselves thanks to legally unlevel playing fields tilting (deliberately or by omission) in their favor. By the time lawmakers levelled the playing field, these new players had gained significant market share and/or had grown to such an extent as to benefit from significant economies of scale.

Strategic implications: Incumbent winners have **extensively monitored/scouted** the world (not limited themselves to their historical industry) for possibly-disruptive new technologies, business model innovations, and loopholes in the legal/regulatory framework. They have

experimented with new technologies and new business models and have been willing to enter into **strategic partnerships** with new players (e.g. joint ventures, minority equity positions). Incumbent winners have successfully **lobbied** their governments for equal treatment (including technology-neutral laws/regulations).

Early-detection signals: Excessive free market (laissez-faire) rhetoric driven by a fear that government intervention will suffocate innovation; strong lobbying by technology companies; widespread view of technology companies as saviors; loopholes and gray areas in the existing legal/regulatory framework for new technologies and/or new business models.

Setting the Stage

New players have benefited from a more favorable legal/regulatory environment. New business models (e.g. made possible by new technologies) and existing business models combined with new technologies have benefited from more favorable laws/regulations. This unequal treatment has most notably resulted in lower compliance costs for new players. Governments have created an unlevel playing field either through deliberate action or by failing to act quickly enough. The latter is especially problematic in winners-take-it-all markets because new players would be able to grow large enough to benefit from (and become protected by) substantial economies of scale and/or network effects. More generally, failing to act quickly is problematic because new players would be able to gain significant market share – by the time regulation finally comes around, the market structure may be irreversibly changed as many incumbent players may have disappeared.

For example, Uber's drivers have not been classified as employees (but instead as "independent contractors"), which has allowed Uber to avoid costs related among other things to unemployment/health insurance, or the minimum wage. Airbnb has not been classified as a hotel which has allowed Airbnb to avoid costs relating to rental and hotel tax laws.

The legal gray area that surrounded crypto assets (and therefore initial coin offerings, ICOs) had given them an advantage in terms of compliance costs and requirements. This "regulator arbitrage" was arguably a key driver of their rise in popularity among issuers during the mid-2010s. Since then regulators levelled the playing field between crypto and non-crypto-based financial products by specifying which types of crypto assets qualify as securities and virtual currencies.

Extreme Fear of Overly Powerful Digital Platform Companies

Likelihood of occurrence: low-medium

Brief description: Governments have focused on curbing the power of large digital platform companies (most notably, of global tech companies) and users have actively taken measures to prevent one digital company from holding too much data on themselves (data diversification). Digital platforms have at times been broken up (separating the platform/matchmaking business from the rest), their size limited, classified as “public utilities”, and their profits restricted. They have been required to allow third-party access to their data (e.g. usage/matchmaking data) via APIs if users have consented to such access, and have been required to make their data publicly available in anonymized form. Governments have mandated openness. They have broken up vertical silos to ensure competition at every step in the supply/value chain. They have required that digital platforms take the form of open digital platforms (open marketplaces), upon which third parties can freely and fairly compete in offering their services. Business pundits have propagated **“The Platform trap – Content is king”**. The profitability of platform businesses (especially their data business) has fallen throughout the securities value chain (issuing venues, trading facilities, CCPs, CSDs). Global tech companies have been prohibited from entering the securities ecosystem.

Strategic implications: Winning platform providers have **moved quickly to monetize their platform-based data** while it is still proprietary by establishing efficient data management throughout their organizations (i.e. absence of silos) and by analyzing their data in real time to uncover/predict unmet customer needs (data mining) and offer tailored solutions to the needs identified in this way. They have also undertaken proactive measures to prevent excessive laws/regulations by taking proactive measures **preventing any suspicions of anti-competitive behavior** (e.g. price reductions and data availability so as to avoid any presumption of monopolistic rents, clear equal treatment of a platform’s own value-added services and those of third parties), and by **constructively engaging with governments** to provide them with a clear/balanced picture of the situation and potential unintended consequences of excessive laws/

regulations (e.g. their IT infrastructure costs, data collection costs, and innovation spending that must all be financed).

More specifically, winner platform operators have prepared themselves for a possible separation from their “platform businesses” and/or for a possible loss of unique proprietary data from their “platform businesses” (loss of trading data as a unique asset) by focusing on developing high-value **unique content around (their own) platforms** (i.e. by focusing on developing unique value-added services). They have adopted an **open innovation approach** and been willing to **move very fast** (usually involving inorganic means) to acquire/develop unique content. **Uniqueness** around platforms may, for instance, be achieved by featuring the star analyst in a particular asset class, by exhibiting deep local/regional expertise, by exhibiting a unique data set, or by catering to a specific group of investors. In so doing, winning incumbents have most notably extended into becoming **financial information providers and rating agencies**.

Early detection signals: Increased discontentment of population with global tech companies; repeated findings of anti-competitive practices and/or rising perception of anti-social behavior on the part of global tech companies; increased political calls for stronger regulation of global tech companies specifically and of digital platform companies generally.

This scenario is a more extreme version of a scenario in which trading fees have gone down to zero. Although in this latter scenario the profitability of the platform business would suffer, the platform business would still be able to monetize its trading data (i.e. the profits from data business are not zero). The strategic implications are, however, the same: monetizing platform-based data and developing unique content around platforms.

Setting the Stage

Governments have become convinced of widespread anti-competitive practices and power abuses by digital platform companies. Governments have been busy updating competition laws driven by a fear of anti-competitive practices. Their actions were most importantly driven by a widespread belief that global tech companies – which are the largest and most popular digital platform companies – heavily engage in anti-competitive practices and by a fear of their growing power. Once their practices became known, widespread anger and fear led to the legal/regulatory pendulum swinging to the opposite extreme, and excessive laws and regulations.

This “tech-lash” has spilled over into other industries, leading to increased laws/regulations for digital platform companies more generally.

Furthermore, the “one-percent movement” and too-big-to-fail rationales have also played a significant role in bringing about these regulations.

Vertical silos have been broken up by bringing in competition at every step in the supply/value chain, typically through mandatory APIs. Governments have required that customers have free choice of supplier at every stage in the supply chain and thus broken up vertical silos by allowing free competition at every stage in the supply chain. Namely, they have mandated openness. Notable early regulations in this regard include the European Union’s “Payment Services Directive 2” (EU-PSD2), requiring banks to give third parties access to customer data if the customer consents) and the “Markets in Financial Instruments Directive II” (EU-MiFID II), requiring trading facilities to offer free choice of clearing venue to the trading parties, which both entered into force in 2018. This was most notably implemented by requiring companies to use application programming interfaces (APIs) as linkages between the IT infrastructure underlying the various steps in the supply/value chain.

Governments have required digital platforms to be operated as open platforms. Governments have required platform operators to offer third-party service providers access to their platform. Namely, they have mandated openness.

Platforms’ data sets have been required to be made publicly available. Governments have adopted a rationale similar to intellectual property rights in the data sphere. They have required that data sets (such as usage/matchmaking data) collected by platform operators be made public in anonymized form within some pre-defined time period after their original collection or at the time of their deletion – other countries have required immediate public availability while giving exclusivity of commercial (though not R&D) usage for a pre-defined time period to the collecting party. Governments have set up a publicly accessible database into which the data ought to be transferred in anonymized form. Companies no longer have a competitive advantage from their “unique” data sets alone.

Platform companies have had caps imposed on their size and have at times been broken up. Governments have sometimes restricted the size of platform companies, most prominently by forbidding M&As that would lead to excessive concentration.

Furthermore, governments have at times broken up large platform companies by separating the “platform business unit” from the “platform services business units”.

Large platform businesses have been classified as public utilities and faced price controls. Governments have classified many platform companies as public utilities by arguing that they amount to natural monopolies (due to economies of scale/scope and network effects), offer services that are vital for consumers, and that consumers do not really have a choice of not using their services. Public utility regulation has led to price controls and upper limits for the profits of these companies. The most notable early proponents for this approach included Steve Bannon in the US in 2017.

