HSLU Lucerne University of Applied Sciences and Arts

IFZ FinTech Study 2024

An Overview of Swiss and Liechtenstein FinTech

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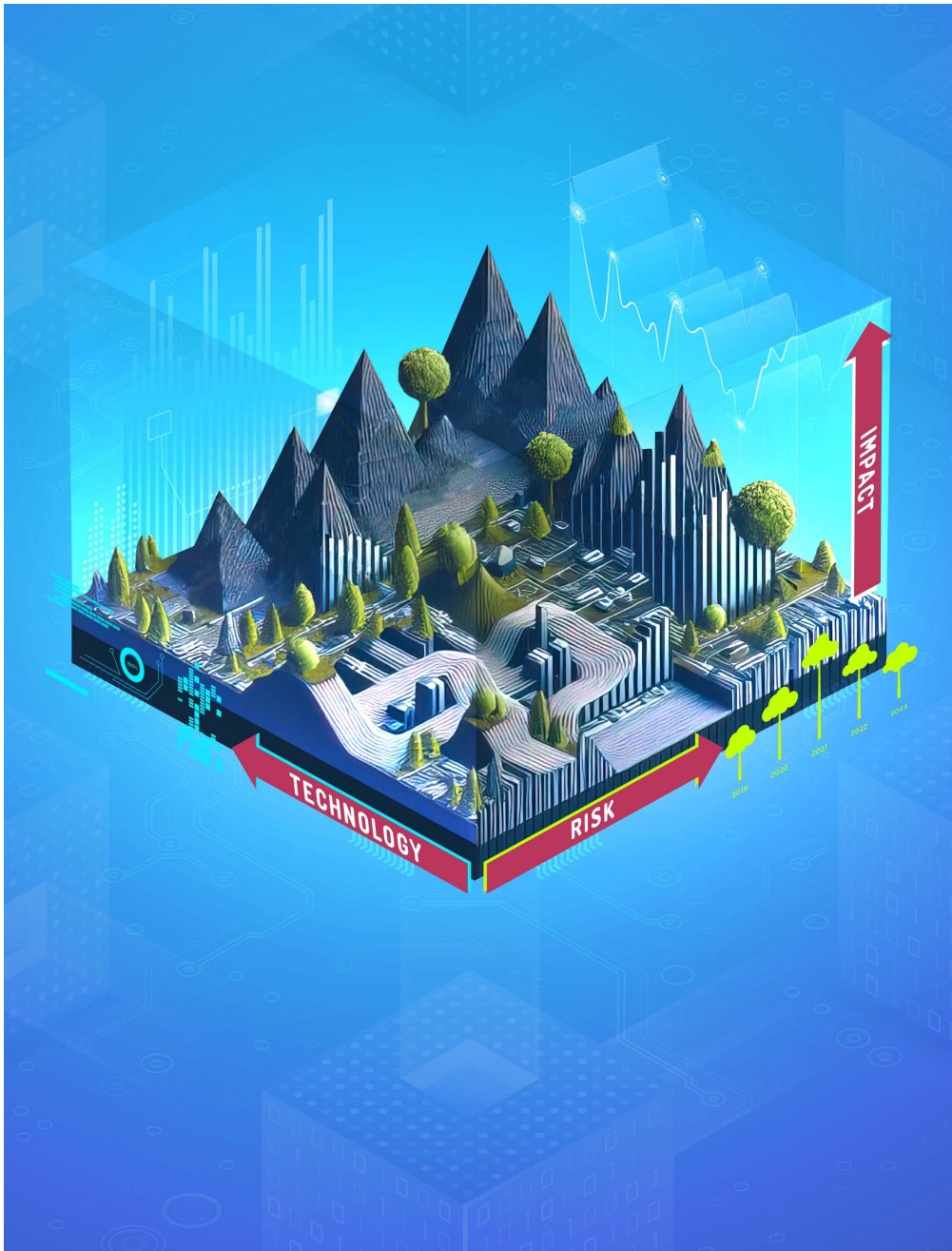

FH Zentralschweiz

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Preface

In the rapidly evolving landscape of financial technology, or "FinTech" in short, the IFZ FinTech Study 2024 serves as a comprehensive examination of the current status and progress within the Swiss and, for the first time, the Liechtenstein FinTech sector. In both countries, FinTech companies are crucial technological solution providers for the financial industry, which is evident in the sector's notable growth. The Swiss FinTech sector reached 483 companies by the close of 2023, a yearly growth of eleven percent, with Liechtenstein hosting 22 FinTech companies. The rise in companies adopting newer technological concepts, like artificial intelligence and blockchain, indicates FinTech companies' role as technological innovators in the Swiss and Liechtenstein financial centre. Another indicator of FinTech's adaptability is the increasing number of sustainable companies, reaching 49 by the end of 2023 with an annual growth exceeding 50 percent. These two trends, as well as others, position FinTech as a transformative force that has the potential to shape the future of the financial sector in Switzerland and Liechtenstein.

However, the realisation of this potential depends on the creation of suitable framework conditions. Although these are good in Switzerland, international competition is also constantly developing. As the general financial landscape continues to evolve, it becomes imperative to establish regulatory and operational frameworks that foster innovation while ensuring stability and security. Achieving this balance is important for FinTech to further unleash its transformative capabilities. Effective collaboration between industry stakeholders and policymakers is central to developing an overall environment that encourages further innovation in the FinTech industry and, consequently, in the financial services industry as a whole. This study is intended to provide a basis of information to further strengthen FinTech in Switzerland and Liechtenstein. This year, it has been conducted for the ninth time, which makes it possible to identify important trends, challenges, and opportunities in this sector in particular, thereby providing insights for stakeholders, political decision-makers, and industry experts alike.

The study is structured to provide an in-depth exploration of the FinTech landscape, beginning with a definition of its scope and a description of the frameworks used (Chapter 1). Subsequently, the focus shifts to an empirical analysis of the Swiss and Liechtenstein FinTech sector, offering insights into the business models applied, sustainable FinTech practices, and financing activities (Chapter 2). A global perspective is then established by examining the landscape of globally listed FinTech companies and forming various FinTech indices based on their valuations (Chapter 3). This is followed by an objective assessment of the quality of the surrounding factors of various locations for FinTech companies by the FinTech hub ranking (Chapter 4). The study proceeds to describe the current political and legal environment for the Swiss FinTech sector (Chapter 5) and explores the dynamics between traditional banks and FinTech companies with a focus on embedded finance (Chapter 6). The role of large language models in financial advice (Chapter 7), the crypto assets market in Switzerland (Chapter 8), and the intersection of quantum computing and artificial intelligence in finance (Chapter 9) are examined in subsequent chapters. Finally, the study concludes by summarising key findings and providing a forward-looking perspective (Chapter 10).

We would like to take this opportunity to thank our research partners, namely, e.foresight, Finnova, Inventx, SIX, Swiss Bankers Prepaid Services, Swiss Fintech Innovations, and Zürcher Kantonalbank, for their financial support and substantive input, which were essential to the comprehensive examination of the FinTech landscape presented in this study. We would also like to thank the guest authors for their valuable contributions.

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1. Definition and Framework of the FinTech Ecosystem

By Thomas Ankenbrand & Denis Bieri, Institute of Financial Services Zug IFZ

The financial industry has experienced a continual transformation over the past decades, significantly influenced by the integration of new technologies. Earlier examples of transformative technological progress include the introduction of semiconductor microprocessors in the 1960s, which played a pivotal role in replacing physical recordings with digital data, and the adoption of the Internet for global data exchange in the 1990s, which enabled digital banking (World Economic Forum, 2016). The term "FinTech", an amalgamation of "Financial Technology", has, however, only gained recognition in more recent years. This is evidenced in Figure 1.1, which shows the relative search interest for all web searches on Google for Switzerland and on a global scale.

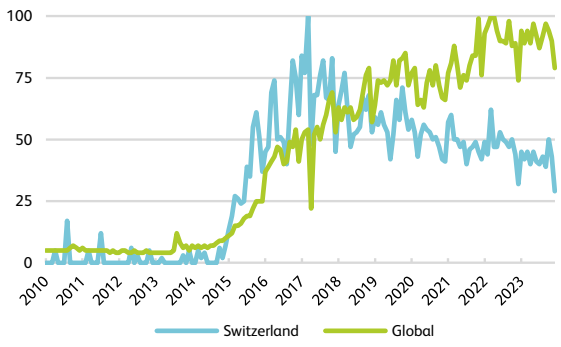

Figure 1.1: Relative search interest for "FinTech" via Google (source: Google Trends (online))

It illustrates that the term only gained popularity in the mid-2010s. Globally, a relatively constant increase in the prevalence of the term can be observed from 2015 to the end of 2023. This is in contrast to Switzerland, where the highest relative search interest in the topic was observed in March 2017. After that, there is a continuous decline in web searches for "FinTech" until the end of 2023. This downward trend is not in line with the growth generally observed in the Swiss FinTech sector in recent years and might therefore be attributed to other reasons, such as the observed shift from B2B to B2C business models, which could be reflected in a lower search interest for the term "FinTech" among the Swiss population.

Although the term "FinTech" has been used for a number of years, a generally accepted definition has not yet been established, which is why the various studies on this topic are not directly comparable with one another. For the purposes of the present study, "FinTech" and companies offering such solutions are defined as follows:

FinTech is defined as technology-based solutions for innovative products, services, and processes in the financial industry, improving, complementing, and / or disrupting existing offerings. Hence, FinTech companies are firms whose main activities, core competencies, and / or strategic focus lie in developing those solutions.

Accordingly, all companies domiciled in Switzerland or Liechtenstein that qualify under the given definition of FinTech are the subject of this study. Wherever there is a deviation from this scope, it is clearly stated. An important distinction from other studies on this topic is that the present study excludes the insurance sector, i.e., so-called "InsurTech" solutions, since corresponding products and services focus on different markets than the traditional financial industry. Furthermore, unlike other studies, no conditions are placed on the age of a FinTech company. This means that both start-ups and established companies can be FinTech companies, provided they qualify under the definition stated.

As in previous editions of this study, the so-called "FinTech grid" is used to categorise the business areas in the FinTech industry. An illustration of the framework is given in Figure 1.2. The framework basically consists of two different dimensions, i.e., the product areas of FinTech in the

horizontal and the underlying technologies of FinTech solutions in the vertical.

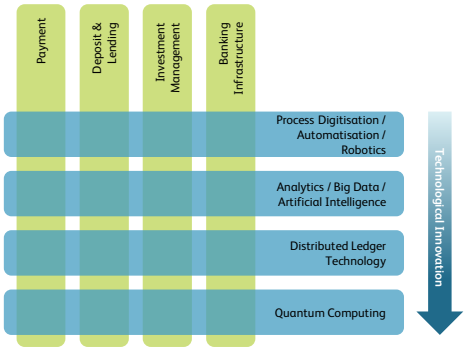

Figure 1.2: FinTech grid

Specifically, the FinTech-relevant product areas include "Payment", "Deposit & Lending", "Investment Management", and "Banking Infrastructure". The technology categories for FinTech solutions are, in ascending order of degree of innovation, "Process Digitisation / Automatisation / Robotics", "Analytics / Big Data / Artificial Intelligence", "Distributed Ledger Technology", and "Quantum Computing". The framework therefore makes it possible to classify each FinTech company into one of the interfaces between product area and technology category, thus providing a structured basis for analysing the corresponding sector.

In addition to structuring the sector on the basis of the FinTech grid, the design of the companies' specific business models is carried out using selected aspects of the Business Model Canvas by Osterwalder and Pigneur (2010). A special focus is on analysing the key partners and target customers of Swiss and Liechtenstein FinTech companies and evaluating their revenue models.

In addition to the FinTech grid and the Business Model Canvas, which form the main frameworks of this study, other methodological approaches are used in the ensuing chapters. These will be introduced and discussed within their respective sections.

2. Swiss and Liechtenstein FinTech Companies

By Thomas Ankenbrand, Denis Bieri & Levin Reichmuth, Institute of Financial Services Zug IFZ

This chapter empirically analyses the Swiss, and for the first time in this edition of the study, the Liechtenstein FinTech sector.[1] The analysis is based on all companies that fall under the definition of FinTech in Chapter 1.[2] The following conclusions are based on a proprietary database compiled through ongoing extensive research of public sources (e.g., newsletters, third-party studies, commercial registries, and company websites), the findings from previous editions of the present study, and information obtained via e.foresight's "Swiss FinTech Map"[3].

In Section 2.1, a general overview of the Swiss and Liechtenstein FinTech sector is given. Section 2.2 evaluates the corresponding landscape from a sustainability perspective and Section 2.3 analyses financing activities. Section 2.4 summarises the findings.

2.1. Overview of Swiss and Liechtenstein FinTech Companies

This section presents facts about the Swiss and Liechtenstein FinTech sector. While Section 2.1.1 provides a general overview of the state of the sector, Section 2.1.2 discusses gender diversity of the management and board members. Section 2.1.3 and Section 2.1.4 focus on analyses relating to the target customers and revenue models of the respective companies, respectively, and Section 2.1.5 gives an overview of the key partners in the Swiss and Liechtenstein FinTech ecosystem.

2.1.1 General Figures on the Sector

Over the last decade, the Swiss FinTech sector has developed from a niche market into a key driver of innovation in the financial industry. This development can be observed in the number of local FinTech companies, as visualised in Figure 2.1.

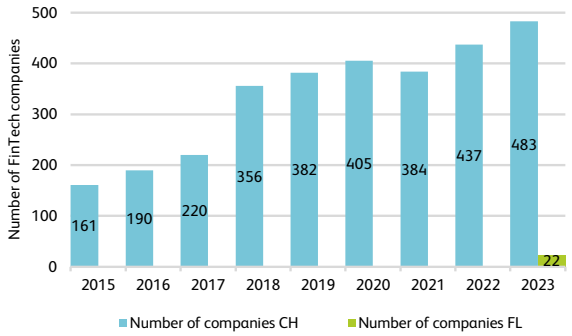

Figure 2.1: Number of Swiss (CH) and Liechtenstein (FL) FinTech companies by year

The figure shows the number of companies in Switzerland and, for the first time, Liechtenstein in 2023 that fall under the definition of FinTech in Chapter 1. Accordingly, the Swiss and Liechtenstein FinTech sectors together counted a total of 505 companies at the end of 2023. With 483 companies, Switzerland accounted for the vast majority, while Liechtenstein was home to 22 companies.

Switzerland's FinTech sector has consistently demonstrated growth, with the notable exception of 2021, during which a minor decrease in the number of FinTech companies was noted. Apart from this isolated case, the sector has shown a continuous upward trend since 2015. This also applies to the year 2023, in which the number of Swiss companies in the sector rose by 46 from 437 to 483. In relative terms, this corresponds to growth of eleven percent, which is slightly below the average annual growth rate since 2015. Over the entire observation period, the Swiss FinTech sector tripled in size, which indicates its increasing relevance for the established financial industry. Note that due to the first-time evaluation of Liechtenstein FinTech companies for 2023, no year-over-year comparison can be made. This also implies that corresponding

[1] Note that in certain statements and analyses that follow, the Principality of Liechtenstein is referenced alongside Swiss cantons, or the two countries are considered collectively. This is done to increase the significance, although it is clear that Switzerland and Liechtenstein are distinct markets.

[2] The full list of companies considered can be found in Appendix A.

[3] The map is accessible at https://fintechmap.ch/.

companies may already have existed for 2022 as well as earlier years but are not shown in Figure 2.1.