People have engaged in data diversification. People have been wary of excessive data concentration with one digital company. Specifically, they have consciously relied on different providers for different aspects of their lives – for example, they have focused on keeping their financial data, health data, ownership data, social media data, GPS data, e-mail data, and internet search data separate.

FMI Providers

Competition has increased for trading facilities, CCPs, and end custodians (e.g, CSDs), leading to reduced profitability. End custodians have been required to provide access to their data (via a standardized API) to issuing venues, trading facilities, and CCPs. Issuing venues have been required to provide free choice of end custodian (e.g. CSD) to issuers. Trading facilities have been required to provide free choice of CCP to the trading participants. This increased competition has led to a reduction in these players' profitability.

Platform providers have in some instances been carved out and qualified as public utilities. Some governments have separated the "platform businesses" (issuing venues, trading facilities, CCPs, CSDs) of FMI providers and classified them as public utilities.

Profits from data businesses have fallen to zero. Governments have required FMI providers to make their pre-trade and post-trade data publicly available in real time.

Global tech companies have been prohibited from entering the securities ecosystem and have therefore been prevented from dominating the retail-focused businesses. Governments have prevented global tech companies from entering the securities value chain. This has, most notably, prevented global tech companies from dominating the retail space of the securities value chain. Specifically, global tech companies have not become dominant in retail investor-focused open-issuing marketplaces (mostly popular for personal interest projects) and in retail investor-focused trading facilities.

Extreme Consolidation of FMI Providers

Likelihood of occurrence: low-medium

Short description: Hindered by little governmental opposition, two outcomes are possible: FMI providers have experienced extreme market consolidation yielding **global one-stop shops**, with a small number of global platforms emerging for every type of FMI provider (issuing venue, trading facility, CCP, and CSD). Specialized services are offered by niche third parties. Or FMI providers have experienced extreme market consolidation by financial instrument type yielding **global specialized shops**, with a single global platform emerging for every asset class. Governments have, however, required that these digital platforms take the form of open digital platforms (open marketplaces) upon which third parties can freely and fairly compete in offering their services.

Strategic implications: Winning platform companies have been much more innovative than the rest – they have exhibited a substantial **innovation budget**, have ensured **the availability of resources**, have fully embraced **open innovation**, have aimed to become **eco-system orchestrators** by adopting an **open platform approach**, have mined their data to identify unmet customer needs (**data mining**), have exhibited an **agile approach** not afraid of **pivoting** often and substantially (experimentation and fail-fast culture), have never compromised on the product (**client-centricity**), and have beaten the rest in **time to market** (faster at bringing new features/functionalities or access to new asset classes to the market by having an operating model allowing agility). Winners have been **first movers** in becoming a **one-stop shop**. They have actively scouted and approached potential acquisition targets, and have been willing to engage in hostile takeovers or in strategic mergers/partnerships because a solely organic approach has most often been insufficient (**inorganic growth**). At the same time, winners have always kept an eye on **cost-effectiveness** – they have been strongly committed to **end-to-end process optimization** and they have been quick to adopt at scale advances in **automation, AI, and cloud computing**.

Platform companies may instead focus on positioning themselves as the winning third-party service providers around the winning platform(s) by adopting the same mindset, but concentrating their resources on developing **unique content around these platforms** (for more details, see the strategic implications of the “Extreme fear of overly powerful digital platform companies” scenario on page 40).

Early-detection signals: No fear of overly powerful digital platform companies; increased market consolidation of FMI providers; reduced national-security concerns; reduced political calls for jurisdictional authority over key FMI providers by governments; reduced protectionism throughout the world; legal/regulatory harmonization across jurisdictions; big tech companies gaining traction with institutional investors; extreme one-stop shop preference on the part of (institutional) investors; cloud infrastructure providers’ issuing venues gain traction; cloud infrastructure providers provide institutional investor trading gateways; widespread usage of a communication platform among investors (only if investors are predominantly made up of people rather than machines/algorithms in a particular financial instrument class).

Setting the Stage

Governments have generally not been wary of extreme market concentration. Governments and regulators have generally not exhibited anti-competition concerns, systemic risk concerns, or a desire to have jurisdiction over players that may be systemically relevant for their domestic market. As such, they have generally not actively prevented extreme market consolidation/concentration.

Governments have required dominant players to operate as open digital platforms. Although governments have not been wary of excessive concentration at the platform level, they have nonetheless required platform operators to offer third-party service providers access to their platform. Namely, they have mandated openness.

Possible Paths (Non-exhaustive)

The market has consolidated due to strong pressure on margins in conjunction with platform economics. Platform businesses tend to exhibit winners-take-it-all dynamics: they exhibit economies of scale (e.g. operational processes, risk monitoring, risk management processes, legal/regulatory compliance), economies of scope (e.g. margin/collateral reduction due to cross-marginalization across a higher number of different financial products), and network effects (e.g. reduced spread and increased matching through higher liquidity, reduced risk through wider pooling). In the face of increasing margin pressure, the markets for issuing venues, trading facilities, CCPs, and end custodians (e.g. CSDs) therefore have strong underlying forces pushing towards consolidation.

Big tech companies have become the dominant issuing venues. Our most-likely scenario holds that global tech companies have set up issuing venues to support their cloud infrastructure businesses.¹²⁵ Their issuing venues may become dominant and they may also start operating a trading facility.

Big tech companies have become the dominant institutional investor trading gateways. Although global tech companies do not have a data advantage with institutional investors as they have with retail clients, institutional investors have moved their entire IT onto cloud infrastructure operated by these global tech companies (investors started by taking advantage of the clouds' big data/advanced analytics platforms, and ultimately moved their entire IT after becoming comfortable using them). Global tech companies may become the dominant brokers in the institutional investor space (including algorithmic traders) by providing a platform that is directly integrated into their cloud services and exhibits the same functionalities as, for instance, BlackRock's institutional investor platform "Aladdin". Ultimately, they may themselves become trading facilities (to internally match orders).

Extreme consolidation of trading desks due to widespread trading desk outsourcing. Margin-pressured investors (including intermediaries such as banks) have outsourced their (buy-side) trading desks. This may yield extreme consolidation in the trading desk space – and ultimately to the trading desk operators becoming issuing venues and trading facilities (to internally match orders).

Automated trading has not become dominant and a communication platform has become dominant. Insofar as trade order decisions still widely involve humans in some class of financial instruments, a communication platform with EMS/OMS capabilities may become the dominant means of communication among these investors – and ultimately become an issuing venue and a trading facility (to internally match orders).

¹²⁵ See "Big/global tech companies" section on page 25.

Low Attractiveness of Switzerland

Likelihood of occurrence: low (but high impact)

Short description: Widespread protectionism, an unfriendly domestic business environment, a lack of domestic venture capital, and an eastward shift of economic growth have led to a substantial drop in issuing and in trading volume (due to drop in AuM) in Switzerland. This has led to a substantial reduction in volume throughout the Swiss securities value chain.

Strategic implications: Winners in small countries/economies have successfully **lobbied** their governments for a business-friendly local environment and for good relationships with key foreign countries/economies, or **relocated** to countries/economies exhibiting these characteristics.

Early detection signals: Rising protectionism; rising discontent of population with free cross-border economic flows; rising security concerns of foreign investments; increasing political calls for protectionism; increasing non-business-friendly laws/regulations in Switzerland; depletion of assets under management in western countries generally, and Switzerland specifically.

Even though this scenario refers specifically to Switzerland, its relevance goes beyond: it applies more generally to small and/or western economies, and it applies to a possible future in which supranational frameworks (such as the EU) have disappeared and countries have become the main international actors again.

Low Attractiveness as a Place for Business

Protectionism has risen around the world and made smaller countries/economies less attractive. Events such as Brexit or the levying of ever more import tariffs in the US in 2018 were symptoms of a deeper anti-globalization sentiment in the population. National security concerns over foreign investments and foreign takeovers have become widespread. An implosion of the EU may occur.