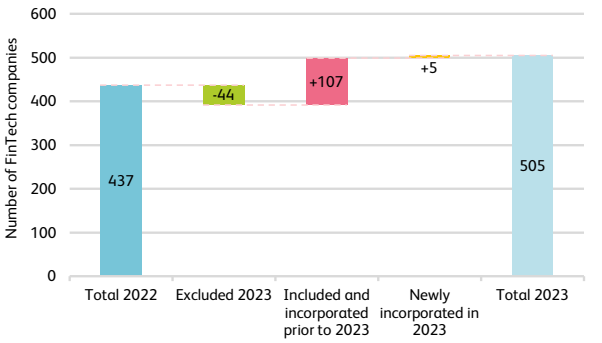

Figure 2.2: Year-over-year change in the total number of Swiss and Liechtenstein FinTech companies

A comparison of FinTech companies with the total number of companies in the tertiary sector in Switzerland and Liechtenstein shows that the Liechtenstein FinTech cluster is relatively larger. More precisely, approximately five out of every thousand companies in Liechtenstein's tertiary sector qualify under the definition of FinTech in Chapter 1. In Switzerland, the proportion is lower, with only around one in a thousand companies in the tertiary sector being a FinTech company.[4]

A breakdown of last year's change from 437 Swiss to 505 Swiss and Liechtenstein FinTech companies is shown in Figure 2.2. It presents that the annual change of 68 companies between 2022 and 2023 is mainly due to the inclusion of companies in the sample that were founded before 2023. This makes a total of 107 companies, including the 22 Liechtenstein FinTech companies that were included in this study for the first time. In addition, this also includes companies that were founded in 2022 or earlier but only appeared publicly in 2023, as well as older companies that only shifted their business focus to the FinTech sector last year. In contrast, a total of 44 companies were excluded from the sample in 2023. The reasons for this are the liquidation of formerly active FinTech companies, public disappearance, or change of business focus away from FinTech. Five companies in the sample were not founded until 2023, which is the final reason for the difference in the total number of FinTech companies between 2022 and 2023.

Figure 2.3 illustrates a classification of all 505 Swiss and Liechtenstein FinTech companies into FinTech product ar-

[4] The number of companies in the Swiss and Liechtenstein tertiary sector was taken from the Swiss Bundesamt für Statistik (online) and the Amt für Statistik Liechtenstein (online), respectively, and refer to the year 2021.

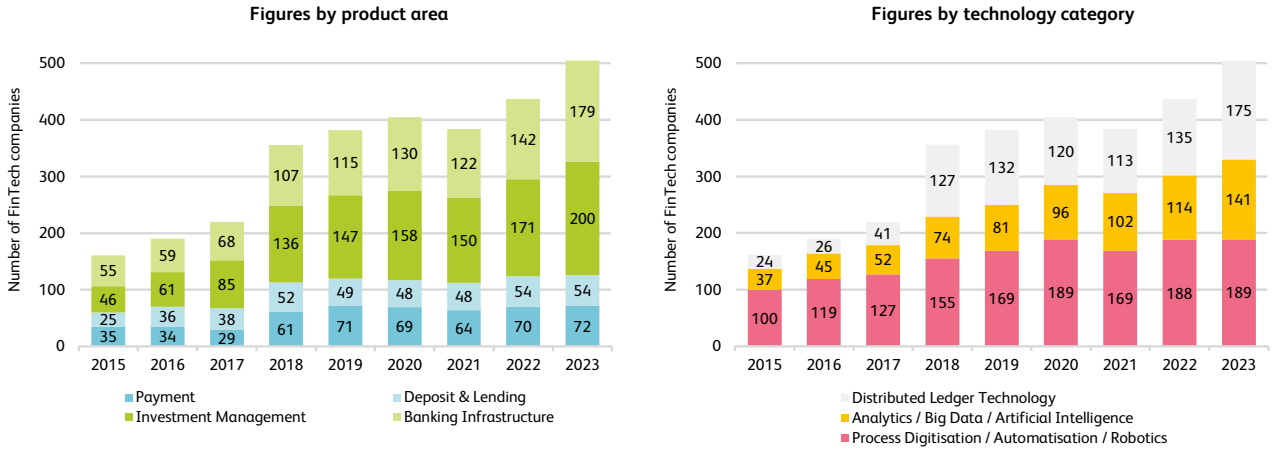

Figure 2.3: Number of FinTech companies by year, and by product area (left-hand graph) and technology category (right-hand graph)

eas (left-hand graph) and technology categories (right-hand graph). The left-hand graph reveals that most FinTech companies are active in the product areas *Investment Management* and *Banking Infrastructure*, with 200 and 179 companies, respectively. 72 companies provide solutions in the area of *Payment* and 54 in the area of *Deposit & Lending*. Compared to 2022, the *Banking Infrastructure* product area has recorded the largest growth (+37 companies; +26 %), followed by *Investment Management* (+29 companies; +17 %), *Payment* (+2 companies; +3 %), and *Deposit & Lending* (no growth).

The technology perspective in the right-hand graph of Figure 2.3 shows that at the end of 2023, the most Swiss and Liechtenstein FinTech companies were applying technologies from the category *Process Digitisation / Automatisation / Robotics* with 189 companies, followed by the categories *Distributed Ledger Technology* and *Analytics / Big Data / Artificial Intelligence* with 175 and 141 companies, respectively. However, a year-over-year comparison shows that companies in the category *Process Digitisation / Automatisation / Robotics*, i.e., the category with the comparatively lowest degree of innovation, clearly recorded the lowest growth (+1 company; +0.5 %). The *Distributed Ledger Technology* category shows the most positive trend with an increase of 40 companies (+30 %) compared to 2022, followed by *Analytics / Big Data / Artificial Intelligence* with an additional 27 companies (+24 %). A comparison with the beginning of the observation period in 2015 highlights that the two comparatively more innovative technology categories in particular have seen stronger growth over the years. It can therefore be said that the local FinTech sector is increasingly evolving from traditional digitisation towards the application of more complex methods and concepts such as artificial intelligence and blockchain.

The connections between the product areas and the technology categories can be visualised using the FinTech grid introduced in Chapter 1. Figure 2.4 shows the corresponding classification of all 505 companies in the Swiss and Liechtenstein FinTech sector. Such an evaluation presents which product areas of FinTech are processed using which technologies, and can point out potential clusters and gaps.

The FinTech grid highlights that the application of technologies in the category *Analytics / Big Data / Artificial Intelligence* in the area of *Investment Management* is most

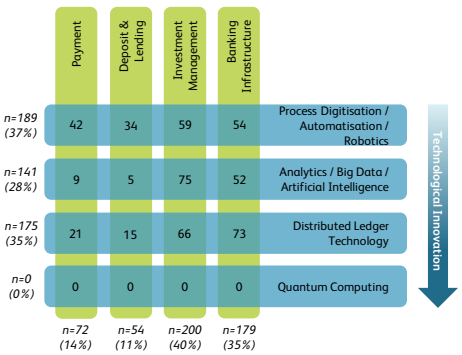

Figure 2.4: Distribution of Swiss and Liechtenstein FinTech companies according to the FinTech grid (n=505)

popular with 75 companies in this intersection. Specific solutions in this field include algorithmic trading, data-supported portfolio allocation, and tools for analysing investment performance. The second most common interface is that of the *Distributed Ledger Technology* category and the *Banking Infrastructure* product area. This intersection includes blockchain-based solutions for trading crypto assets and corresponding custody solutions. Apart from the category *Quantum Computing*, in which no company is represented, the two least popular intersections are found in the technology category *Analytics / Big Data / Artificial Intelligence* in combination with the product areas *Payment* and *Deposit & Lending*, in which only nine and five companies, respectively, were classified at the end of 2023.

The number of incorporations of Swiss and Liechtenstein FinTech companies by product area (left-hand graph) and technology category (right-hand graph) per year is presented in Figure 2.5. It shows that the number of company foundations generally increased steadily until 2018, reaching a high of 70 in that year. Thereafter, with the exception of the year 2021, a downward trend can be observed. The left-hand graph in Figure 2.5 highlights that the three record years, i.e., 2017, 2018, and 2021, saw the most company foundations in the *Investment Management* product area, while the technological perspective in the right-hand graph shows that the growth in these years is clearly attributable to the emergence of companies in the *Distributed Ledger Technology* category and hence is

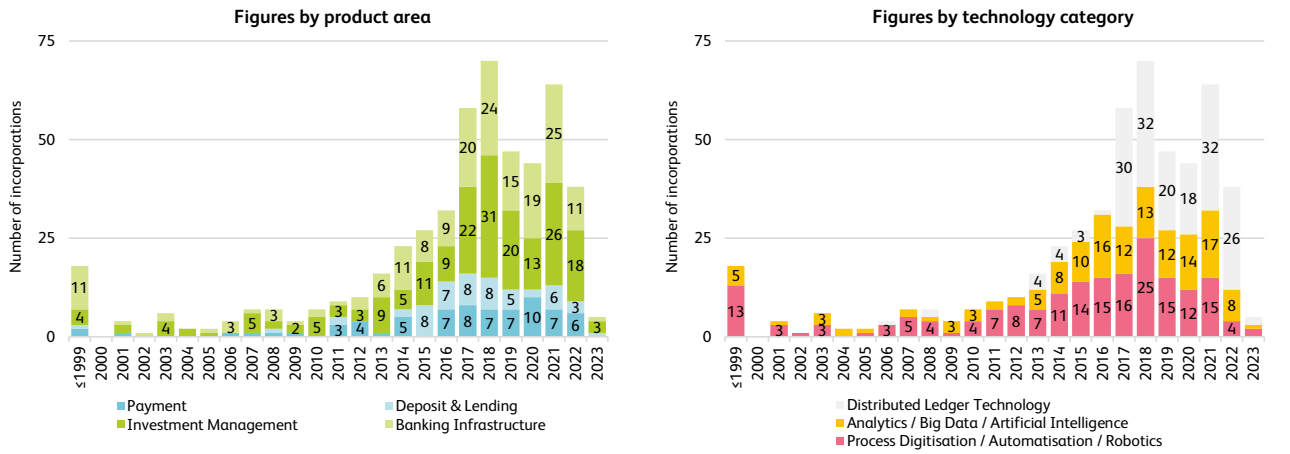

Figure 2.5: Number of FinTech company incorporations per year by product area (left-hand graph) and technology category (right-hand graph) (n=505)

related to the emergence of the so-called "Crypto Valley" within the Greater Zurich Area up to Liechtenstein.

As in Figure 2.2, Figure 2.5 furthermore shows that 2023 was a year with only five new entries of FinTech companies in the commercial register. Foundation activity therefore appeared to have been comparatively low last year. This statement should be treated with caution, as many new companies do not go public in the year they are legally founded, but rather a little later, as they are still working on developing their solution. However, a comparison with earlier editions of the present study shows that even taking this effect into account, there were rather few business incorporations. More specifically, the studies for 2020, 2021, and 2022 counted 20, 14, and 14 foundations, respectively, for the current year at that time. The five comparatively few company incorporations for 2023 could therefore indicate a slowdown in start-up momentum in the Swiss and Liechtenstein FinTech sector. Furthermore, of these five companies, three are focused on the product area *Investment Management* and one each on the areas *Banking Infrastructure* and *Deposit & Lending*. From a technological perspective, the five companies can be attributed to the categories *Process Digitisation / Automatisation / Robotics* and *Distributed Ledger Technology*, each with two companies, and *Analytics / Big Data / Artificial Intelligence*, with one company. From a cantonal perspective, two of these five companies are located in Zurich, two in Ticino and one in the canton of Neuchâtel.

Figure 2.6 shows the regional distribution of all 505 companies in the Swiss and Liechtenstein FinTech sector, again broken down by product area (left-hand graph) and technology category (right-hand graph). This shows that the canton of Zurich is home to the largest FinTech cluster, with a total of 190 companies, followed by the canton of Zug with 129 and the canton of Geneva with 47 companies. With 29 and 22 companies, respectively, the canton of Vaud and the Principality of Liechtenstein account for the fourth- and fifth-highest number of resident FinTech companies. The remaining 88 companies are spread across the other Swiss cantons, with the cantons of Glarus, Nidwalden, Solothurn, and Uri each not being home to a single FinTech company. Figure 2.6 also shows that the canton of Zurich recorded the highest year-over-year growth with 26 additional companies, followed by Zug (+6 companies), Geneva (+5 companies), and Neuchâtel, Fribourg, and Schwyz (+2 companies each).

With regard to the concentration of companies in terms of product areas (left-hand graph), it can be observed that this distribution is proportional to the total number of companies in the individual cantons and Liechtenstein. This means that no clear regional clusters can be identi-

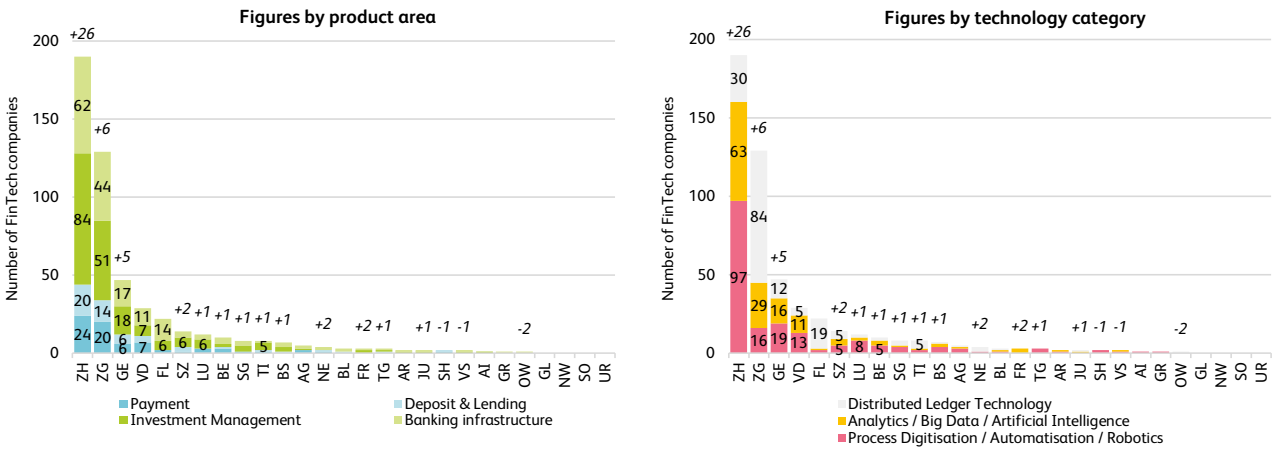

Figure 2.6: Number of FinTech companies by region, and by product area (left-hand graph) and technology category (right-hand graph) (n=505)

fied for the four product areas. This is in contrast to the breakdown by technology category (right-hand graph). In this respect, there is a clear concentration of companies in the category *Distributed Ledger Technology* in the cantons of Zug and Ticino, as well as the Principality of Liechtenstein. FinTech companies that use technological approaches from categories *Process Digitisation / Automatisation / Robotics* and *Analytics / Big Data / Artificial Intelligence*, by contrast, seem to be disproportionately located in Zurich.

2.1.2 Gender Diversity

In the Swiss start-up ecosystem, an observed imbalance that has been noted earlier is the under-representation of female leaders (Startup Campus, online). This also applies to the FinTech sector, as presented in Figure 2.7. The figure shows the proportion of female members in the management teams and boards of directors since 2019.[5] Both proportions have been subject to a positive trend in recent years, which has narrowed the gender gap. However, the fact that only twelve percent of the members of the management teams and only eight percent of the members of the boards of directors of Swiss and Liechtenstein FinTech companies were women as of the end of 2023 shows that there is still a significant gender gap.

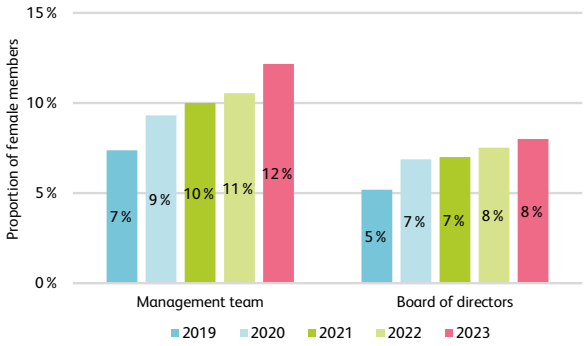

Figure 2.7: Proportion of female members of management team and board of directors by year (n_{2023}=505)

Compared to traditional Swiss retail banks, where 29 percent of board members were women as of mid-2023 (Dietrich et al., 2023), the proportion of women on the boards of directors of FinTech companies is particularly low. In terms of the management team, however, the FinTech sector is slightly more diverse, with twelve percent women than the traditional Swiss retail banks with eleven percent (Dietrich et al., 2023).

[5] Note that the categorisation into female and male is determined by the first names of the individuals and therefore provides a first simplified representation which actually does not account for non-binary gender identification.