Domestic protectionist policies have restricted the free movement of persons, restricting the inflow of talent and leading other countries to counter with protectionist measures of their own. Foreign protectionist policies have dried up the cross-border inflow of investments into Switzerland and restricted market access for Swiss products/services.

Non-business-friendly regulations have spread in Switzerland. A constant increase in laws and regulations has suffocated new ventures through innovation-unfriendly rules and through increasing compliance costs. A lack of investment in education has also dried up the local supply of talent.

Tax harmonization at the global level has eliminated Switzerland's tax advantage and new laws imposing worldwide liability on Swiss companies have, among other things, reduced the incentive for MNEs to establish themselves (their headquarters) in Switzerland.

Switzerland has lacked a sustainable supply of capital for investment in young/early-stage firms. A lack of domestic venture capital for Series A and onward (usually requiring a couple of million CHF) financing has forced local start-ups to leave Switzerland and establish themselves abroad as venture funds, which have preferred their investments to be incorporated in their own country.

Low Attractiveness as a Financial Center

Protectionism has risen around the world and led to a reduction in AuM in smaller countries/economies.

Rising protectionism (capital controls) has restricted cross-border investment flows in both directions. It has restricted the access of domestic investors to foreign markets, and it has restricted the access of foreign investors to domestic markets.

Issuers

The low attractiveness as a place for business has reduced issuing in Switzerland. Local new ideas have mostly been pursued and turned into viable commercial undertakings abroad. The formation of Swiss commercial enterprises has become a rare sight, and so has the issuing of financial products in Switzerland.

Foreign ideas and firms have no longer viewed Switzerland as a more attractive place to pursue their commercial undertakings.

The lack of a sustainable supply of capital for investments in young/early-stage firms has also furthered the buying up of young/early-stage local firms by global tech companies.

The low attractiveness as a financial center has reduced issuing in Switzerland. Demand for capital (issuers) has followed the supply of capital (i.e. AuM) away from smaller countries/economies. Issuers have preferred to rely on issuing venues located in jurisdictions where the AuM are located.

FMI Providers

The reduction in issuing has adversely impacted all FMI providers in Switzerland. The reduction in issuing has reduced the volume throughout the Swiss securities value chain as Swiss companies have at best issued new financial products abroad, and at worst delisted in Switzerland to relist abroad.

Protectionism has adversely impacted trading and clearing volumes in Switzerland. Rising protectionism has reduced the flow of foreign trade orders being processed on Swiss trading facilities and Swiss CCPs by restricting cross-border investment flows.

Extreme Reduction of Digital Exposure

Likelihood of occurrence: low (but high impact)

Short description: It has become common knowledge that privacy cannot be guaranteed in the digital sphere because of the ephemeral nature of any cyber-security measure. AI-based automation/robots have repeatedly led to adverse outcomes. The abundance and extent of behavioral digital data has repeatedly been exploited to manipulate people into taking certain actions. Issuers and investors have both actively weighed the costs and benefits of digitalization, have significantly reduced their digital exposure, and have demanded that FMI providers reduce their digital exposure as well. Where people or corporations have kept a digital exposure, they have become very wary of providing any given company with too much data on themselves (data diversification), have generally relied on established/trusted brands rather than start-ups, and have required extensive cyber-security measures throughout the supply chain. Global tech companies have not been able to enter the securities value chain because of this data diversification preference. The digital representation of rights to real-world assets has only taken place very selectively.

Strategic implications: Winning FMI providers' cyber-security measures have included **human and analog elements** in the value chain, have added **monitoring by human beings** of other elements in the value chain, have **disconnected/isolated some systems from the internet entirely** (e.g. DBs containing personally-identifiable information), and have **selectively reduced their reliance on automation technologies**. They have been very thorough when selecting suppliers and (ecosystem) partners. Winners have become **thought leaders** and **early-adopters** in deploying these measures.

Early-detection signals: Massive increase in successful cyber-attacks; repeated high-profile data thefts, especially of highly-sensitive information; repeated undesirable decisions by AI; rising belief in the impossibility of digital privacy; repeated data-usage abuses by digital companies; digital exposure reduction in certain aspects of life; cyber-warfare; untrusted governments.

Setting the Stage

Cyber-attacks have become performed by increasingly sophisticated cyber-criminals. Nation states, companies, criminal syndicates and terrorist groups have all relied on, or themselves developed, increasingly sophisticated cyber-capabilities with the goal of destabilizing foreign governments/economies (cyber-warfare),¹²⁶ stealing IP/strategies (corporate espionage) and/or paralyzing competitors' businesses.¹²⁷

Either one has personally been hacked or one knows someone who has been hacked. Everybody (individuals, corporations, public utilities, governments) has been

hacked in one way or another, and if they haven't, they definitely know personally someone who has been hacked. Indeed, the explosion of connected devices (from one's fridge to one's pacemaker) and of online data storage has also created many possible points of entry for hackers.

Machine learning-based AI has repeatedly led to undesirable outcomes. Machine learning-based AI – especially those based on deep learning algorithms because of their black-box nature – have repeatedly taken decisions that were against the will of the person programming/training it.¹²⁸ The causes for such undesirable

¹²⁶ For instance through political election interference/ manipulation, through interruption/malfunction of critical infrastructure such as electricity, or through paralysis of a country's food supply (e.g. by attacking farmers' connected devices).

¹²⁷ For instance through denial of service (DoS) attacks, through corruption of DBs, or through corruption of automated processes (e.g. automatic toxicity test, or automated food bacteria test).

¹²⁸ "If a neural network managing an electric grid were told to save energy ... it could cause a blackout"; for more examples, see e.g. Wired, 2018, When Bots Teach Themselves To Cheat (8 August 2018). This could pose a new source of systemic risk; see e.g. WEF, 2018, The New Physics of Financial Services (August 2018), page 80 and 83.

outcomes could be found in corrupt/non-representative training data sets (in the case of unsupervised and supervised learning), in bugs in the mathematical environment used to train the algorithm, or in hackers corrupting an algorithm that has already been trained (e.g. by changing the algorithm's code itself, or by developing adversarial examples).

Privacy in the digital sphere has become impossible.

Hackers have been able to compromise and decrypt all digital data. Vulnerabilities in chips have repeatedly been exploited by cyber-criminals to steal private keys (used for data encryption/decryption).¹²⁹ Furthermore, if quantum computing has become reality, then it will not only have rendered all pre-quantum cryptography useless, but it may also have led to the decryption of every single (stored) message sent over the Internet since 1990.¹³⁰

It is widely understood that data which has been anonymized cannot really be expected to remain anonymized forever due to continuous advances in AI and due to the constant increase in additional data sources.

The trove of digital behavioral data has repeatedly been used to manipulate users. Digital data on users has made it possible to gain ever-deeper insights into their motivations and emotional buttons. These insights have repeatedly been exploited to manipulate users into taking certain actions – such as buying a product or voting for a certain president.¹³¹ Indeed, knowing people's deepest fears, prejudices or beliefs allows messages to be tailored by focusing the narrative and arguments to play on people's fears/desires, to build on their existing prejudices/beliefs, or to frame it in such a way as to elicit the greatest emotional connection.

Note: loss of trust in governments may also have led to a retreat from the digital world. Although a loss of trust in governments is likely to push people to rely on “decentralized systems”, it does not necessarily push them to rely on a “decentralized digital system” – people may indeed decide to retreat instead from the digital world.¹³²

Economy

People have reduced their digital exposure. The explosion of successful cyber-attacks has let people consciously weigh the costs/risks of going digital against its supposed benefits (flexibility/ease). The costs/risks most notably include loss of privacy,¹³³ identity theft, data theft (e.g. one's medical records), which may result in blackmailing and/or be used against us by hiring companies or insurance providers, location data (including of one's children), malfunctioning of one's medical implants (e.g. pacemakers), unavailability/malfunctioning of services/products (connected cars, possibly self-driving), or repeated abuses of data usage by digital companies.

As a result, people have decided what aspects of their lives they want to keep offline. This has especially had an adverse effect on the digital representation of rights to real-world assets.

People have engaged in data diversification. People have been wary of excessive data concentration because of the associated privacy risks in case of a data breach. For more details, please refer to the “Extreme fear of overly powerful digital platform companies” scenario.

Companies have taken systems offline and added analog as well as human elements back into processes. Traditional cyber-security measures have been no match for the increasing sophistication of cyber-crim-

¹²⁹ In the first half of 2018 alone, three such vulnerabilities in chips were discovered. These three (speculative-execution) attacks are known as Meltdown, Spectre and Foreshadow.

¹³⁰ Spies and policemen have reportedly been storing encrypted digital data since the early 2000s, patiently waiting for their encryption to become obsolete; see e.g. Economist, 2018, Future-proofing the internet: Prime Factors (20 October 2018).

¹³¹ Yuval Noah Harari, 2018, Why Technology Favors Tyranny, The Atlantic (October 2018), page 68, “we might have to deal with hordes of bots that know how to press our emotional buttons better than our mother does and that use this uncanny ability ... to try to sell us something—be it a car, a politician, or an entire ideology. The bots might identify our deepest fears, hatreds, and cravings and use them against us. We have already been given a foretaste of this in recent elections [US presidential elections in 2016] and referendums [UK vote on leaving the EU in 2016] across the world, when hackers learned how to manipulate individual voters by analyzing data about them and exploiting their prejudices.”

¹³² For a more extensive treatment, please refer to the “Untrusted governments” scenario on page 50.

¹³³ In 2014, over 400 million people worldwide reportedly already used software to browse the internet anonymously; see Global Web Index, 2014, White Paper: The Missing Billion (Global Web Index: London).

inals. Instead, cyber-security measures have taken the form of adding human and analog elements in the value chain (thus reducing automation), adding monitoring by human beings of other elements in the value chain, and disconnecting/isolating some systems from the internet entirely (such as those DBs containing personally identifiable information).¹³⁴

Companies have back-paddled on the automation of their processes. The rise of undesirable decisions by machine learning-based AI has led companies to reduce their reliance on automated processes – especially where deep-learning algorithms (i.e. black boxes) would be necessary.

Companies have requested the same measures from companies in their supply chain. Companies have selected partners in their supply chain based on their implementation of cyber-security measures. Companies have in general preferred working with established/trusted brands rather than start-ups.

FMI Providers

FMI providers have reduced their digital exposure. Issuers, investors, and regulators have demanded that FMI providers take appropriate cyber-security measures and reduce their digital exposure because FMIs make up a country's critical infrastructure.

¹³⁴ See for instance Andy Bochman, 2018, Internet Insecurity, in Andy Bochman (ed.), The End Of Cybersecurity, Harvard Business Review The Big Idea (May 2018), page 3, "Identify the functions whose failure would jeopardize your business, isolate them from the internet to the greatest extent possible, reduce their reliance on digital technologies to an absolute minimum, and backstop their monitoring and control with analog devices and trusted human beings."

Untrusted Governments

Likelihood of occurrence: low (but high impact)

Short description: People have lost trust in governments and in traditional institutions. This may lead people to overcome their potential trust issues with new fully-decentralized technologies (it is important to realize that these technologies do not get rid of the trust element) and engage/experiment with them.

For the sake of discussion, it is assumed that permissionless distributed ledgers have become the underlying IT infrastructure of interpersonal dealings in the digital sphere. Crypto currencies have replaced central bank-issued currencies and crypto assets have become the most popular investment class. While issuing venues, trading facilities, and CCPs have kept their relevance, CSDs have been disrupted – replaced by permissionless distributed ledgers as the end custodians. Crypto issuing venues, and therefore initial coin offerings (ICOs), have become the dominant issuing venues. And crypto trading facilities have become the dominant trading facilities.

Strategic implications: Winners were able to move quickly onto permissionless distributed ledgers when these became dominant because they committed budget and resources to internal ventures for **experimenting** with permissionless distributed ledgers by building proofs of concept and minimum viable products and they followed an **open innovation** approach through close collaboration with leading universities and early-moving fintech startups (e.g. joint ventures, minority equity positions). Winners have specifically devised a list of potential **acquisition targets** and exhibited the necessary **integration and M&A capabilities** to move quickly based on early detection signals since an organic approach would be insufficient (inorganic growth).

Winners have devised an **action plan for transferring** existing digital assets rapidly from their permissioned (central or distributed) ledgers onto permissionless distributed ledgers. Winners have (re)located themselves in **permissionless distributed ledger-friendly countries** – or have successfully **lobbied** their home governments for such laws and regulations.

Early detection signals: Increased mistrust in governments; improved efficiency (throughput) of permissionless distributed ledgers; reduced costs of permissionless distributed ledgers; increased trust in code; reduced errors in code.

No attempt is made here to fully elaborate on this future possible world – such a task would go far beyond the scope of this white paper. Instead, we elaborate on this scenario with the primary goal of allowing a discussion about permissionless distributed ledgers by showing the conditions under which we believe they may become dominant.

Setting the Stage

A large portion of the world population has lost trust in governments. The surveillance activities of the US governments revealed by Snowden were only the tip of the iceberg. Governments have at times successfully served tech companies for access to their user data (surveillance) and to block/restrict the circulation of certain information on their platforms (censorship). Multiple governments have restricted the freedom of speech and led campaigns against individual journalists. Also, rising inequality and a lack of improvement in the incomes of everyone except the top 10% has led to a widespread belief that governments are under the control of a small elite (puppet masters), yielding political decisions that are against the interest of the majority of the population.

People are likely to turn to decentralized systems for their interpersonal dealings. If most people have no trust in governments, then these people are likely to turn to decentralized systems for their interpersonal dealings because they are likely to have lost trust in centrally-run entities/systems more generally. Indeed, it is difficult to believe that a centrally-run entity/system could not be taken over by a government.

However, even if they do, it does not imply that they will turn to a “decentralized digital system” (see next paragraph) – they could just as well turn toward scarce physical objects (e.g. gold) as stores of value, or they could turn to physical communication (e.g. in person, letters) for communication. Also, even if they do turn to “decentralized digital systems”, they may only do so selectively (i.e. not for all their interpersonal dealings).¹³⁵

It is not clear whether people turning to decentralized systems will turn to “digital decentralized systems” (i.e. permissionless distributed ledgers). Contrary to what proponents generally proclaim, it is important to realize that these fully-decentralized technologies still involve an element of trust: they require putting trust in the code (i.e. absence of bugs),¹³⁶ in the consensus protocol (e.g. proof of work, proof of stake), in the actual decentralization of power/governance (especially in the long term),¹³⁷ in the functioning of a fully decentralized and anonymized (economic) system,¹³⁸ in the functioning of a fully open-source economic system,¹³⁹ in the benevolence and competence of programmers (not to take advantage of non-technical participants), in the system’s resilience against cyber-attacks, and in other people also willing to put their trust in the system. It is therefore far from clear that people would be willing to trust permissionless distributed ledgers¹⁴⁰.

It is furthermore unclear whether permissionless distributed ledgers will be able to overcome their scaling problems (number of transactions processed per second), and whether they will be able to reduce their energy consumption.

Finally, it is unclear whether an (authoritarian) government would be able to thwart the usage of a permissionless distributed ledger in its territory. Indeed, the government (or alliance between like-minded governments) may be able to overpower the consensus protocol, it may prevent access to the permissionless distributed ledger by ensuring that all internet communication travels via

¹³⁵ For a more extensive treatment of digital-exposure reduction, see the “Extreme reduction of digital exposure” scenario on page 47.

¹³⁶ It has been reported that 1000 lines of code exhibit on average 15–20 bugs.