2.1.3 Target Customers

Developing a strategy for target customers, whether in the business-to-business (B2B) or the business-to-consumer (B2C) segment, is crucial for the success of FinTech companies. Such strategic clarity serves as a foundational element, facilitating alignment between the offerings of FinTech companies and the demands and expectations of their chosen markets. In addition to the customer types, i.e., B2B or B2C, the customer strategy of a FinTech company also includes the geographical reach, i.e., whether there is a national or international market orientation.

The targeted customer segments of the Swiss and Liechtenstein FinTech companies are presented in Figure 2.8.[6] A distinction is made between the targeted customer types and the geographical orientation. Note that an international orientation also includes the national market.

	B2B	B2B & B2C	B2C	*Total*
National	31 (6 %)	44 (9 %)	19 (4 %)	***94 (19%)***
International	223 (44 %)	180 (36 %)	8 (2 %)	***411 (81%)***
Total	***254 (50%)***	***224 (44%)***	***27 (5%)***	***505 (100%)***

Figure 2.8: Number and proportion of FinTech companies by customer segments (n=505)

The figure highlights that the clear majority of Swiss and Liechtenstein FinTech companies pursue either a pure B2B strategy (50 % of companies) or a combination of B2B and B2C (44 %). Only five percent of companies pursue a pure B2C strategy. In terms of geographical focus, the majority of companies are clearly geared towards the international market. 81 percent of companies pursue a corresponding strategy. Accordingly, only 19 percent of companies have an exclusively national orientation.

The trend towards an international orientation has intensified in recent years, as can be seen in Figure 2.9. While

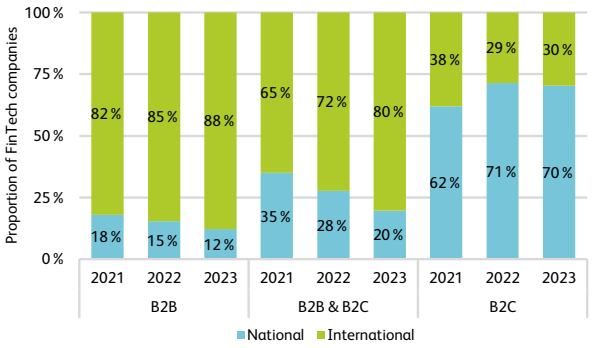

Figure 2.9: Proportion of FinTech companies by customer segments and by year (n_{2023}=505)

18 percent of companies in the B2B sector were still nationally oriented in 2021, this proportion fell to 15 percent in 2022 and 12 percent in 2023. A similar trend can be observed for companies that pursue a combined B2B and B2C customer strategy, only at a comparatively higher level. While more than a third of companies in the corresponding segment was still nationally oriented in 2021, the proportion fell significantly to 28 percent and 20 percent in the subsequent two years. Only the B2C customer segment has a majority focus on the Swiss and Liechtenstein domestic market. Compared to 2021, the corresponding share in 2023 has risen from 62 percent to 70 percent. However, as comparatively few companies operate in this segment, the proportions and, in particular, shifts over time should be interpreted with caution.

That target customers differ depending on the product area and technology category can be seen in Figure 2.10, which shows corresponding proportions for the six possible customer segments, i.e., “national B2B”, “national B2B & B2C”, “national B2C”, “international B2B”, “international B2B & B2C”, and “international B2C”.

The left-hand graph presents that Swiss and Liechtenstein FinTech companies from the product areas *Payment* and *Banking Infrastructure* most frequently target the international B2B market. The majority of companies from the areas *Deposit & Lending* and *Investment Management* predominantly also pursue an international market strategy, but not purely in the B2B segment, but in combination with the B2C segment. It should also be noted that

[6] Note that discrepancies in figures may occur due to rounding.

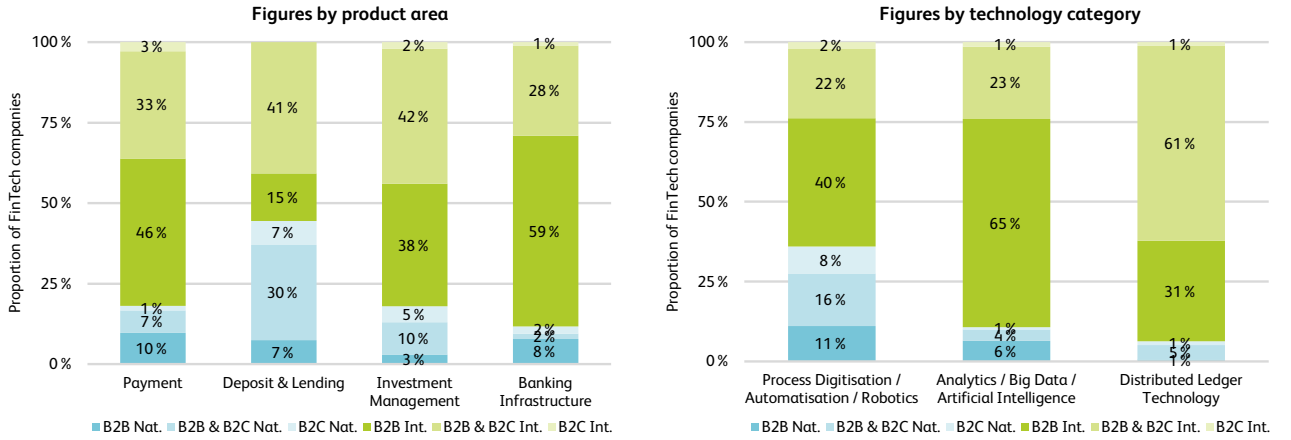

Figure 2.10: Proportion of FinTech companies by customer segments, and by product area (left-hand graph) and technology category (right-hand graph) (n=505)

the proportion of nationally oriented companies is clearly highest in the *Deposit & Lending* product area.

The technological perspective in the right-hand graph of Figure 2.10 reveals that the proportion of companies targeting the Swiss and Liechtenstein home market is largest in the *Process Digitisation / Automatisation / Robotics* category. However, an international B2B market strategy is also most frequently observed in this category. The same applies to the technology category *Analytics / Big Data / Artificial Intelligence*, of which around two-thirds target the international market for business customers. The *Distributed Ledger Technology* category has the highest proportion of internationally oriented companies, and the combined B2C and B2B strategy is the most common. The correspondingly broad customer focus may be related to the decentralised nature of the technology, which often makes it usable by anyone and from anywhere.

As the majority of FinTech solutions are digital, a company's website is an important interaction channel with the defined target customers. Figure 2.11 presents an overview of the global web traffic for Swiss and Liechtenstein FinTech companies for the year 2023. The assessment of a company's global web traffic involves considering 36 domain extensions associated with its primary domain or website. Following a manual review of a company's active domains, the global web traffic data was sourced from Semrush (online) and aggregated for companies that manage multiple domain extensions.

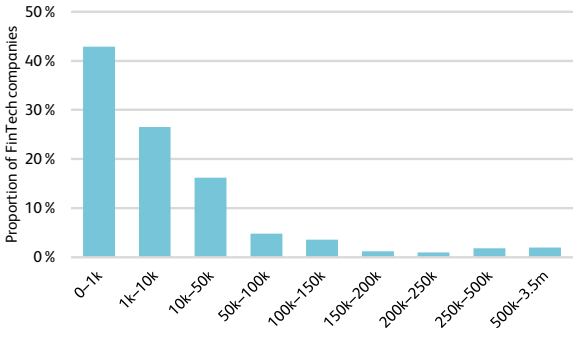

Figure 2.11: Global web traffic of Swiss and Liechtenstein FinTech companies in 2023 (n = 505) (source: Semrush (online))

The histogram displayed in Figure 2.11 shows the web traffic, measured in clicks, divided into nine ranges on the x-axis, and the proportion of FinTech companies in the respective range on the y-axis. Of the total number of 505 FinTech companies, 43 and 27 percent are considered in the first and second range, respectively. The first range includes companies with at least 1,000 website vis-

its in 2023, and the second range includes companies with 1,000 to 10,000 website visits. Furthermore, 16 percent of the companies are associated with the third range, and report between 10,000 to 50,000 website visits. The median of 1,761 website visits in 2023 is located in the second range of the histogram, whereas the mean value is recorded at 46,037 website visits in the third range. The large gap between median and mean value points out the rather wide distribution of reported web traffic data, and possible differences in the business models of the FinTech companies. Specifically, two-thirds of the 72 companies (14 %) with more than 50,000 website visits in 2023 show an international business model and target B2B and B2C clients.

2.1.4 Revenue Models

Deciding on a revenue model is crucial for FinTech companies, as it establishes the foundation for sustainable growth and profitability. As FinTech is located at the interface between the financial and technology industries, revenue models from both areas are generally possible.

Figure 2.12 shows the proportions of Swiss and Liechtenstein FinTech companies for different revenue models since 2015. The blue-coloured bars include sales models that are common in banking, i.e., interest, commission, and trading revenue, while the green bars represent those from the IT industry, i.e., revenue generation via software-as-a-service (SaaS) or licence fees. The revenue models in magenta, i.e., advertising or selling (analysed) data, represent further alternative options.

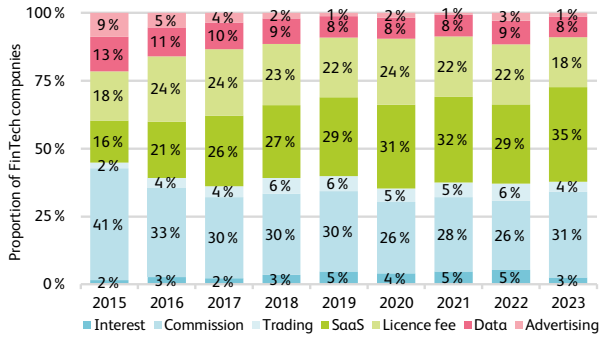

Figure 2.12: Proportion of FinTech companies by revenue model and by year (n_{2023}=505)

According to Figure 2.12, the proportion of business models from the IT sector, in particular the SaaS model, has gained in importance, while the models originating from the banking industry have tended to lose relevance over the years. The proportion of alternative models has also decreased. The breakdown for 2023 shows that across all Swiss and Liechtenstein FinTech companies, revenue generation via SaaS is the most popular, accounting for 35 percent of all companies, followed by commission business (31 %), licence fees (18 %), the sale of (analysed) data (8 %), trading (4 %), interest business (3 %), and advertising (1 %). IT-based revenue generation therefore accounted for over 50 percent of all revenue models in the Swiss FinTech sector in 2023.

However, the prevalence of revenue models differs depending on the product area and technology category of a FinTech company, as shown in Figure 2.13. The left-hand graph reveals that in the product areas *Payment* and *Investment Management*, revenue generation via commission and SaaS are similarly popular. This contrasts with the *Deposit & Lending* area, where commission business is clearly the most popular. This cluster can be explained by the fact that many intermediary platforms, e.g., crowdfunding platforms, fall into this area, which typically function via commission payments. The *Banking Infrastructure* area has the largest share of IT-driven revenue models, with SaaS accounting for 40 percent of all models and 25 percent attributable to licence fees.

With regard to the technology categories, there are also differences in the popularity of the various options for generating revenue. Commission-based business (32 %) and SaaS (34 %) exhibit the most significant and comparable relevance within the *Process Digitisation / Automatisation / Robotics* category. In the category *Analytics / Big Data / Artificial Intelligence*, in contrast, banking-driven revenue models are comparatively rare. In addition to the SaaS and licence fee business (45 % and 20 %, respectively), the sale of (analysed) data is also comparatively relevant here (16 %). FinTech companies in the category *Distributed Ledger Technology* are comparatively strongly driven by commission business, accounting for roughly half of all revenue models. This could be related to the often open-source nature of the corresponding software solutions, which is why sales are less easily generated via the IT-driven models. However, the technology often

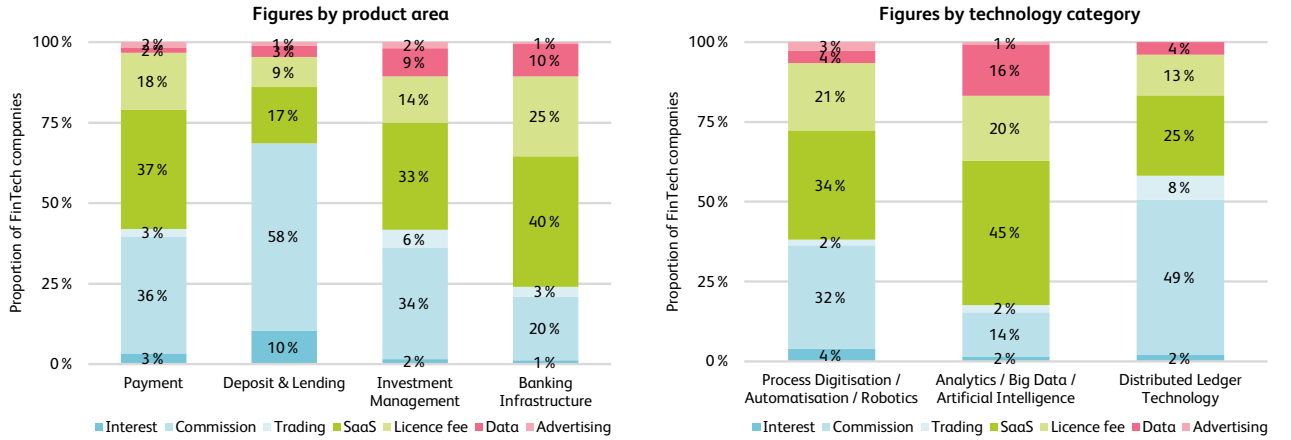

Figure 2.13: Proportion of FinTech companies by revenue model, and by product area (left-hand graph) and technology category (right-hand graph) (n=505)

serves as a direct intermediary, e.g., in the case of decentralised exchanges, which is why commissions are in many cases suitable for generating turnover.

2.1.5 Partners

FinTech companies often do not cover all processes in the value chain of their business in-house but instead utilise the potential of partnerships with other companies. Such partnerships can involve technology companies, e.g., for cloud or cybersecurity services, or traditional financial institutions. The latter can be used in particular to gain access to an existing customer pool or to ensure compliance with regulatory requirements.

In the Swiss and Liechtenstein FinTech sector, the most frequently named partners belong to these two types of companies. The most frequently mentioned company is SIX, with 27 mentions on websites of the 505 in-scope FinTech companies. Microsoft and UBS[7] follow in second place with 21 mentions each. The list of the top five partners in the Swiss and Liechtenstein FinTech sector is completed by Swisscom and PostFinance, with 17 and 14 mentions, respectively.

[7] As a result of the takeover of Credit Suisse by UBS, Credit Suisse's mentions were also attributed to UBS.

2.2. Sustainable FinTech

The consideration of sustainability in the banking and finance sector has gained increasing attention in recent years. This is also reflected at the investor level, with analyses showing that around half of people in Switzerland say they have a (certain) preference for sustainability in financial investments (Dietrich et al., 2024). The topic is also highly relevant at a regulatory level, as the new self-regulation of the Swiss Bankers Association came into force on 1 January 2024, which obliges banks to survey the sustainability preferences of their customers (Swiss Bankers Association, 2023a). If customers express sustainable investment preferences, banks hence have to ensure that the investment products they offer are in line with these preferences.

Such changes in the banking landscape also offer potential for the FinTech sector to efficiently meet the new requirements with innovative solutions. Accordingly, the term "Sustainable FinTech" is increasingly being used in this context. The aim of this section is therefore to analyse the relevant developments in the Swiss and Liechtenstein FinTech sector in a structured manner.

2.2.1 Definition of Sustainable FinTech

The definition of "Sustainable FinTech" used for this study is derived directly from the definition of the more general term "FinTech" in Chapter 1 and reads as follows:

> **Sustainable** FinTech is defined as technology-based solutions for **sustainable** innovative products, services, and processes in the financial industry, improving, complementing, and/or disrupting existing offerings. Hence, **sustainable** FinTech companies are firms whose main activities, core competencies, and/or strategic focus lie in developing those solutions **with the principal goal to contribute to sustainable development**.

Compared to the general definition of "FinTech", which combines the dimensions of technology and finance in particular, "Sustainable FinTech" is characterised by the additional focus on sustainable solutions. This focus is interpreted relatively strictly in the following analysis. To be considered a sustainable FinTech company, it is therefore not enough to make certain selected processes, products, or services in the value chain of the corresponding solution sustainable. Rather, the focus on sustainability must be anchored in a company's business strategy. It should be noted that due to the lack of numerical measurability of a company's sustainability focus, the differentiation between sustainable and non-sustainable FinTech is not trivial in certain cases.

It should also be noted that sustainability is a multifaceted concept. A widely used framework for understanding sustainability is to categorise it into three main dimensions "Environmental", "Social", and "Governance", commonly referred to as "ESG". Alternatively, sustainability can also be assessed against the United Nations' 17 Sustainable Development Goals.

In the present analysis, a general distinction is made between "social", "green" (also known as "environmental"), and "sustainable supporting activities" FinTech companies which support sustainability within the financial industry.[8] The same classification was already used in the initial analysis of sustainable FinTech companies in last year's edition of this study, and therefore allows for comparability of the corresponding figures. For green FinTech companies, the taxonomy by Green Digital Finance Alliance and Swiss Green Fintech Network (2021) is additionally used for further in-depth classification of the corresponding companies' business models.

2.2.2 Market Overview of Sustainable FinTech

In line with the growth of the overall FinTech sector in Switzerland and Liechtenstein, the number of sustainable FinTech companies also increased in 2023. This can be seen in Figure 2.14, which shows the number of sustainable FinTech companies by year, and by product area (left-hand chart) and technology category (right-hand chart).

At the end of 2023, there were a total of 49 companies that met the sustainable FinTech criteria described in Section 2.2.1. At the end of 2022, this figure was still 32, which implies an annual growth rate of 53 percent. Growth in the area of sustainable FinTech has therefore been greater than for the FinTech sector as a whole, which recorded growth in the number of companies of 16 percent last year. From a regional perspective, the largest cluster of sustainable FinTech companies can be found in the canton of Zurich (22 companies), followed by Geneva and Zug (8 each), Basel-City and Schwyz (3 each), Vaud (2), and Jura, Neuchâtel, and Thurgau (1 each).

The left-hand chart in Figure 2.14 shows that most sustainable FinTech companies can be found in the product areas of *Investment Management* (28 companies) and *Banking Infrastructure* (15 companies). As can be seen from the technological perspective in the right-hand graph in Figure 2.14, sustainable FinTech companies predominantly use concepts from the category *Analytics / Big Data / Artificial Intelligence* (27 companies). This is also the category which showed the largest absolute growth year-over-year.

[8] See Section 2.2 of Ankenbrand, Bieri, Kronenberger, and Reichmuth (2023) for more details on this categorisation.

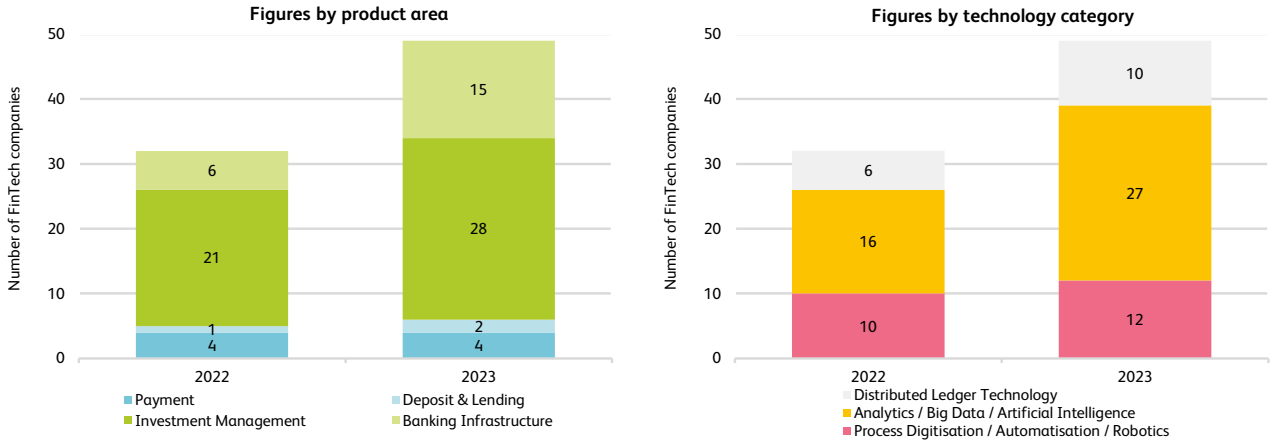

Figure 2.14: Number of sustainable FinTech companies by year, and by product area (left-hand graph) and technology category (right-hand graph)

The breakdown of Swiss sustainable FinTech companies into the focus categories "Green", "Social", "Green & social", and "Sustainable supporting activities" for the last two years is shown in Figure 2.15.

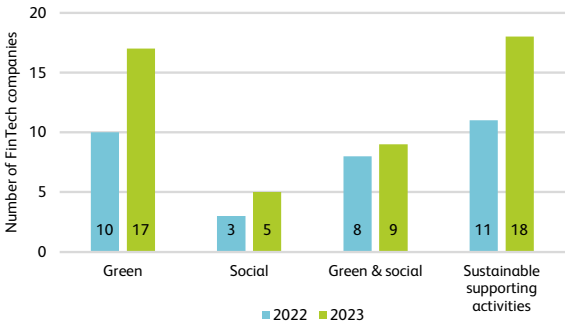

Figure 2.15: Number of sustainable FinTech companies by sustainability focus (n_{2023}=49)

It reveals that as per the end of 2023 most sustainable FinTech companies fell under the focus category "Sustainable supporting activities" and hence provide solutions to enhance the decision-making process by offering data and analytical insights for sustainability assessments in the financial sector. The second-largest focus category is "Green" with a total of 17 companies at the end of 2023. FinTech companies in this category aim to have a direct, real positive impact on the environment, e.g., by providing platforms to invest in climate projects or renewable energy. FinTech companies that focus on the social dimension of sustainability represent the smallest group with five companies in 2023. These include, for example, solutions that promote the financial inclusion of certain population groups by offering specific services and products for the relevant clientele. There is also a group of eight companies in the "Green & social" focus category that aim to achieve a positive impact on both the environment and society with their solutions. Figure 2.15 also shows that the two largest focus categories at the end of 2023 are also those with the highest absolute growth in a year-over-year comparison.

The founding years of the sustainable FinTech companies based in Switzerland are shown in Figure 2.16, broken down into four different sustainability focuses.

It presents that around half of all sustainable FinTech companies were founded in the last three years, which indicates a certain momentum in this area. The figure also implies that the annual growth in the total number of corresponding companies from 32 to 49 is not only due to new company incorporations in 2023, as these amounted to only two (out of a total of five incorporations in the en-

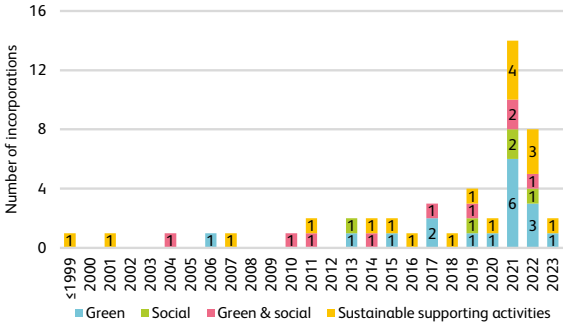

Figure 2.16: Number of sustainable FinTech company incorporations per year (n=49)

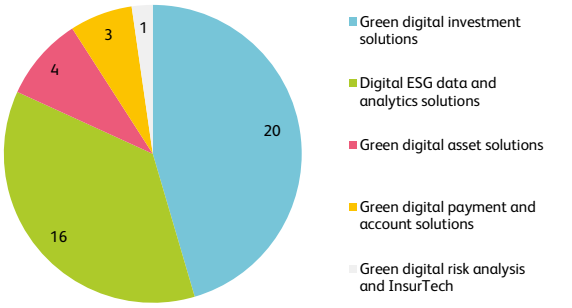

Figure 2.17: Number of sustainable FinTech companies according to the taxonomy of Green Digital Finance Alliance and Swiss Green Fintech Network (2021) (n=44)

tire FinTech sector, i.e., including also non-sustainable FinTech companies). Rather, the increase is driven by companies that were legally registered earlier than 2023 but only shifted their business model towards sustainable FinTech in the last year. In terms of sustainability focus, it can be seen that companies with purely environmental or social objectives tend to have been founded comparatively more recently.

Another way of classifying the focus of sustainable FinTech companies, particularly those with environmental objectives, is the taxonomy provided by the Green Digital Finance Alliance and Swiss Green Fintech Network (2021). A corresponding evaluation is given in Figure 2.17. Note that as the taxonomy does not directly cover the social dimension of sustainability, the five Swiss sustainable FinTech companies in this focus category are not considered in the figure.

The breakdown shows that Swiss sustainable FinTech companies predominantly provide green digital investment solutions (20 companies) and digital ESG data and analytics solutions (16). Solutions in the areas of green digital assets (4 companies) and green digital payment and accounts (3 companies) follow at a considerable distance. In addition, a single company offers solutions in the area of green digital risk analysis and InsurTech. No company provides solutions in one of the remaining three categories of the taxonomy, i.e., green digital crowdfunding and syndication platforms, green digital deposit and lending solutions, and green RegTech solutions.

2.3. Funding of FinTech Companies

This section analyses the financing activities that are driving the development of the FinTech sector as a key resource, as well as the exit strategies of the corresponding companies. Specifically, the analysis includes venture capital investments (Section 2.3.1), token sales (Section 2.3.2), acquisitions (Section 2.3.3), and initial public offerings (Section 2.3.4).

2.3.1 Venture Capital

Venture capital (VC) investments play a strategic role in the development and maturation of FinTech companies, offering not just financial backing but often also strategic guidance and industry validation.

The number of venture capital rounds in FinTech globally and corresponding volumes by year are depicted in Figure 2.18. The figure reveals that VC activity has increased from 2015 to the peak year 2021, when 6,172 VC rounds raised USD 140.8 billion. In contrast, the figures observed for 2023 are significantly lower, with 3,801 deals and a total funding volume of USD 39.2 billion. Compared to the previous year, the volume has roughly halved, which indicates a significant slowdown in VC activities in the global FinTech sector.

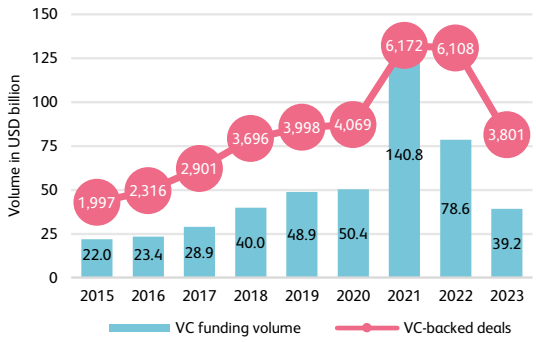

Figure 2.18: Global venture capital investments in FinTech (sources: CB Insights (2022, 2024a))

A similar trend can also be observed in Switzerland.[9] While VC activity in the Swiss FinTech sector was still able to defy the global decline last year, a significant decline in both the number of deals and the volume raised can be observed for 2023. This is underlined by Figure 2.19, which shows the number of VC rounds in the Swiss FinTech sector by year (left-hand graph) and the corresponding volumes raised (right-hand graph). In both graphs, a distinction is made between three different funding stages. Specifically, the figure distinguishes between Seed funding for initiating a business, Series A funding for growing a business, and Series B funding for scaling a business.

The left-hand graph of Figure 2.19 reveals that the number of total VC rounds fell from 84 in 2022 to 68 in 2023, representing a decline of 19 percent. Of the total rounds in 2023, 35 can be attributed to Seed funding, 18 to Series A funding, and 15 to Series B funding. In a year-over-year comparison, a decline can be observed for all three financing stages. In line with the number of financing rounds, a decline in the financing volume can also be observed, as shown in the right-hand graph of Figure 2.19. In total, Swiss FinTech companies were able to raise CHF[10] 457 million in VC funds in 2023. This corresponds to a decrease of 24 percent compared to the peak year 2022, which had a total VC volume of CHF 605 million.[11] The sharpest decline was recorded for Series B financing rounds and is related to the fact that, in contrast to the previous year, they did not see any so-called mega rounds, i.e., rounds with a financing volume of more than CHF 100 million, in 2023. While there was also a slight year-over-year decline in Series A financing, the volume of Seed financing

[9] Note that the Principality of Liechtenstein is not included in the analysis of financing activities.

[10] The conversion of non-CHF volumes to CHF volumes has been executed utilising the average exchange rates prevailing throughout the year 2023.

[11] Note that there may be small differences between the figures described in the text and those shown in the illustrations due to rounding differences.

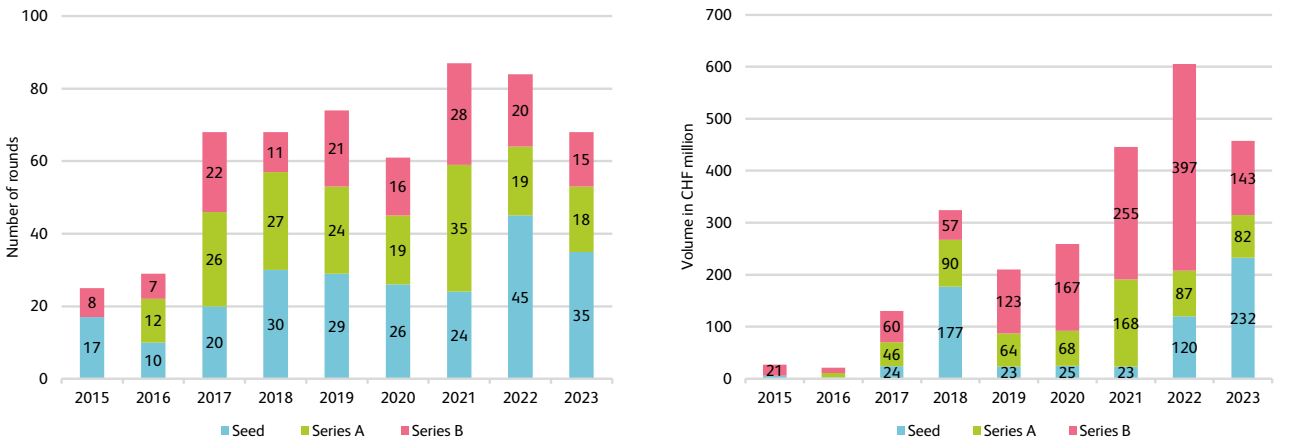

Figure 2.19: VC activity in the Swiss FinTech sector in 2023

increased from CHF 120 million in 2022 to CHF 232 million in 2023. This increase was mainly driven by the mega-round of Haqq Association, raising a total of USD 200 million in the first half of 2023 (Wamda, 2023). This financing round is also the largest in the Swiss FinTech sector in 2023, followed by Taurus SA's round of CHF 65 million (Taurus, 2023) and SwissBorg Invest SA's round of CHF 21.2 million (SwissBorg, 2023).[12] Despite these significant rounds, it can be said, however, that general VC activities in Switzerland also cooled down in 2023, similar to the global trend.

A breakdown of the financing rounds and volumes into product areas (left-hand graph) and technology categories (right-hand graph) can be found in Figure 2.20. The left-hand graph shows that with 29 rounds, most VC deals were conducted by Swiss FinTech companies in the *Investment Management* product area, although the volume raised, i.e., CHF 90 million, is only the second largest. In terms of volume, the *Banking Infrastructure* product area is the largest, raising a total of CHF 314 million in 20 rounds. FinTech companies from the product areas of *Deposit & Lending* (9 rounds; CHF 36 million) and *Payment* (10 rounds; CHF 18 million) recorded the least VC activity, both in terms of total financing rounds and funds raised.

[12]Note that Tradeplus24 AG's CHF 45 million mezzanine facility (Startupticker.ch, 2023) is not included in the evaluation.