¹³⁷ It has, for example, been reported that the Bitcoin blockchain has become quite centralized: 60% of the computing power in the Bitcoin blockchain resides in China. Recall that one controls the Bitcoin blockchain (since its consensus protocol is proof-of-work) if one owns 50% or more of the entire computing power in the system. For the data, see Bryan Ford, 2018, Clubs, Coins, and Crowds: Fairness and Decentralization in Blockchains and Cryptocurrencies, Presentation at IEEE Security & Privacy on the Blockchain (23 April 2018).

¹³⁸ Namely, trust that full decentralization of decision-making is possible and desirable. And if not, then trust that centralization/delegation of decision-making (e.g. minimal/libertarian government) is possible in an anonymized world wherein (economic) transactions may be kept secret/private.

¹³⁹ Any participant must be able to verify all the codes for the system to remain trustless, which requires that all code be open source. An incentive model may therefore be needed to reward those developing new code since anyone can readily copy the code once it is published in the system – such an incentive model must be built directly into the system’s core code base.

¹⁴⁰ Most notable examples are the “Bitcoin blockchain” and “Ethereum blockchain”.

its own servers, or it may hack individual participants of permissionless distributed ledgers to steal their digital belongings (“crypto assets”). Also, when a permissionless distributed ledger is used in combination with real-world assets (e.g. purchase of a non-digital good or service), the government has even more means at its disposal to undermine such transactions.

Permissionless Distributed Ledgers

For the sake of discussion, let us nevertheless assume in the following that people have turned to permissionless distributed ledgers as the backbone of their interpersonal dealings. Since we believe this scenario describes the only situation in which “permissionless distributed ledgers” could become dominant,¹⁴¹ we will assume for the sake of discussion that they have indeed become dominant.

Governments have not been able to prevent businesses from operating on the basis of these permissionless distributed ledgers. Governments have not been able to stop companies with distributed ledger-based activities from operating in their jurisdictions as companies have become increasingly adept at working in (physically) decentralized manners, relying on AR/VR and communication networks running themselves on the basis of these distributed ledgers.

Some governments have actively promoted themselves as “permissionless distributed ledger-friendly places for businesses”. Some governments have not tried to prevent companies from operating distributed ledger-related businesses and have instead promoted a legal/regulatory framework facilitating/supporting such commercial undertakings. These governments have labelled themselves as “permissionless distributed ledger-friendly places for businesses”.

Despite these governments’ historical record of not meddling, they have not been able to gain the trust of most people having lost trust in governments. Nonetheless, distributed ledger-friendly governments have attracted some companies, led by people who have not lost trust in all governments, offering services on the

basis of these distributed ledgers and creating employment and wealth in the region.

Economy

Crypto currencies have replaced central bank-issued currencies. Several crypto assets have established themselves as widely accepted means of payment (replacing central bank-issued currencies) and as the preferred store of value. These crypto assets have therefore come to be referred to as “crypto currencies”.

Commercial undertakings have taken the form of code running on the basis of permissionless distributed ledgers. Commercial enterprises and dealings have built on a permissionless distributed ledger as their underlying IT infrastructure and have therefore taken the form of code running on it (sometimes referred to as “smart contracts”).

Investors

Crypto assets have become the most popular asset class. Wary of government intervention, investors have developed a strong preference for financial products created/issued on top of these permissionless distributed ledgers.

FMI Providers

Issuing venues, trading facilities, and CCPs have remained relevant. The function of digital platforms for bringing together buyers and sellers (issuing venues, trading facilities)¹⁴² and for settlement risk management (CCP) have remained relevant. FMI providers have, however, rewritten their software as code running on the basis of permissionless distributed ledgers.

Crypto issuing venues (i.e. ICOs) and crypto trading facilities have become dominant. Since crypto assets have become the most popular asset class, crypto issuing venues and crypto trading facilities have become dominant.

Crypto trading facilities have mainly become run as decentralized systems. First-generation crypto asset trading facilities were centralized systems: parties who

¹⁴¹ We mention in the “Listed investment classes remain dominant amid disintermediation and explosion of digitized assets” scenario (page 29) that we understand the value proposition of “permissionless distributed ledgers” as “allowing a digital ledger in the absence of trusted parties”.

¹⁴² These two platforms solely serve a matchmaking function; i.e. for communicating sell and buy orders.

wanted to trade on them had to first transfer their crypto assets on the underlying permissionless distributed ledger to the operator of the trading facility (who then acted as their “custodian”). Many of these first generation trading facilities experienced high-profile breaches in which clients had their crypto assets stolen.¹⁴³

Due to these events and due to a general mistrust of centralized models, trading facilities have mostly taken the form of decentralized systems, which do not require a transfer of one’s crypto assets to the trading facility’s operator. Early examples of these second-generation crypto asset trading facility were IDEX and raidEX on the Ethereum blockchain.

Custodians¹⁴⁴

The role of CSD has disappeared. The role of CSD has disappeared because financial products are issued/registered directly on top of permissionless distributed ledgers. Permissionless distributed ledgers have therefore replaced CSDs as “end custodians”.

Custodians have remained relevant as intermediaries for some investors. Most people having lost trust in governments are also suspicious of intermediaries when it comes to value storage. Some investors, however, have continued to rely on them for custody services – typically by relying on a combination of distinct custodians (spreading the keys of their multi-sig accounts across them).

Custodians have established direct connections to various permissionless distributed ledgers and have therefore allowed investors to acquire crypto assets without themselves being directly connected to the permissionless distributed ledgers (custodians hold the crypto assets on behalf of these investors).

Custodians have offered offline custody services (vault service) for the private keys of investors which are directly connected to the various permissionless distributed ledgers.

¹⁴³ Mt. Gox was hacked and coins stolen valued at USD 370m in 2014. Coincheck was hacked and coins valued at USD 530m stolen in January 2018.

¹⁴⁴ The impact of permissionless distributed ledgers on the custody business is very similar to the impact of permissioned distributed ledgers. See the discussion in the “Listed investment classes remain dominant amid disintermediation and explosion of digitized assets” scenario on page 23.

3 Securities Value Chain Overview

| | Primary market | Secondary market | | Post-trading | |
|--|--|---|--|---|---|
| Issuers | Issuing | Trading | Clearing | Settlement | Custody |
| Potential financial product issuers | Connectivity to investors | Connectivity of traders/investors | Verification of trade-related information** | Delivery versus Payment (DVP) | Transfer of ownership |
| Rationales for issuing: <ul style="list-style-type: none"> – Capital raising – Hedging/risk management – Liquidity – Leveraging/speculation – Other Possibly: Young-firm ecosystems: <ul style="list-style-type: none"> – Incubators – Accelerators – Mentors – Lawyers – Tax specialists – Networking platforms – Corporate Venture Funds | Types of issuing venues: <ul style="list-style-type: none"> – Listing venues – Closed issuing venues – Open issuing marketplaces Possibly: Risk management:* <ul style="list-style-type: none"> – Issuer collateral management (collateralized securities) – Underwriting | Types of trading facilities: <ul style="list-style-type: none"> – Bilateral/multilateral – LIT/dark – Exchange/OTC – Analog/digital Data: <ul style="list-style-type: none"> – Order book – Trades – Indices Trade repository | Possibly: Risk management: <ul style="list-style-type: none"> – Central Counterparty (CCP) clearing house – Counterparty collateral management* | Possibly: Liquidity management (Cash and securities financing): */*** <ul style="list-style-type: none"> – Repurchase agreement – Securities lending – Collateral management (collateralized financing) | Electronic book-entry Execution of settlement End-custodians: <ul style="list-style-type: none"> – New issuing service – Vault services (Safekeeping of securities) – Possibly: Central Securities Depository (CSD) Custodians: <ul style="list-style-type: none"> – Bank custody (Agent custody bank) Asset servicing: <ul style="list-style-type: none"> – Corporate actions – Entitlements – Rights trading – Proxy voting Possibly: fund services |
| Operations/IT Infrastructure | | | | | |
| <ul style="list-style-type: none"> – Automation (robotic process automation, RPA; machine learning, ML; artificial intelligence, AI) – Cloud computing – Cyber-security (cyber-resilience) – Permissioned (central or distributed) ledger or permissionless distributed ledger | | | | | |

* These services are most notably provided by end custodians and custodians because securities (which are already in their custody) amount to permissible collateral.

** For both primary-market and secondary-market trades.

*** We mention liquidity management (securities financing) under settlement because this is the time when one must actually be in possession of the securities.

Definitions¹

Financial Products (or “financial instruments”) are contracts between two parties stipulating future cash-flow obligations between these two parties. Financial products most notably take the form of equity contracts, debt contracts, futures, swaps, derivative contracts, structured products, and insurance contracts.

Security is a legal classification of a financial product that may bring about certain legal obligations (e.g. prospectus requirement if it is to be issued/offered to the public or if it is to be admitted to trading on an exchange or MTF; license requirement for primary/secondary-market operators; license requirement for professional underwriters). The legal definition varies between jurisdictions. Generally speaking, a financial product qualifies as a security (i) if it is suitable for mass standardized trading (i.e. fungible) and (ii) if it represents a right to a claim against the issuer.

Issuers are the parties issuing financial products. Issuers most notably include private parties (e.g. a musician), non-financial corporations, financial corporations (banks, investment managers),² governments (e.g. treasury departments) or multilateral organizations (e.g. World Bank, International Monetary Fund).

We distinguish between three types of issuers: initiatives without a primarily commercial purpose, young/early-stage firms with a commercial purpose, and mature firms (includes SMEs, large firms, and MNEs – but also governments and multilateral organizations).

Investors (or “asset owners”, “traders”) are the parties buying the issued financial products, either on the primary market (issuing venues) or on the secondary market (trading facilities).

Retail investors are defined as individual persons buying financial products on their own behalf.

Institutional investors are defined as large institutions buying financial products on their own behalf or as parties buying financial products on behalf of pools of underlying clients. Institutional investors most notably include insurance companies, pension funds, banks, governments (e.g. sovereign wealth funds, central banks), trusts, private foundations, and asset managers (bespoke mandate or funds³).

Brokers are financial intermediaries which execute specific trading orders on behalf of investors. The broker therefore essentially connects two parties to a transaction. On the primary market, it connects issuers and investors (see “issuing venues” below), and on the secondary market, it connects investors and investors (see “trading facilities” below).

Brokers are typically investment banks, retail banks and online trading platforms. Brokers in the secondary market tend to also be custodians for these investors.

FMI Providers are “the platforms and plumbing of the securities ecosystem” and most notably include issuing venues, trading facilities, securities clearing houses, central counterparties (CCPs), custodians and central securities depositories (CSDs).

Issuing Venues are the places (typically a digital platform) where the financial product (whether a “security” or not) is first offered/sold by the issuer (with or without a prior subscription period); namely, they describe a financial product’s **primary market** where it is first put into circulation. Note: if additional financial products are issued at a later date, then this is referred to as a “secondary offering” and is still a primary-market activity. Each type of issuing venue may be characterized as a **public issuing venue** (accessible to any investor) or a **private issuing venue** (accessible only to a select set of investors, aka “private placement” in the capital-raising context).

¹ We have focused on those concepts that are key for understanding this white paper and whose definitions tend to vary between sources.

² Banks may for example issue financial products for asset liability management (to respond to changes in assets-liabilities profile or to market movements) or to strengthen their balance sheet (regulatory capital requirements). Investment managers (e.g. hedge funds) may for example issue financial products to generate leverage.

³ Funds most notably include mutual funds, hedge funds, private equity funds and venture capital funds.

The issuing process has traditionally involved a broker (e.g. investment bank) which provides advice on market conditions (demand-side analysis)⁴, creates the necessary

legal documents (e.g. prospectus), runs roadshows (marketing of the financial products to be issued), and acts as underwriter (risk management)⁵.

We distinguish between three types of issuing venues depending on the barriers faced by a potential issuers:

| Barriers | | |
|---|--|--|
| Open Issuing Marketplaces (non-listed financial products) ⁶ | Listing Venues (Exchanges) (listed financial products) | Closed Issuing Venues (non-listed financial products) |
| <ul style="list-style-type: none"> – AngelList – ASX issuing services – Lending Club – Prosper Marketplace – Seedrs – Loanbox (since 2018)⁷ – Vontobel's Cosmofunding – Etc. | <ul style="list-style-type: none"> – Australian Stock Exchange (ASX) – Deutsche Börse – London Stock Exchange – Nasdaq Stock Exchange – New York Stock Exchange – SIX Swiss Exchange – Etc. | <ul style="list-style-type: none"> – Investiere – Syndicate Room – Loanbox⁷ – Structured-product issuer's own issuing platform – Contineo, Leonteq's Constructor, Vontobel's Deritrade⁸ – Etc. |

Open issuing marketplaces are defined as issuing venues on which only “non-listed financial products” can be issued, with low barriers of access for potential issuers (see Exhibit 1: Open issuing marketplaces on page 38).

Listing venues are defined as issuing venues on which products that can be admitted to trading on an exchange – better known as “listed financial products” – can be issued. Listing venues must be run by an operator with an “exchange license” (see below). Note: Applicable laws tend to impose minimal “listing criteria”, and at times a listing criteria fulfilment check is even carried out by a regulatory agency. We distinguish between two types of issuing on listing venues: initial public offering (IPO),⁹ whereby new financial products are created (“originated”), and direct listing, whereby no new financial products are created.¹⁰

Closed issuing venues are defined as issuing venues on which only “non-listed financial products” can be issued, with very high barriers of access for potential issuers (access is typically at the discretion of the venue's operator).

NB: Crypto issuing venues refer to a specific technical back-end (IT infrastructure) of an issuing venue and are therefore not treated as a category of their own; specifically, they describe venues which are built on the basis of a permissionless distributed ledger. The issuing, which essentially amounts to digitally representing financial products on a permissionless distributed ledger, is referred to as an **initial coin offering (ICO)** and the issued digital assets issued in this way as **crypto assets**. (A crypto listing venue thus describes an issuing venue on which listed crypto assets can be issued.)

⁴ Market conditions impact the price of the financial product to be issued and therefore influence size, structure (e.g. maturity of debt-based products), and timing (i.e. when to issue).

⁵ The underwriter acts as insurer by guaranteeing a minimum price for the financial products to be issued.

⁶ Notice that some platforms mentioned in this category are not fully open (i.e. do not have zero access barriers) as they screen issuers, for example using a proprietary credit-rating algorithm, and only accept a certain subset thereof.

⁷ Before 2018, the platform was restricted to public institutions (governments, cantons, cities, etc.) issuing public-sector debt and therefore amounted to a “closed issuing venue”. Since 2018, any corporation can issue debt-based contracts on it.

⁸ They amount to multi-issuer platforms, but restrict access to a predefined set of issuers of structured products.

⁹ This label has become misleading because issuing venues for non-listed financial products may also offer them to the broad public and therefore constitute public issuing venues.

¹⁰ Direct listing amounts to issuing (hitherto) non-listed financial products, that is, financial products that had already been issued on an issuing venue (corporate bonds and structured products tend to be issued in this way).

Trading Facilities are the places (typically a digital platform) where the issued financial products (independently of whether they qualify as securities) are traded; namely, they describe a financial product's **secondary market**. They may function as a multilateral or bilateral trading system, and they may constitute a lit or dark system.¹¹ The trading orders are routed either directly to the trading facility (referred to as a "principal order") or indirectly via a broker (who then places an "agency order").

Exchanges (or "regulated markets", RMs) are defined as trading facilities that have an "exchange license" (or "RM license"). Only listed financial products can be admitted to trading on exchanges.