The right-hand graph of Figure 2.20 reveals that the technology categories *Process Digitisation / Automatisation / Robotics* and *Distributed Ledger Technology* are leading in terms of the number of financing rounds in 2023 with 25 each. However, the funds raised in the latter category are significantly higher, totalling CHF 337 million compared to CHF 53 million. FinTech companies in the category *Analytics / Big Data / Artificial Intelligence* raised a total of CHF 68 million in 18 financing rounds. Given the absence of FinTech companies in the *Quantum Computing* category, there is no recordable venture capital activity within this category in FinTech companies for the year 2023.

A breakdown of VC volumes by canton for the last two years is presented in Figure 2.21. It emphasises that the canton of Zug accounted for the largest VC volume in 2023 at CHF 227 million, which is only slightly below the level reported for the year 2022. At CHF 100 million, Zurich had the second-largest volume in 2023 but recorded a significant decline of CHF 154 million, or minus 61 percent in relative terms, compared to the previous year. The canton of Geneva is in third place, with a financing volume of 89 million in 2023, similar to that of 2022. It is followed by Vaud and all other Swiss cantons combined, with CHF 22 million and CHF 18 million in 2023, respectively.

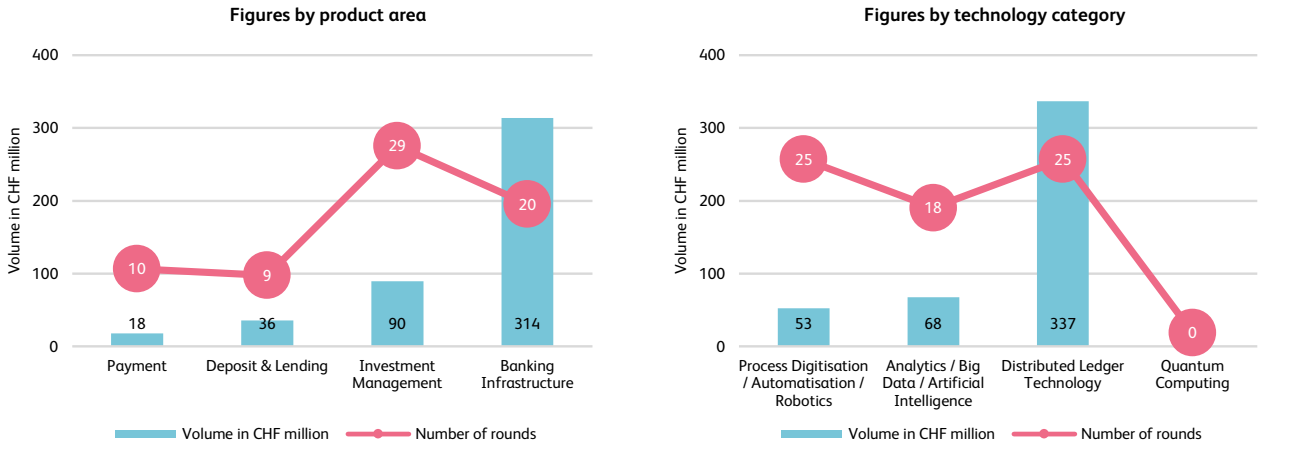

Figure 2.20: VC investments in Swiss FinTech companies in 2023 by product area (left-hand graph) and technology category (right-hand graph)

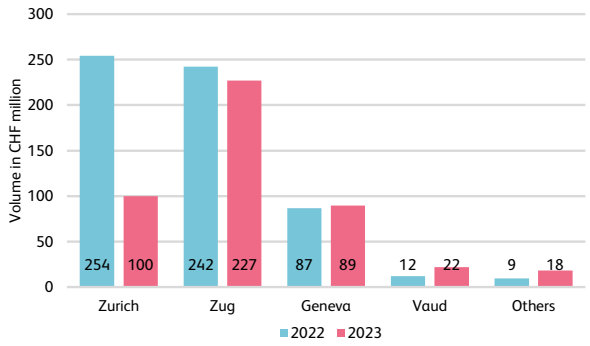

Figure 2.21: VC volume in Swiss FinTech companies in 2022 and 2023 by canton

2.3.2 Token Sales

Token sales are a comparatively newer approach to fundraising for FinTech companies utilising distributed ledger technology. In addition to raising funds, the resulting distribution of tokens among investors allows companies to tailor their corporate strategies to the specifics of their technological innovations.

In 2023, a total of USD 362 million was raised in 767 public token sales across all industries globally (CryptoRank, online). This represents a significant decrease compared to previous years 2021 and 2022, in which USD 2.1 billion and USD 670 million were raised in 1,772 and 1,199 token sales, respectively (CryptoRank, online). Public token sales therefore appear to have lost further relevance as an alternative form of financing in the past year.

In the Swiss and Liechtenstein FinTech sector, financing rounds based on public token sales tend to be an exception. In 2023, WeCanGroup SA was the only resident FinTech company to conduct a reported token sale (WeCan Group, 2023).

2.3.3 Acquisitions

In the past, the FinTech industry has seen acquisitions as a consequential exit strategy for the acquired FinTech company. In this context, an exit strategy refers to a deliberate move by stakeholders, such as founders and investors, to divest their interests in the company, to access new resources, or to expand market reach, for example.

Figure 2.22 shows the number of acquisitions of FinTech companies by year and by continent. The number of acquisitions of FinTech companies worldwide since 2010 totals 1,570. Acquisition activity increased continuously from 2010 to 2021 and has been declining since then. A total of 214 takeovers of FinTech companies were counted worldwide in 2023. This signifies a 29 percent decrease compared to the figures recorded in 2022 and a 40 percent decline compared to the peak levels observed in the year 2021. From a continental perspective, North America accounted for the largest share of acquired FinTech companies in 2023 with 42 percent, followed by Europe with 36 percent and Asia with 16 percent.

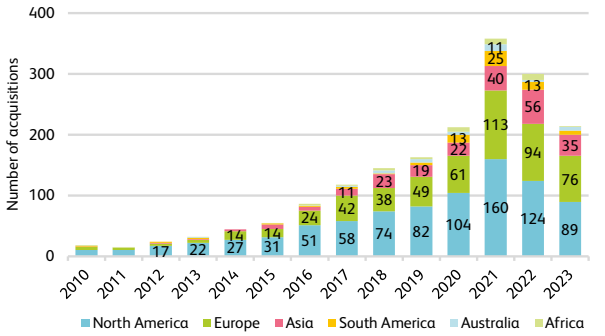

Figure 2.22: Number of FinTech acquisitions by continent and year (source: Crunchbase (online))

In Switzerland, the year 2023 counted several takeovers of FinTech companies. Examples of acquired companies include eCollect AG (eCollect, 2023), Heidi Pay AG (Compass, 2023), IMburse AG (IMburse, 2023), and Metaco AG (Metaco, 2023).

2.3.4 Initial Public Offerings

The decision to go public through an Initial Public Offering (IPO) is a multi-layered strategy for the stakeholders of a FinTech company that typically goes beyond a mere sale. An IPO is a transformative financial event that offers a spectrum of motivations for stakeholders such as founders, early investors, and employees. In addition to

realising liquidity through the sale of shares, stakeholders may be driven by a strategic focus and see the IPO as an opportunity to join a broader investor base and raise the company's profile in the market.

Figure 2.23 shows the number of IPOs by year and by continent. Since 2010, a total of 286 IPOs of FinTech companies has taken place. With a total of 49, most of these were recorded in 2021. In 2023, however, there were only eleven IPOs of FinTech companies globally, a figure that has not fallen short of since 2012. Of these eleven IPOs, eight took place in North America, two in Asia, and one in Europe.

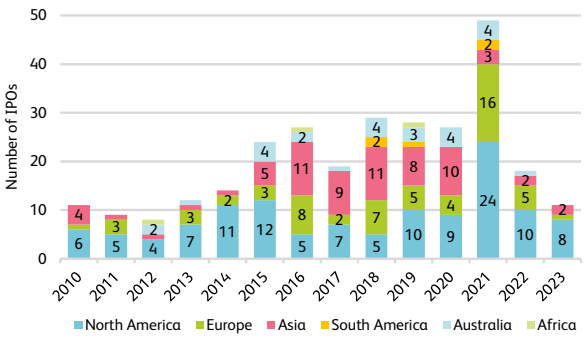

Figure 2.23: Number of FinTech IPOs by continent and year (source: Crunchbase (online))

Measured against the IPOs of companies from all sectors, which totalled 1,298 in 2023 (Ernst & Young, 2024), the FinTech sector only accounted for around one percent. In earlier years, this share was over two percent, which shows that IPO activity in the FinTech sector has slowed compared to other sectors. Furthermore, 17 of the total of 286 IPOs of FinTech companies since 2010 were delisted again, which corresponds to around six percent of the total.

In Switzerland, no public sale of a FinTech company was observed in 2023.

2.4. Summary

The Swiss FinTech market, which is predominantly internationally oriented and mostly targets business clients, continued to grow in 2023. At the end of 2023, together with Liechtenstein, it counted a total of 505 companies. Compared to previous years, companies offering comparatively more innovative technologies in the categories of analytics, big data, artificial intelligence, and DLT have grown the most. In addition, the group of sustainable FinTech companies has an even higher annual growth rate than the sector as a whole, which indicates increasing traction in this area that is also becoming more and more relevant for the traditional financial industry.

Apart from the positive growth figures, there are recognisable signals that point to areas with potential challenges or weaknesses. Two of these signals are the comparatively low number of new FinTech company foundations in Switzerland and Liechtenstein in 2023, as well as the decline in financing activities in the sector. In addition, the sector has a significantly lower proportion of women on boards of directors compared to the traditional financial industry, which indicates a gender gap.

3. Globally Listed FinTech Companies

By Thomas Ankenbrand, Denis Bieri & Levin Reichmuth, Institute of Financial Services Zug IFZ

IPO activity in the FinTech sector has declined globally in recent years (see Section 2.3.4). Still, the share price performance of the respective companies can be an indicator of the attractiveness of the sector from an investor's perspective and thus offers valuable insights into market sentiment, perceived growth potential, technological advances, and the general state of the sector.

In this chapter, a FinTech index is constructed for this purpose, which includes the globally listed FinTech companies and thus offers the possibility of comparing the sector with other (industry) indices. While Section 3.1 contains information on the corresponding methodology and the data basis, Section 3.2 shows the results of the corresponding procedure.

3.1. Data and Index Construction

The construction of an industry index is not trivial and can be done in various ways. In addition to the decision on the weighting of the index components, the definition of the sample and thus the collection of the corresponding data is of significant relevance. With regard to the latter, the following steps were carried out:

Step 1: The Crunchbase (online) database was utilised to identify a comprehensive list of companies which are tagged with a "FinTech" label and also having the status "listed" or "delisted". This search resulted in an initial sample of 424 companies.

Step 2: Publicly available data was collected to classify these FinTech companies. In particular, the companies were categorised in the FinTech grid outlined in Chapter 1 and segmented according to their customers (i.e., B2B and / or B2C) and markets served (i.e., national or international). As part of this classification, further 84 companies were excluded from the analysis, as their business focus, as is the case with InsurTechs or venture capital firms, for example, was evidently not compatible with the definition of FinTech in Chapter 1.

Step 3: The data provider Bloomberg was accessed to capture relevant information for each company, including its stock price ticker, monthly stock prices, and monthly market capitalisations, both in USD. The latter was particularly important for excluding "micro caps" referring to FinTech companies with a market capitalisation of less than USD 150 million, in order to mitigate extreme return and volatility patterns. After correcting for micro caps, the final sample as of 31 December 2023 amounted to 276 companies. Compared to last year, the sample size has increased from 102 to 276 FinTech companies in the current year. This increase can be explained by the fact that more FinTech companies were included due to the generally better availability of data and that fewer micro-cap companies were excluded at the end of 2023 compared to the end of 2022 due to the generally larger market capitalisation of the companies.

Following this comprehensive data collection, an equally weighted and, since its first edition in 2021, yearly rebalanced global FinTech index was established[1], known as the "IFZ FinTech Index". As of 31 December 2023, the 276 index constituents had a cumulative market capitalisation of USD 1,860 billion, as shown in the portrait of the index in Table 3.1.

The portrait furthermore highlights that the composition of the index from a product area perspective consists of 40.9 percent companies from the *Banking Infrastructure* area, followed by *Investment Management* (21.4 %), *Payment* (20.3 %), and *Deposit & Lending* (17.4 %). Compared to the FinTech sector (see Figure 2.4), the index therefore appears to be more evenly distributed across the product areas. In addition, the *Banking Infrastructure* area is over-represented among the globally listed

[1] A justification for this approach can be found in Chapter 7 of Ankenbrand et al. (2022).

FinTech companies compared to Switzerland, while the *Investment Management* area is comparatively less well served.

The technology perspective shows that the globally listed FinTech companies clearly rely most on relatively established approaches from the category *Process Digitisation / Automatisation / Robotics*, accounting for around two-thirds of all companies. More innovative technologies from the categories *Analytics / Big Data / Artificial Intelligence* and *Distributed Ledger Technology* are only used by 19.5 and 13.8 percent of companies, respectively. This is in clear contrast to the Swiss FinTech sector (see Figure 2.4), where comparatively innovative technologies, particularly from the category *Distributed Ledger Technology*, are used significantly more frequently. One reason for the lower proportion of innovative technologies by listed companies could have to do with the fact that they are already more established in the market, which might have often been achieved by providing less experimental technological approaches to the rather risk-averse financial services industry.

With regard to the targeted customer segments, the index portrait in Table 3.1 highlights that globally listed companies predominantly pursue a pure B2B customer strategy (40.6 % of companies), followed by a combined B2B and B2C (30.1 %) strategy. A pure focus on the B2C segment is pursued by 29.3 percent of companies. In addition, around one-third of the companies are targeting their national market, while two-thirds are internationally oriented. Compared to the Swiss FinTech sector, they are therefore more nationally oriented and have a stronger focus on private customers. This difference might be related to the relatively small Swiss market, which makes a pure focus on resident private customers less attractive.

Finally, Table 3.1 shows the regional exposure of the "IFZ FinTech Index". Accordingly, companies from North America account for 46.0 percent of all index constituents. The second largest share is accounted for by companies from Europe (28.3 %), followed by companies from Australia (12.3 %). The other continents account for 13.4 percent of the index constituents. Note that compared to Figure 2.23, listed FinTech companies from Asia seem to be underrepresented in the index. This is primarily due to a high proportion of micro caps (36 companies) and partly due to the lack of price data for the stocks of companies from the respective continent. In contrast, companies from Australia tend to be slightly over-represented, likely because of few micro caps and high data availability.