Over-the-counter (OTC) trading facilities are defined as trading facilities that do not constitute exchanges. Both listed and non-listed financial products may be admitted to trading on them. Laws/regulations tend to distinguish between **multilateral trading facilities (MTFs)**¹² and **organized trading facilities (OTFs)**.¹³

NB: Crypto trading facilities refers to trading facilities that crypto assets can be traded on. (A crypto exchange thus describes a trading facility which has an "exchange license" and on which only listed crypto assets can be traded.¹⁴)

Securities Clearing Houses are financial intermediaries that check whether all of the conditions required for the settlement of a trade are met – this check is referred to as **clearing**. The clearing process typically involves matching buyer and seller instructions,¹⁵ the calculation of net obligations (netting of individual trades), and the transmission of settlement instructions (on the settlement date to the settlement system – typically the CSD).

Clearing houses often also act as **central counterparties (CCPs)** on both primary and secondary markets. A CCP describes the financial intermediary which becomes the counterparty to both parties to a trade (i.e. it becomes the buyer to the seller, and the seller to the buyer) – hence the name. Both parties to a trade therefore only have counterparty risk (settlement risk) with the CCP. Central counterparties require parties in the system to post collateral as a fixed contribution to a default fund and as variable contributions (margin calls) based on their individual trades. In so doing, the CCP reduces counterparty risk in any given trade (collateral posting, risk diversification across parties in the system) and reduces collateral requirements for any given trade (risk diversification across trades).

Custodians are the places where financial products are recorded as electronic book entries. This electronic registry most importantly contains the ownership information of the financial products (digital representation of ownership rights to financial products). As such, they are responsible for the **settlement** of a trade by changing the book entries accordingly.

End custodians are defined as the parties operating the ultimate electronic ownership registry of a financial product and/or as the parties operating the physical vault for the safekeeping of physical financial assets ("certificated securities"). They typically take the form of a **central securities depository (CSD)** because they operate the ultimate electronic ownership registry for a wide range of financial products.

NB: Crypto assets are digital assets which are registered/represented directly on a permissionless distributed ledger (see above) and therefore do not require a third-party end custodian. the permissionless distributed ledger acts as the end custodian by design.

¹¹ In a "lit system" the trading interest is publicly displayed (e.g. via a public order book); in a "dark system" (also known as "dark pools") the trading interest is non-public/not displayed.

¹² This MTF concept is used in EU and CH law; this concept is roughly equivalent to the concept of "alternative trading systems" (ATSS) used in US law.

¹³ Systematic internalisers (SIs) are not mentioned although they qualify as OTC because they are technically a counterparty rather than a trading facility. Broker crossing networks are not mentioned explicitly because they either qualify as MTF, as OTF, or as SI.

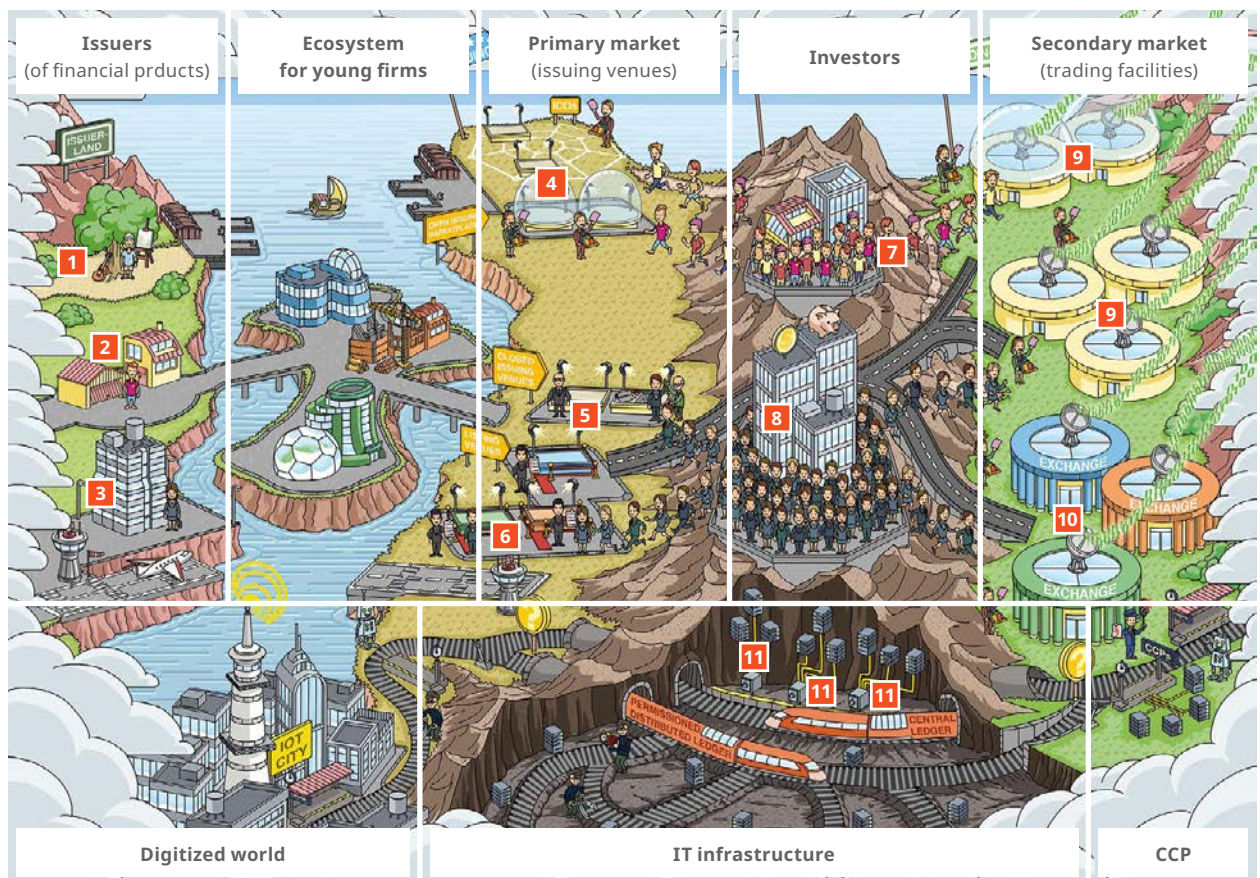
¹⁴ Notice that today's crypto trading facilities are wrongly labelled "crypto exchanges" since they do not have exchange licenses.

¹⁵ This is necessary in bilateral trading because the parties to the trade, rather than the trading facility, may submit it themselves.

4 Explanation of the Visualizations

The securities value chain is very complex. We have attempted to visualize it in its entirety as a single picture. Even the simplest visualization we were able to come up with still necessitates substantial additional explanations.

Most-Likely Scenario: Listed Investment Classes Remain Dominant Amid Disintermediation and Explosion of Digitized Assets



- 1 Initiatives not mainly with commercial purpose
- 2 Young/early-stage firms with commercial purpose
- 3 Mature firms
- 4 Open issuing marketplace
- 5 Closed issuing venues
- 6 Listing venues

- 7 Retail investors
- 8 Institutional investors
- 9 MTFs & OTFs
- 10 Exchanges
- 11 CSDs

High-level description:

The roads, paths, bridges, boats, and planes represent the flow of financial assets. The railroads represent the underlying IT infrastructure. Institutional investors (people in suits) are the dominant source of capital (the skyscrapers represent banks, pensions funds, insurance companies, asset managers etc.). To reduce complexity, the picture most notably does not depict private issuing venues.

Mature firms of all sizes issue financial products via listing venues and closed issuing venues (they can use the plane to directly access the issuing venues). Young/early-stage firms issue financial products to the public only once they are mature via listing venues (they have to use the bridge, the airport is not reachable for them). Initiatives that do not mainly have a commercial purpose issue financial products only on open-issuing venues (they have to use the sailing boat – the bridge and airport are not reachable for them).