Table 3.1: Portrait of the "IFZ FinTech Index" as of 31 December 2023

IFZ FinTech Index	
Currency	USD
Number of constituents	276
Market capitalisation in USD billion	1,860
Product area exposure	
Payment	20.3 %
Deposit & Lending	17.4 %
Investment Management	21.4 %
Banking Infrastructure	40.9 %
Technology category exposure	
Process Digitisation / Automatisation / Robotics	66.7 %
Analytics / Big Data / Artificial Intelligence	19.5 %
Distributed Ledger Technology	13.8 %
Customer segment exposure	
B2B	40.6 %
B2B & B2C	30.1 %
B2C	29.3 %
Market served exposure	
National	31.5 %
International	68.5 %
Regional exposure	
North America	46.0 %
Europe	28.3 %
Australia	12.3 %
Others	13.4 %

3.2. Performance of the IFZ FinTech Index

In this section, the performance of the "IFZ FinTech Index" is visualised and analysed. The observation period covers the period from 2015 to 2023. The start year 2015 is due to the increased number of IPOs in the corresponding year, with more than 20 such equity financing transactions counted for the first time globally (see

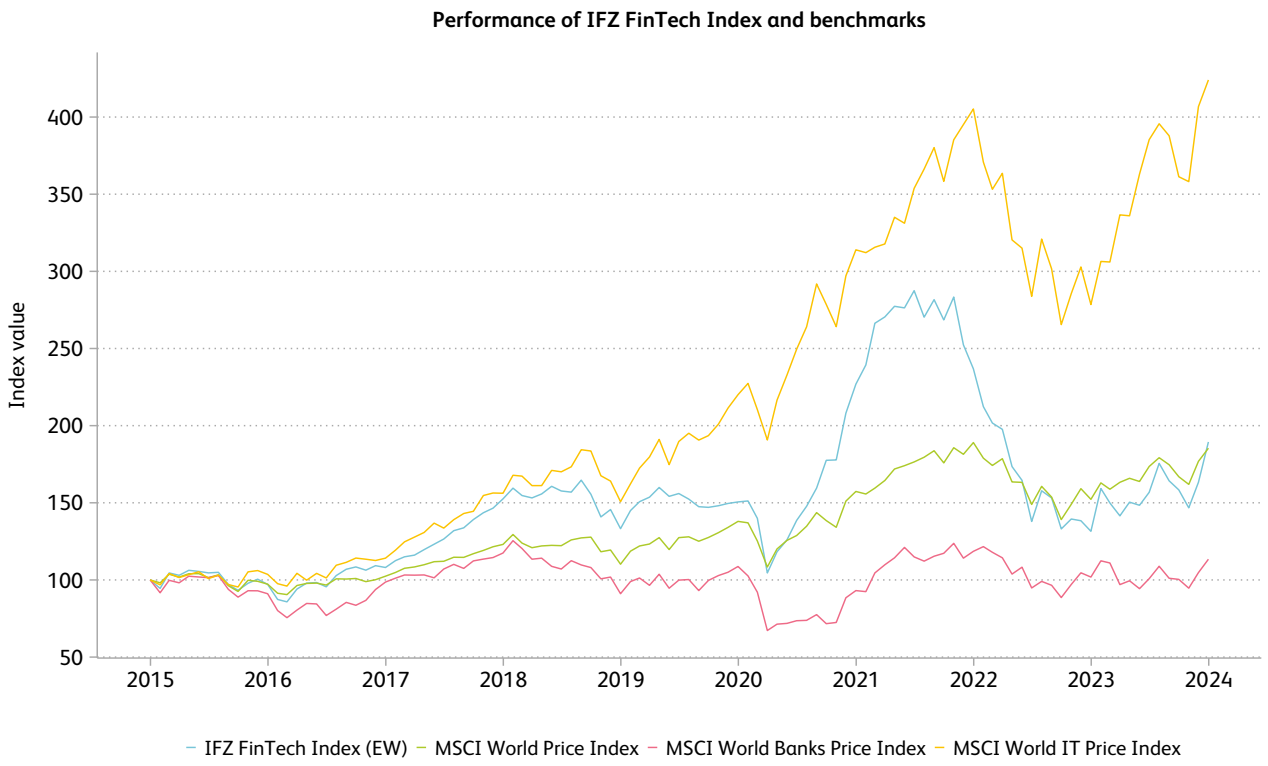

Figure 3.1: Comparison of the "IFZ FinTech Index" with selected benchmarks

Figure 2.23). A global IT index and a global banking index serve as benchmarks for the "IFZ FinTech Index", as FinTech operates at the interface between technology and finance. Specifically, the "MSCI World Information Technology Price Index" and the "MSCI World Banks Price Index" are used alongside the "MSCI World Price Index" as a proxy for the development of the general global equity market.[2]

The performance of the three MSCI price indices mentioned and that of the "IFZ FinTech Index" is illustrated in Figure 3.1, with their levels indexed to 100 in 2015 in each case.

The figure shows that the index for the IT industry clearly performed best over the entire observation period, with a cumulative return of 324 percent. The cumulative return is very similar for the global equity index (85 %) and the FinTech index (89 %), although the latter was clearly subject to stronger fluctuations. The worst-performing index is the banking index, with a total return of 13 percent between the beginning of 2015 and the end of 2023. The year 2023 reveals a similar trend in the returns of the four indices compared to the entire observation period. While the IT index again yields the highest return of 52 percent over the specified period, the FinTech market outperforms the overall stock market performance, achieving a return of 44 percent compared to the latter's 22 percent. The banking sector is again the worst performer, with a return of 11 percent in 2023.

The annualised performance indicators for return, risk, measured by the standard deviation of returns, and the Sharpe ratio, a measure for quantifying the risk-adjusted performance of an investment, are shown in Table 3.2. It indicates that, over the observation period, the average annual return for the IT index stood at 17.4 percent,

[2] Corresponding data was obtained from Bloomberg.

Table 3.2: Annualised performance metrics of the "IFZ FinTech Index" and benchmarks

Index	Mean return	Volatility	Sharpe ratio
IFZ FinTech	7.4 %	24.5 %	0.24
MSCI World	7.1 %	15.6 %	0.37
MSCI World Banks	1.4 %	23.0 %	0.003
MSCI World IT	17.4 %	19.9 %	0.80

the FinTech index registered 7.4 percent, the general stock index displayed 7.1 percent, and the banking index reported a comparatively lower 1.4 percent. The risk measure for the four indices, i.e., the standard deviation of returns, shows that higher returns are not consistently associated with a higher risk. While the corresponding measure for the IT index is 19.9 percent and for the FinTech index 24.5 percent, it is significantly lower for the general stock index at 15.6 percent, respectively. The bank index displays a standard deviation of 23 percent and is therefore the second most volatile. The Sharpe ratio provides a risk-adjusted view of the performance of the four different indices. It quantifies the risk-adjusted return of an investment by assessing the excess return[3] per unit of risk, where risk is again measured as the standard deviation of returns. In simpler terms, it gauges how much return an investment achieves relative to the volatility or risk it carries. Hence, a higher Sharpe ratio indicates a more favourable risk-adjusted performance. Table 3.2 presents that the risk-adjusted performance was largest for the IT index, with a Sharpe ratio of 0.80. The general stock market index follows in second place. Although this index yields a lower cumulative return compared to the FinTech index, it does so with a clearly lower risk. The resulting Sharpe ratio of 0.37 is therefore higher than that of the FinTech index with 0.24. In risk-adjusted terms, the banking sector clearly performed the worst over the observation period, achieving a Sharpe ratio of 0.003.

The index comparison therefore shows that the (risk-adjusted) performance of the listed FinTech companies cannot keep up with that of the IT industry. However, it has been significantly better than that of the banking industry. In terms of its risk and return profile, the FinTech sector is therefore positioned between the two sectors for which it serves as an intersection. However, the comparison shows that in terms of performance, it is closer to the comparatively lower-performing banking industry than to the IT industry, which performed better over the period under review. Compared to the general stock index, the FinTech index performs worse on a risk-adjusted basis.

In addition to the creation of the general "IFZ FinTech Index", the categorisation of the globally listed FinTech companies into the FinTech grid also allows the calculation of sub-indices based on the corresponding product areas and technology categories. The sub-indices for the product areas are illustrated in Figure 3.2.

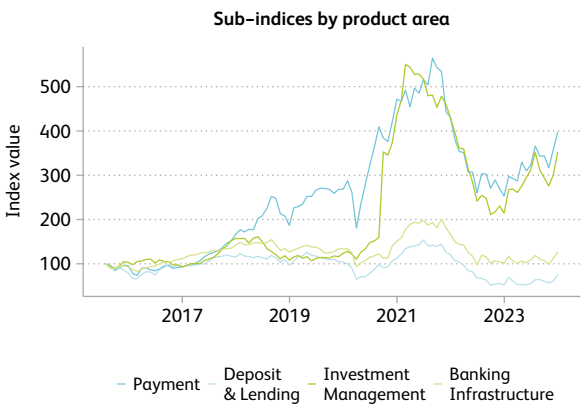

Figure 3.2: Comparison of the product area sub-indices

The figure shows that the performance of the areas can be divided into two clusters. The first cluster represents those from the areas of *Payment* and *Investment Management*, i.e., those indices that show a clearly positive performance over the observation period. By contrast, product areas *Deposit & Lending* and *Banking Infrastructure*, the second cluster, performed comparatively worse. The same conclusion can also be drawn for the year 2023. Translated into annualised performance, this results in an annualised return of 17.8 percent for the *Payment* product area, 16.1 percent for *Investment Management*, 2.9 percent for *Banking Infrastructure*, and minus 3.2 percent for *Deposit & Lending*. A risk-adjusted analysis based on the Sharpe ratio does not change this order. With Sharpe ratios of 0.50 and 0.30, these are clearly the highest for the *Payment* and *Investment Management* areas, respec-

[3] As all price indexes are denominated in USD, the risk-free rate to calculate the excess returns is defined as the US 1 Month Treasury Bill rate.

tively. Those for the areas *Banking Infrastructure* and *Deposit & Lending* are significantly lower at 0.06 and minus 0.15, respectively.

The sub-indices categorised by technology are illustrated in Figure 3.3. It's important to highlight that, as of 2021, no sub-index was computed for the category of *Distributed Ledger Technology*. This absence is attributed to the fact that, by that point, the minimum requisite of five companies in the sub-index had not been met, preventing the attainment of an essential level of diversification in the index.

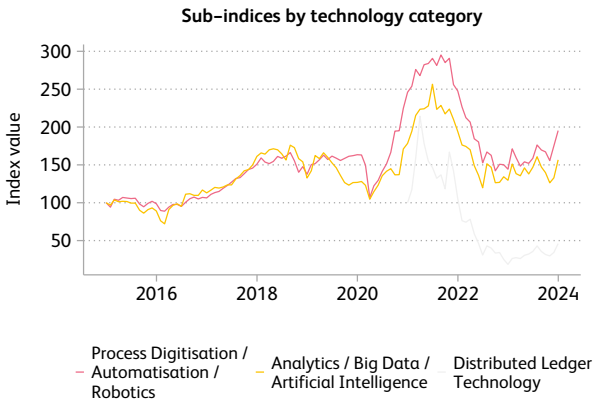

Figure 3.3: Comparison of the technology category sub-indices

A comparison of the index developments shows that the performance of the two technology categories *Process Digitisation / Automatisation / Robotics* and *Analytics / Big Data / Artificial Intelligence* is both relatively high, with cumulative returns of 95.3 and 56.6 percent, respectively, over the observation period. At minus 54.0 percent, the category *Distributed Ledger Technology* is the only sub-index to achieve a negative cumulative return. One explanation for this could be the general price trend in the crypto asset market, which was also strongly negative from the end of 2021 to the end of 2022. The negative development of the *Distributed Ledger Technology* sub-index is also reflected in the annualised return, which is minus 22.8 percent, while those of the two technology categories *Process Digitisation / Automatisation / Robotics* and *Analytics / Big Data / Artificial Intelligence* stand at 7.7 and 5.1 percent, respectively. The risk-adjusted analysis based on the Sharpe ratio also shows that the latter two categories, with values of 0.27 and 0.13, respectively, are clearly ahead of the DLT category, which has a Sharpe ratio of minus 0.32. What all categories have in common is that they all recorded a positive return in the last year of the observation period, i.e., in 2023.

It should be noted at this point that past performance is by no means indicative of future performance and that the figures only reflect globally listed FinTech companies. In a fast-moving sector such as FinTech in particular, market dynamics can change rapidly. It will therefore be interesting to see how the sector performs in the future in relation to its related established industries, i.e., the IT and banking sectors. Further observation of the product area and technology category-related sub-indices may also be of interest in order to recognise any changes in the corresponding market expectations.

4. FinTech Hub Ranking

By Thomas Ankenbrand & Denis Bieri, Institute of Financial Services Zug IFZ

This chapter introduces the eighth edition of the FinTech hub ranking, aiming to assess the appeal of various destinations for FinTech companies and to highlight potential changes in their competitive standings. A recurring key insight from previous rankings has emphasised Switzerland's favourable environment for the FinTech industry. The ensuing FinTech hub ranking serves as a valuable tool for tracking shifts in the conditions surrounding FinTech companies. Such insights are important for adjusting policies and strategies to ensure the long-term sustainability and competitiveness of these FinTech ecosystems.

4.1. FinTech Hub Ranking

The FinTech hub ranking is a comprehensive evaluation of the attractiveness of 35 diverse cities for FinTech companies. The primary focus is on assessing these locations through the lens of the PEST framework, which examines the political/legal, economic, social, and technological dimensions. This structured framework provides a systematic analysis of the environmental factors that impact the FinTech industry.

The performance evaluation of each location within these four dimensions is grounded in publicly available indicators. Notably, the composition of these indicators has undergone some adjustments compared to the previous year's assessment. This adaptation is essential to ensure that the rankings reflect the most current and relevant information, as outdated indicators could present an inaccurate portrayal of a location's appeal.

Specifically, indicators that had not been updated for more than two years and for which no update has been announced were removed from consideration. In contrast, indicators that, while not updated, remained current within the past two years were retained in the ranking, maintaining continuity while accommodating the evolving landscape of FinTech competitiveness.

Such properties relate to the following indicators:

- **Exclusions** (older than two years): Human Capital Index (country)
- **No update** (not older than two years): Cities Competitiveness Index (city), Digital Competitiveness Index (country), Digital Skills Index (country), Global Talent Competitiveness Index (city), Global Cybersecurity Index (country), Financial Secrecy Index (country), Ease of Getting Credit Index (country), Ease of Protecting Minority Investors Index (country), Resolving Insolvency Index (country), Ease of Starting a Business Index (country)

One indicator was therefore removed in the year-over-year comparison. No update for 2023 was available for ten indicators, but the last available figures were not older than 2021.

Altogether, the ranking incorporates a total of 72 distinct indicators. Among these, eleven are specific to individual cities, while 61 operate at the national level. This arrangement implies that, despite the FinTech hub ranking being carried out at the city level, the majority of the indicators gauge the performance of an entire country. Consequently, locations within the same country typically exhibit closely aligned performances in the FinTech hub ranking.

To assess the performance of the 35 cities included in this year's ranking and compute their overall scores, the following methodological steps are employed:

Step 1: Each of the 72 performance indicators is categorised based on its alignment with one of the four PEST dimensions. A comprehensive list of all indicators, along with their sources and their association with the PEST dimensions, can be found in Appendix B.

Step 2: For every individual indicator, a unique ranking is established for all 35 cities within the scope of the assessment. This results in 35 distinct scores, ranging from 1 (representing the lowest-performing city) to 35 (indicating the top-performing city). In cases where data is missing,

the void is filled with the average rank of all available indicators for the corresponding city within the respective PEST dimension.

Step 3: Within each of the four PEST dimensions, a sub-ranking score is computed for each city under scrutiny. This is achieved by determining the average of the rankings associated with the indicators in that dimension. The score remains within the range of 1 (if a city performs poorest across all indicators) to 35 (if a city performs best across all indicators).

Step 4: The overall score for each city in the hub ranking is derived by summing up its subscores for the PEST dimensions from step 3. Consequently, the total score for each city falls within the range of 4 to 140.

The result of this approach is outlined in Figure 4.1.

The figure reveals that Singapore takes the leading spot, significantly ahead of Stockholm in position two. The two Swiss cities of Zurich and Geneva follow in third and fourth place, with a comparatively small gap to the runner-up. Amsterdam, New York City, San Francisco, and London, ranking from five to eight, respectively, form another cluster with similar total scores. The top ten is concluded by Toronto and Berlin on ranks nine and ten, respectively. Therefore, of the top ten cities with the best surrounding factors for FinTech companies, six are located in Europe, three in Northern America, and one in Asia.

The rankings of this year's top ten cities of the current and across all previous FinTech hub rankings are visualised in Figure 4.2, highlighting year-over-year changes in positions. It shows that Singapore has taken the top spot in all rankings to date, underpinning its long-standing leading role as a location for FinTech solutions. One development that stands out in the current ranking is Zurich's loss of second place to Stockholm for the first time. Geneva

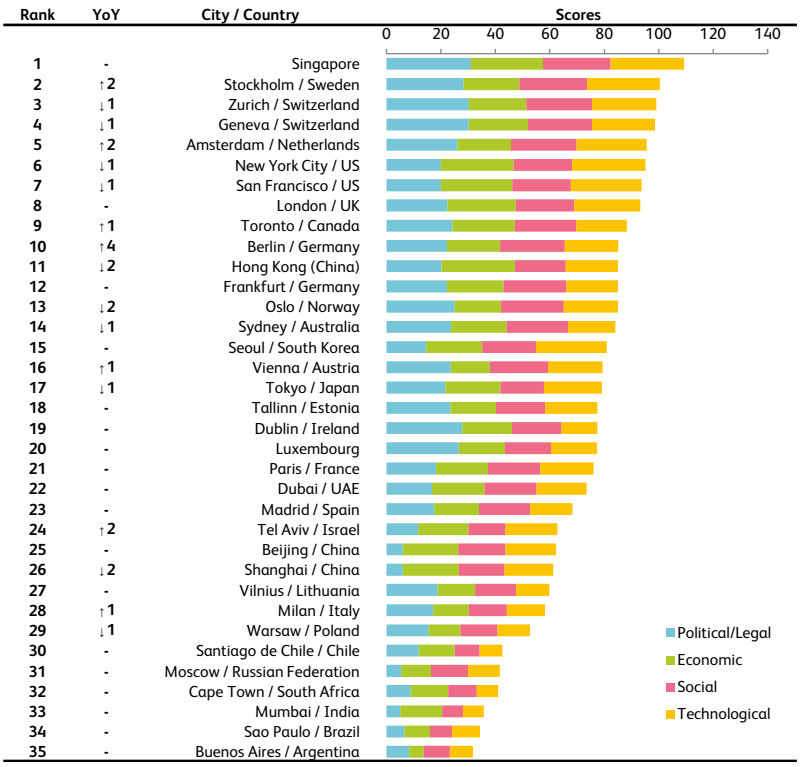

Figure 4.1: FinTech hub ranking

also lost the third place it had regained in last year's ranking. In addition to Stockholm, Amsterdam also climbs two places in this year's ranking, overtaking the two US locations, New York City and San Francisco. London retains its eighth place, and Toronto climbs one place to ninth. New in the top ten is Berlin in tenth place. Hong Kong, which was in ninth place in last year's ranking, was pushed out of the top ten this year. Across all rankings, the relatively continuous improvement of Stockholm and the decline of Toronto are particularly noteworthy.

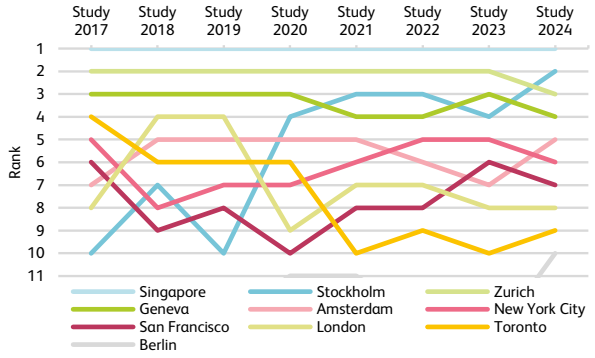

Figure 4.2: FinTech hub ranking by year

For Switzerland, Figure 4.3 shows a more detailed picture of the relative shifts in the general quality of surrounding factors for FinTech companies. It illustrates the relative shift in Zurich's performance compared to this year's other top ten cities over the years.[1] Accordingly, Singapore and San Francisco were the only two cities with a slight deterioration compared to Zurich year-over-year. The remaining seven cities in this year's top ten have improved the quality of surrounding factors for FinTech companies relative to Zurich. While Stockholm has already overtaken Zurich this year, the difference to Geneva has narrowed to a small margin over the last two years. Furthermore, the distance between Amsterdam and the two Swiss cities has also clearly decreased this year, making it the biggest threat from a Swiss perspective at present.

A general overview of the strengths and weaknesses of the top ten countries is shown in Table 4.1, which lists their

[1] The values for each city are calculated by dividing its total score in the hub ranking by Zurich's total score for each year. The resulting values for Zurich are therefore equal to 1.00 in each year.

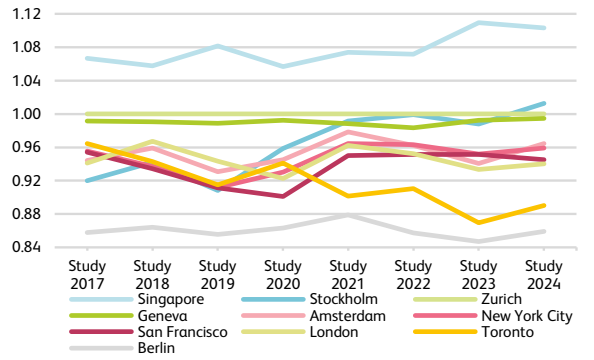

Figure 4.3: Top ten cities' total ranking scores relative to Zurich

ranking in the individual PEST dimensions and the corresponding year-over-year changes. It reveals that Singapore has the best political/legal conditions, followed by Switzerland. Hong Kong (not in the top ten of the overall ranking) offers the best economic environment, followed by New York City. In social terms, Stockholm is in the lead and outperforms Singapore, while Singapore is ahead of New York City in technological terms.

The biggest change compared to the previous year can be observed in the economic dimension for Stockholm, which improved by five ranks. This improvement forms the basis for the Swedish capital's advance to second place in the overall FinTech hub ranking. The second biggest improvement can be observed for New York City and Toronto in the social dimension and Berlin in the technological dimension, all rising four places. The economic dimension shows the greatest deterioration. Berlin lost three places in this regard compared to the previous year's ranking.

A look at Zurich and Geneva shows that, as in previous years, they perform strongest in the political/legal dimension. Furthermore, both Swiss cities report a year-over-year improvement in social environmental factors, where they achieve fourth and sixth places, respectively. The only deterioration for both cities can be found in the technological dimension, where they generally perform worst across all four PEST dimensions.

Table 4.1: PEST dimension rankings

	Rank (year-over-year change)			
City (overall rank)	**Political/Legal**	**Economic**	**Social**	**Technological**
Singapore (1)	1 (±0)	3 (↓2)	2 (±0)	1 (±0)
Stockholm (2)	4 (±0)	12 (↑5)	1 (±0)	3 (↑2)
Zurich (3)	2 (±0)	8 (±0)	4 (↑1)	8 (↓2)
Geneva (4)	2 (±0)	7 (±0)	6 (↑3)	9 (↓1)
Amsterdam (5)	7 (±0)	16 (↑2)	3 (↑1)	6 (↑1)
New York City (6)	18 (±0)	2 (↑1)	11 (↑4)	2 (±0)
San Francisco (7)	18 (±0)	4 (±0)	13 (↓1)	5 (↓1)
London (8)	13 (↓1)	5 (±0)	12 (↓2)	7 (↑2)
Toronto (9)	9 (↑1)	6 (±0)	9 (↑4)	20 (↑2)
Berlin (10)	14 (↓1)	17 (↓3)	5 (↑1)	13 (↑4)

4.2. Input and Output Comparison

While the FinTech hub ranking assesses the surrounding factors for FinTech companies, the size of the respective industry in the in-scope locations is not considered. An output-driven perspective is taken in the following, taking into account the following three measures for the size of the FinTech industry in a given country:

1. Number of FinTech companies per capita
2. Number of jobs at FinTech companies per capita
3. Total funding of FinTech companies per capita

The data is obtained from Crunchbase (online) and aggregated at the national level. Consequently, the scope of consideration narrows from 35 cities in the FinTech hub ranking to 31 countries, with China, Germany, Switzerland, and the United States each represented by two cities in Section 4.1. Within these 31 countries, a comprehensive count reveals 20,823 FinTech companies, employing a cumulative workforce of 2,802,181 individuals and reaching a combined financing volume of USD 482 billion.

For every one of the three output indicators, a distinct ranking is established for the 31 countries under examination. The highest-performing country receives an indicator output score of 31, while the least favourable is assigned a value of one. The overall output score for each country is subsequently determined by the summation of its individual indicator output scores. As a result, the overall output score is constrained within the range of three to 93.

In Table 4.2 the subrankings, overall output scores, and total rank of the top ten countries are presented. Similar to the FinTech hub ranking in Section 4.1, Singapore is in the lead in the overall ranking, not changing its position year-over-year. Estonia reaches second place in the ranking, followed by Hong Kong and the United Kingdom, sharing third position. Relative to last year's ranking, Estonia and Hong Kong improved their position by one place, whereas the United Kingdom ranks two places higher. Next up are Luxembourg and Switzerland, ranking fifth and sixth, respectively. However, Luxembourg's ranking decreased by three positions, while Switzerland maintains last year's rank. Israel's position worsens to seventh place, representing a decrease of one position year-over-year. The United Arab Emirates maintains its eighth place in the ranking, followed by the United States and Canada. The United States improves its rank by one position to ninth place, whereas Canada loses one rank, now listing at tenth place. In addition, compared to last year's ranking, Sweden does not appear in the ranking anymore, currently ranking in eleventh place. However, it should be mentioned that the ranks nine to 13 are only three points apart regarding their overall output scores.

Table 4.2: FinTech-related output ranks for the top ten countries of the total output ranking

	Rank (year-over-year change)				
Location	**Companies per capita**	**Jobs per capita**	**Funding per capita**	**Overall output score**	**Total rank (YoY)**
Singapore	2 (±0)	2 (↑1)	1 (±0)	91	**1** (±0)
Estonia	1 (±0)	1 (±0)	8 (↑4)	86	**2** (↑1)
Hong Kong	6 (↓1)	6 (±0)	5 (±0)	79	**3**(↑1)
United Kingdom	8 (↓1)	7 (↑3)	2 (±0)	79	**3** (↑2)
Luxembourg	3 (±0)	3 (↓1)	14 (↓8)	76	**5** (↓3)
Switzerland	4 (±0)	10 (↓1)	7 (↑1)	75	**6** (±0)
Israel	7 (↓1)	9 (↓1)	6 (↑1)	74	**7** (↓1)
United Arab Emirates	9 (↑1)	4 (±0)	11 (↓2)	72	**8** (±0)
United States	12 (±0)	12 (↑1)	4 (±0)	68	**9** (↑1)
Canada	11 (±0)	8 (↓1)	10 (±0)	67	**10** (↓1)

Furthermore, the subrankings in Table 4.2 allow describing the three indicator rankings in more detail. On a year-over-year comparison, Singapore is still the leader in the funding per capita metric, and Estonia is again ranking in first place for FinTech companies per capita and jobs per capita. It is noteworthy that Estonia skips four positions in the funding per capita indicator; nevertheless, Singapore improves its strong position by gaining one rank in the jobs per capita ranking too. Luxembourg's descent in the overall ranking is mainly based on losing eight positions in the funding per capita column, from a sixth rank in last year's study to the current fourteenth position. However, for most of the countries, the changes in the subrankings are more subtle. Switzerland, for example, gained one rank in the funding per capita metric but lost one place regarding the jobs per capita.

While Figure 4.1 and Table 4.2 show two different perspectives of selected FinTech locations, namely the input perspective, i.e., the one relating to the quality of environmental factors, and the output perspective, i.e., the one relating to the actual size of the sector, Table 4.3 attempts to link these two perspectives. Of the 72 indicators in the FinTech hub ranking, it lists those indicators for each of the four PEST dimensions that show the greatest Pearson correlation with the inverse output ranking[2], along with the leading countries.

In the political/legal dimension, qualitatively strong regulatory frameworks, fewer financial constraints, and lower perceived corruption, as observed in the locations Singapore, Australia and Switzerland, and Norway, respectively, correlate positively with higher output.

In the economic dimension, high venture capital, joint venture activity, as well as the ease of starting a business reveal the highest correlation with the output of a FinTech industry. Countries leading in at least one of these indicators are Luxembourg and Canada.

Tertiary-level inbound mobility and the quality and competitiveness of the talent environment show the largest correlation with the size of the FinTech industries in the selected countries. While the proportion of students from

[2] The inverse output rank (i.e., the first rank for the country with the smallest relative FinTech output) is used to obtain a descending ranking order analogous to the rankings of the indicators from the FinTech hub ranking. As a consequence, it leads to positive correlation coefficients that are more logically interpretable when the country's ranking for an indicator closely mirrors the output ranking.

Table 4.3: Correlations between the output rank and individual input indicators

Political/Legal		
Indicator	**Correlation**	**Leading Location(s)**
Regulatory Quality	0.72	Singapore
Financial Restrictions	0.69	Australia, Switzerland
Corruption Perception	0.66	Norway

Economic		
Indicator	**Correlation**	**Leading Location(s)**
Venture Capital Deals	0.91	Luxembourg
Joint Venture Deals	0.78	Canada
Starting a Business	0.61	Canada

Social		
Indicator	**Correlation**	**Leading Location(s)**
Tertiary-Level Inbound Mobility	0.73	Luxembourg, United Arab Emirates
World Talent	0.67	Switzerland
Talent Competitiveness	0.66	Singapore, Switzerland

Technological		
Indicator	**Correlation**	**Leading Location(s)**
GitHub Commits	0.76	Hong Kong, Singapore, Switzerland
Mobile App Creation	0.62	Israel
Digital Competitiveness	0.60	United States of America

abroad (tertiary-level inbound mobility) is highest for the United Arab Emirates, the talent ecosystem is best in Switzerland and Singapore.

For the technological domain, indicators like the number of GitHub commits, high mobile app creation activity, and the general digital competitiveness of a country exhibit the strongest relationship with the output ranks. Countries performing strongly in this regard are Hong Kong, Singapore, and Switzerland, Israel, and the United States of America, respectively.

These correlations illustrate the complex interplay between the quality of the surrounding factors for the FinTech industry in a given country and its overall output performance. More precisely, factors within the political/legal, economic, social, and technological dimensions each contribute uniquely to a country's ability to achieve higher output ranks, emphasising the multifaceted nature of success on a global scale. Understanding these correlations might help policymakers and stakeholders in identifying crucial areas for improvement and strategic focus to enhance a country's competitive standing. However, it should be noted that correlation does not automatically equate to causality.

5. Political and Legal Environment

By Daniel Haeberli & Alexander Wherlock, Attorneys-at-Law, Homburger AG

FinTech companies, which are domiciled in Switzerland or approach Swiss-based clients, need to assess the applicable financial market regulation, in order to determine whether their activities trigger regulatory requirements under the applicable Swiss regulatory framework. Switzerland's[1] regulatory[2] framework governing activities of FinTech companies consists of various federal laws and implementing ordinances. This subchapter outlines the key elements of the relevant Swiss financial market regulations.

- The *first part* provides an overview of the Financial Services Act (Section 5.1.1) and the Financial Institutions Act (Section 5.1.2), governing the provision of financial services, offering financial instruments and the respective licensing requirements in Switzerland.
- The *second part* then discusses Switzerland's FinTech specific regulation (Section 5.2.1) as well as select federal laws, which may apply to FinTech related activities (Section 5.2.2).
- Finally, the *third part* outlines the *FINMA* categorisation of tokens (Section 5.3.1) and summarises the cornerstones of the Swiss DLT Law, which entered into force in 2021 (Section 5.3.2).

5.1. Swiss Financial Market Architecture – FinSA and FinIA

The Financial Services Act ("FinSA") sets out the supervisory framework governing the provision of financial services and the offering of financial instruments in Switzerland. The Financial Institutions Act ("FinIA") provides for a comprehensive supervisory licensing regime applicable to portfolio managers, trustees, managers of collective investment schemes, fund management companies and securities firms.

FinSA and FinIA apply to both "traditional" financial service providers and FinTech companies. For FinTech companies, in particular the following elements of the Swiss supervisory framework may be of relevance:

- The provision of portfolio management or investment advice may trigger requirements to comply with rules of conduct (Section 5.1.1.2.2) or organisational rules (Section 5.1.1.2.3) under FinSA, even if such services are provided into Switzerland on a strict cross-border basis. In addition, the performance of portfolio management activities may trigger licensing requirements under FinIA (Section 5.1.2).
- Companies trying to obtain funding in Switzerland through the issuance of (tokenised) equity rights and/or bonds may need to comply with the prospectus regime set out under FinSA (Section 5.1.1.2.6).

5.1.1 Financial Services Act (FinSA)

With regard to FinSA, FinTech companies must in a first step assess whether their activities are within the scope of application of FinSA (Section 5.1.1.1). If this is the case, a series of requirements and duties may apply, in particular with regard to client segmentation, rules of conduct, organisational requirements and prospectuses (Section 5.1.1.2). Non-compliance with FinSA requirements may lead to criminal sanctions and fines.[3] Furthermore, if the relevant individual or legal entity is subject to prudential supervision in Switzerland, non-compliance may also have regulatory implications.

5.1.1.1 Scope of Application

FinSA applies to financial service providers, client advisers as well as producers and distributors of financial instruments.[4]

[1] This chapter does not discuss any regulatory frameworks of jurisdictions other than Switzerland.