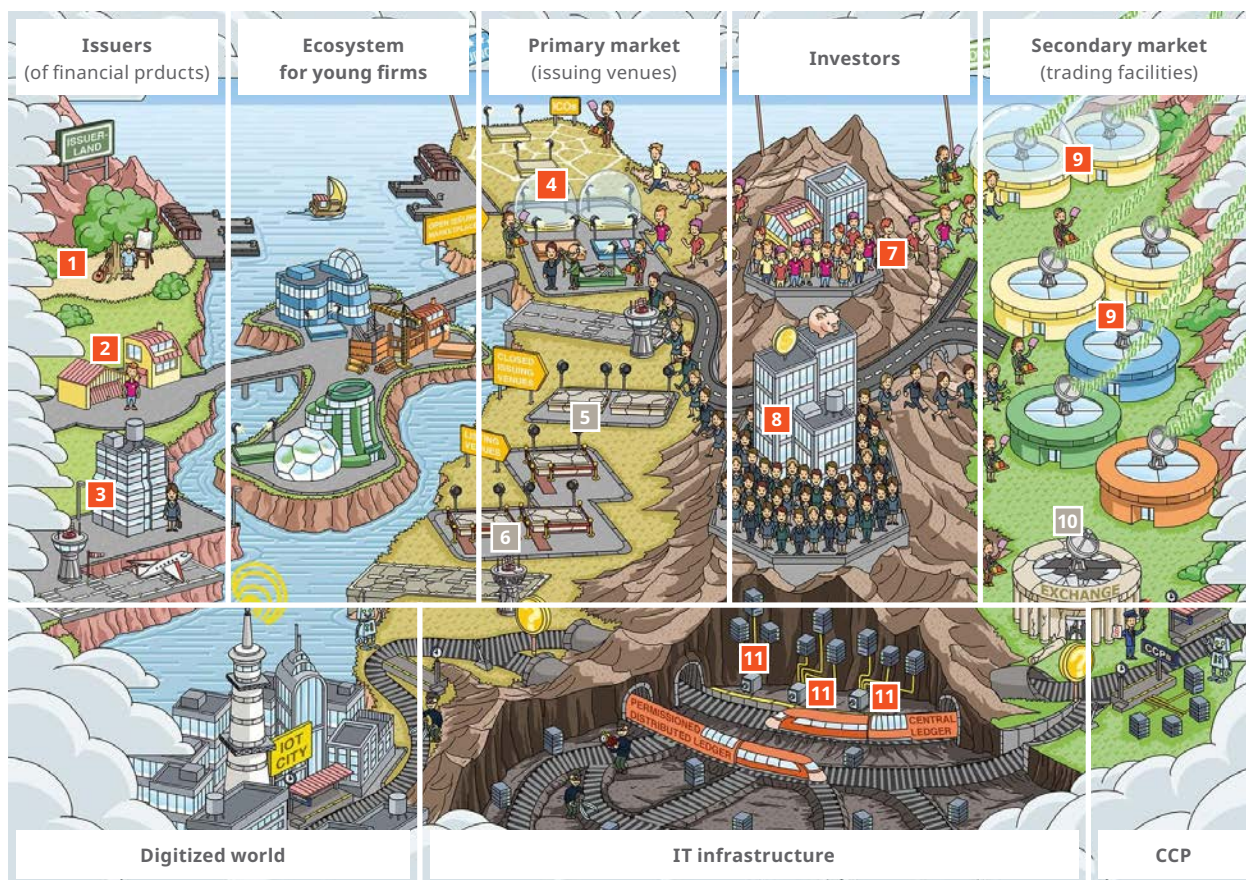
Primary markets (issuing venues) take the form of digital platforms offering direct access/connectivity to issuers and investors (both issuers and investors can directly access the issuing venues – there is no intermediary). Listing venues compete for young/early-stage firms by operating ecosystems to help them grow (the ecosystems are outside of the corporate environment/culture, which is represented by them being placed on an island; each ecosystem is connected to a listing venue, which is represented by their respective color). Institutional investors almost exclusively invest via listing venues and closed issuing venues (institutional investors walk to these issuing venues). Specifically, listing venues are the dominant issuing venues for non-tailored financial products, and closed multi-issuer issuing venues are dominant for tailored structured financial products (the tailors take the measurements of the investors). Open issuing marketplaces are only used for personal-interest projects and for P2P lending (the sailing boat arrives there); these marketplaces mostly attract retail investors (retail investors walk to these issuing venues); and big tech companies mainly operate these open-issuing marketplaces (the bubbles represent Amazon's new headquarters in Seattle). Crypto issuing venues (i.e. ICOs) are only a side-show (see the net at the far north) because permissionless distributed ledgers (e.g. Bitcoin/Ethereum blockchains) have not become dominant.

Trading mainly takes place on exchanges, MTFs, and OTFs (institutional investors walk there). The retail investor-focused trading facilities (retail investors walk there) are mainly operated by big tech companies (the bubbles represent Amazon's new headquarters in Seattle).

The world exhibits an explosion in the number and diversity of digitized assets (the IoT devices in the city at the bottom left are a subset of these digitized assets).

It is unclear whether the IT infrastructure will take the form of permissioned central ledgers (upper train and railroads) or of permissioned distributed ledgers (lower train and railroads). If a permissioned distributed ledger becomes dominant, then CSDs (the safes above the upper train and railroads represent the CSDs) would be disrupted (the safes disappear around the lower train and railroads).

Medium-Likelihood Scenario: Non-Listed Investment Classes and Open Issuing Marketplaces Become Dominant



- 1 Initiatives not mainly with commercial purpose
- 2 Young/early-stage firms with commercial purpose
- 3 Mature firms
- 4 Open issuing marketplace
- 5 Closed-issuing-venues
- 6 Listing-venues

- 7 Retail investors
- 8 Institutional investors
- 9 MTFs & OTFs
- 10 Exchanges
- 11 CSDs

High-level description: (please read the previous description first for context).

The roads, paths, bridges, boats, and planes represent the flow of financial assets. The railroads represent the underlying IT infrastructure. Institutional investors (people in suits) are the dominant source of capital (the skyscrapers represent banks, pensions funds, insurance companies, asset managers etc.). To reduce complexity, the picture does most notably not depict private-issuing venues.

All firms and individuals issue all their financial products on open-issuing marketplaces as non-listed financial products.

Primary markets (issuing venues) take the form of digital platforms offering direct access/connectivity to issuers and investors (both issuers and investors can directly access the issuing venues – there is no intermediary). All investors invest via open-issuing marketplaces (institutional and retail investors walk there). Open issuing marketplaces compete for young/early-stage firms by operating ecosystems to help them grow (the ecosystems are outside of the corporate environment/culture, which is represented by them being placed on an island; each ecosystem is connected to an open-issuing marketplace, which is represented by their respective color). These ecosystems also include issuing venues for these young/early-stage allowing them to issue financial products to the public before they are mature. Open issuing marketplaces focused on retail investors (retail investors walk to these issuing venues) are mainly operated by big tech companies (the bubbles represent Amazon's new headquarters in Seattle). Crypto issuing venues (i.e. ICOs) are only a side-show (see the net at the far north) because permissionless distributed ledgers (e.g. Bitcoin/Ethereum blockchains) have not become dominant.

Exchanges have disappeared because listed products have disappeared. Trading takes place on MTFs and OTFs (institutional and retail investors walk there). The retail investor-focused trading facilities (retail investors walk there) are mainly operated by big tech companies (the bubbles represent Amazon's new headquarters in Seattle).

The world exhibits an explosion in the number and diversity of digitized assets (the IoT devices in the city at the bottom left are a subset of these digitized assets).

It is unclear whether the IT infrastructure will take the form of permissioned central ledgers (upper train and railroads) or of permissioned distributed ledgers (lower train and railroads). If a permissioned distributed ledger becomes dominant, then CSDs (the safes above the upper train and railroads represent the CSDs) would be disrupted (the safes disappear around the lower train and railroads).

Note to the Reader

Authors

The views expressed in this paper are those of the authors and do not necessarily reflect those of SIX or of those having contributed. For more information about this paper, please contact the authors.

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