[2] This chapter focuses on regulatory aspects. There are other legal aspects which may be relevant for FinTech companies and FinTech related activities such as questions concerning tax law, contract law, intellectual property or data protection. Such legal aspects are not covered herein.

[3] Articles 89 et seqq. FinSA.

[4] Article 2 para. 1 FinSA.

Individuals as well as legal entities that qualify as a *Financial Service Provider* are subject to FinSA, if they provide Financial Services (see definition below) on a commercial basis in Switzerland or to Swiss-based clients.[5] Consequently, a FinTech company must in particular assess the following:

1. Are Financial Instruments (see definition below) involved and do the activities constitute Financial Services?

2. Are such Financial Services provided on a *commercial basis*?

3. Are such Financial Services provided *in Switzerland* or *to Swiss-based clients*?

When assessing whether a specific activity qualifies as a Financial Service under FinSA, in particular the following definitions are of relevance:

- *Financial Instruments* within the meaning of FinSA are equity and debt securities, including bonds, units in collective investment schemes, structured products, derivatives and certain types of structured deposits ("Financial Instruments").[6] Pure cryptocurrencies do, for example, not qualify as Financial Instruments. In contrast, certain asset tokens may be deemed Financial Instruments.

- *Financial Services* within the meaning of FinSA are the following activities: (1) acquisition or disposal of Financial Instruments, (2) receipt and transmission of orders in relation to Financial Instruments, (3) management of Financial Instruments (portfolio management), (4) provision of personal recommendations relating to transactions regarding Financial Instruments (investment advice), and (5) granting of loans to finance transactions regarding Financial Instruments ("Financial Services").[7]

The mere offering of Financial Instruments does, in principle, not qualify as a Financial Service. However, there is only limited guidance with regard to the question under which circumstances a specific activity would be considered as a mere offer and hence not a Financial Service.

A commercial activity is an independent economic activity pursued on a permanent and for-profit basis. Financial Services are presumed to be provided on such *commercial basis* if the relevant Financial Service Provider (i) either provides Financial Services to more than 20 clients or (ii) promotes the provision of Financial Services in advertisements, prospectuses, circulars or electronic media (irrespective of whether such Financial Service Provider services 20 or less clients).

Financial Services are deemed to be provided *in Switzerland* if the Financial Service Provider is either (i) domiciled in Switzerland or registered in the Swiss commercial register or (ii) domiciled abroad but provides the relevant services to clients based in Switzerland. To the extent a Financial Service Provider domiciled abroad performs Financial Services on behalf of Swiss clients, FinSA will apply, also on a strict cross-border basis, irrespective of whether the relevant Financial Service Provider maintains a physical presence in Switzerland.

The latter, in particular, has an impact on FinTech companies domiciled abroad, which engage in activities in the Swiss market without maintaining a physical presence in Switzerland. For example, a foreign FinTech company providing portfolio management services or investment advice to Swiss-based clients via an online application will be subject to FinSA and certain requirements set-out thereunder. In this context, it must be noted that the requirements under the FinSA largely mirror requirements set out in corresponding regulations of the European Union ("EU")[8], but that there are nonetheless notable differences and therefore a FinTech company compliant with EU rules is not automatically compliant with Swiss regulatory framework.

However, there are certain exemptions under FinSA, specifically applicable to Financial Service Providers domiciled outside of Switzerland. Pursuant to a *reverse-solicitation* exemption, the FinSA does not apply to:

- Financial Services provided by a foreign Financial Service Provider as part of a previously existing

[5] Article 3 let. d FinSA.

[6] Article 3 let. a FinSA.

[7] Article 3 let. c FinSA. Note: Article 3 para. 3 FinSO exempts from the definition of Financial Services the provision of advice regarding the structuring or raising of capital as well as the provision of advice in the context of mergers and acquisitions or the acquisition or sale of participations and the services related to such advice.

[8] MiFID II, Prospectus Directive, PRIIPs.

client relationship (e.g., an existing portfolio management or investment advisory agreement) that was entered into at the express initiative of a Swiss-based client; and

- Financial Services provided by a foreign Financial Services Provider that have been expressly requested by a Swiss-based client on such client's own initiative.[9]

5.1.1.2 Key Elements

Key elements set out under FinSA relate to client segmentation (Section 5.1.1.2.1), rules of conduct (Section 5.1.1.2.2), organisation (Section 5.1.1.2.3), client advisers (Section 5.1.1.2.4), the ombudsman scheme (Section 5.1.1.2.5) and prospectuses (Section 5.1.1.2.6).

5.1.1.2.1 Client Segmentation – Retail / Professional / Institutional

If a FinTech company qualifies as a Financial Service Provider, it must allocate each of its clients – as part of the onboarding process – to one of the following client segments: retail, professional or institutional:[10]

1. *Retail Clients*, also referred to as private clients, are all clients that do not qualify as Professional Clients (as defined below).

2. *Professional Clients* are: (a) financial intermediaries licensed under the Swiss Banking Act, the Swiss Financial Institutions Act or the Swiss Collective Investment Schemes Act; (b) insurance companies licensed under the Swiss Insurance Supervision Act; (c) foreign clients subject to prudential supervision equivalent to the financial intermediaries and insurance companies within the meaning of let. (a) and let. (b); (d) central banks; (e) public entities with professional treasury operations; (f) occupational pension schemes, and other institutions whose purpose is to serve occupational pensions, with professional treasury operations; (g) companies with professional treasury operations; (h) large companies (companies which exceed two of the following parameters: (1) balance sheet total of CHF 20 million, (2) turnover of CHF 40 million and (3) equity of CHF 2 million); and (i) private investment structures with professional treasury operations created for high-net-worth Retail Clients.

3. *Institutional Clients* are Professional Clients as defined in 2. (a)-(d) above, as well as national and supranational public entities with professional treasury operations.

Depending on the client segment, different duties and hence different levels of "client protection" will apply. Consequently, in order to limit the impacts of FinSA, a FinTech company may opt to restrict its offering to Professional Clients and / or Institutional Clients.

Certain clients may declare that they waive certain client protection provisions (so-called "opting out"), whereas certain other client types may declare that they want to benefit from a higher level of protection (so-called "opting in").[11] Any such declaration to "opt-out" or "opt-in" must be in writing (e.g., a physical letter) or in another manner verifiable by text (e.g., an email or WhatsApp message).[12]

5.1.1.2.2 Rules of Conduct

The FinSA sets out rules of conduct, which namely cover A) information duties, B) suitability and appropriateness checks, C) documentation and accountability duties as well as D) duties regarding transparency and due care.

A) Information Duties
The information duties aim at providing clients a comprehensive and transparent overview of the services and products offered by the Financial Service Provider. There are general and specific duties and information may be provided either in writing or electronically, e.g., via a website. If provided electronically, it must be ensured that clients may at all times access, download and save such information to a durable medium (e.g., a hard disk).[13]

Depending on the respective client segmentation, the following will apply:

1. In constellations in which Financial Services are provided to Retail Clients, the information duties apply to the full extent.

[9] Article 2 para. 2 FinSO.
[10] Article 4 FinSA.
[11] Article 5 FinSA.
[12] Article 5 para. 8 FinSA.
[13] Article 9 para. 3 FinSA and article 12 FinSO.

2. Professional Clients, on the other hand, may waive the *general* information duties.[14]

3. In constellations in which Financial Services are provided to Institutional Clients, the information duties set out under FinSA are not applicable.[15]

B) Suitability and Appropriateness

If a FinTech company provides portfolio management services or renders investment advice, it must meet the appropriateness or suitability test requirements set out under FinSA, also if such services are (in whole or in part) provided through an automated or semi-automated "robo-advice" system.

1. *Suitability*: When providing portfolio management services or rendering investment advice under consideration of the client's entire portfolio (so-called "Portfolio-Related Investment Advice"), a Financial Service Provider must enquire about the relevant client's financial situation and investment objectives as well as its knowledge and experience and must based on such information assess whether the investment in question is suitable for such client.[16]

2. *Appropriateness*: When rendering investment advice for individual transactions without taking into account the client's entire portfolio (so-called "Transaction-Related Investment Advice"), a Financial Service Provider must obtain information on the client's knowledge and experience and must based on such information assess whether the investment in question is appropriate for such client.[17]

3. *Execution-only*: If a Financial Service Provider is only involved in the mere execution or transmission of a client order, the Financial Service Provider is not required to conduct such suitability or appropriateness checks.[18] Nevertheless, prior to providing mere execution or transmission services, the client needs to be informed that no appropriateness or suitability checks will be performed.[19]

In constellations in which the relevant Financial Services are provided to Retail Clients, the duties outlined above apply to the full extent. With regard to Professional Clients, certain alleviations are set out under FinSA: a Financial Service Provider may, unless there are indications to the contrary, in particular, assume that Professional Clients have sufficient knowledge and experience as well as the capacity to bear the risks underlying the Financial Service in question when conducting the suitability and appropriateness checks.[20] For Institutional Clients, FinSA provides for a blanket non-application of the information duties.[21]

C) Documentation and Accountability Duties

FinSA namely requires Financial Service Providers to record and document (i) the information collected from the client and the services provided in Switzerland or to clients in Switzerland as well as (ii) the results of suitability and appropriateness checks.[22] Generally, Financial Service Providers are free to decide on how they organise such documentation, and purely digital solutions are possible.[23] In any case, a Financial Service Provider must be in a position to render account to a client within, as a rule, ten business days after a client requested to obtain his / her files. Furthermore, the relevant records and documents must be stored for at least ten years.[24]

If Retail Clients are involved, the duties concerning documentation and accountability apply to the full extent. Professional Clients may declare that he / she waives his / her rights under the documentation.[25] For Institutional Clients, the FinSA provides for a blanket non-application of the information duties.[26]

D) Transparency and Due Care

Financial Service Providers must implement systems and procedures that are appropriate with regard to their size, complexity and business activities and ensure the protection of clients' interests and the equal treatment of their clients when executing transaction orders. In particular, they must ensure (i) that client orders are registered and

[14] Article 20 para. 2 FinSA.
[15] Article 20 para. 1 FinSA.
[16] Article 12 FinSA.
[17] Article 11 FinSA.
[18] Article 13 para. 1 FinSA.
[19] Article 13 para. 2 FinSA.
[20] Article 13 para. 3 FinSA.
[21] Article 20 para. 1 FinSA.
[22] Article 15 para. 1 FinSA; Dispatch FinSA I FinIA, 8959. Cf. article 25 paras. 5 et seqq. MiFID II.
[23] Dispatch FinSA I FinIA, 8959 et seq.; Pre-consultation report FinSO, 27.
[24] Article 18 FinSO; Dispatch FinSA I FinIA, 8959 et seq.
[25] Article 20 para. 2 FinSA.
[26] Article 20 para. 1 FinSA.

allocated promptly and correctly, (ii) that comparable orders are executed in the order in which they were received, unless this is not in the client's interest or not possible due to the nature of the client's order or the market conditions, (iii) that in case orders are pooled, the interests of the clients involved are safeguarded and (iv) that Retail Clients are informed of any material difficulties which could affect the correct execution of their orders.[27]

Financial Service Providers must ensure the best execution of client orders in terms of cost (taking into account, *inter alia*, any inducements provided by third parties), timing and quality. In order to satisfy the best execution requirement, Financial Service Providers must define and annually review the criteria necessary for the selection of the execution venue (in particular, the price, costs, efficiency and probability of the execution and settlement) and implement appropriate internal directives.[28]

If Retail Clients or Professional Clients are involved, the duties concerning transparency and due care apply to the full extent. For Institutional Clients, FinSA provides for a blanket non-application of the information duties.[29]

5.1.1.2.3 Organisational Requirements

Financial Service Providers must have adequate internal regulations and an appropriate organisation of operations in order to ensure compliance with all applicable duties under FinSA. They must namely (i) define and implement internal rules that are appropriate with respect to their size, complexity and legal form, as well as in relation the Financial Services they offer and the risks associated therewith; and (ii) select their employees carefully and ensure that they receive training in the rules of conduct as well as in the skills they need to carry out their specific tasks.[30] Furthermore, FinSA provides for organisational requirements with regard to outsourcing,[31] conflicts of interest,[32] payments from third parties ("inducements" or "kick-backs"),[33] and employee transactions.[34]

Whilst FinSA does not set-out an express exemption, it remains disputed in the relevant Swiss legal doctrine whether the organisational requirements set out under FinSA apply to Financial Service Providers providing their services to Swiss clients on a strict cross-border basis.

5.1.1.2.4 Client Advisers

FinSA makes a clear distinction between "Client Advisers" and "Financial Service Providers": Client Advisers are *natural persons* (i.e., not legal entities) that render Financial Services either on behalf of a Financial Service Provider or in their own capacity as a Financial Service Provider.

With regard to Client Adviser, the following aspects must be considered:

- *Knowledge and Expertise of Client Advisers*: If a FinTech company qualifies as a Financial Service Provider, its Client Advisers will need to possess the required knowledge with regard to the Swiss rules of conduct (see Section 5.1.1.2.2 above) and a level of expertise appropriate for their activities. If a foreign Financial Services Provider acts on a strict cross-border basis, such Swiss requirements regarding knowledge and expertise are, in our view, only applicable to Client Advisers that actually render Financial Services to Swiss-based clients. Nonetheless, most foreign Financial Service Providers will likely need to establish a "Swiss Desk", i.e., designate specific employees / Client Advisers that are familiar with the Swiss rules of conduct and meet all requirements set out under FinSA.

- *Client Adviser Register*: The following Client Advisers are required to be registered in the so-called Client Adviser Register (*Beraterregister*) in order to be permitted to carry out Financial Services in Switzerland: (i) Client Advisers of *Swiss* Financial Service Providers, which are not subject to prudential supervision (i.e., independent client advisers) and (ii) Client Advisers of *foreign* Financial Service Providers, which (aa) are not subject to prudential supervision abroad or (bb) provide Financial Services to Swiss-based Retail Clients.[35]

[27] Article 17 FinSA and article 20 FinSO.
[28] Article 18 FinSA and article 21 FinSO.
[29] Article 20 para. 1 FinSA.
[30] Article 21 et seq. FinSA and article 23 FinSO.
[31] Article 23 et seq. FinSA.
[32] Article 25 FinSA.
[33] Article 26 FinSA.
[34] Article 27 FinSA.

[35] Client Advisers of foreign Financial Service Providers that are subject to prudential supervision abroad are exempted from this registration requirement to the extent that their activities in Switzerland are directed exclusively at Institutional Clients and / or Professional Clients (Article 31 FinSO).

Persons having only very limited contact with clients or potential investors do not qualify as Client Advisers and are thus not subject to the requirements regarding knowledge and expertise as well as the Client Adviser Register. The same applies to employees of a Financial Service Providers that merely support the provision of Financial Services. Examples of such supporting activities include, *inter alia*, the dispatch of product documentation following the expression of interest by a client, the arrangement of meetings with his / her Client Adviser or the support of technical procedures with respect to electronic customer portals or websites of a Financial Service Provider.

5.1.1.2.5 Ombudsman Scheme

Financial Service Providers are required to accede to the Swiss ombudsman scheme.[36]

5.1.1.2.6 Prospectus Requirements

FinSA sets-out a comprehensive prospectus regime, which *inter alia* provides for an ex-ante approval requirement for prospectuses if Financial Instruments are publicly offered or admitted to trading in Switzerland. To date BX Swiss AG and SIX Exchange Regulation AG have been approved by *FINMA* as Reviewing Bodies, tasked with the review and approval of prospectuses.

In principle, the requirement to publish an approved prospectus applies to all public offerings in or into Switzerland and to all securities (incl. DLT securities) that are to be admitted to trading on a trading venue (see Section 5.2.2.2 below) or a DLT trading facility (see Section 5.3.2.2 below) in Switzerland.[37] However, FinSA contains a number of exemptions and there is for example no requirement to prepare a prospectus to the extent the public offer is addressed exclusively at Professional Investors or if it is directed at fewer than 500 retail investors.

Under FinSA, an offer is any invitation to purchase a Financial Instrument, if such invitation contains sufficient information on the terms and conditions of the offer and the Financial Instrument itself.[38] Therefore, FinTech companies providing information relating to Financial Instruments on an internet-based platform must in particular take into account the following:

- The mere publication of information relating to Financial Instruments on a platform in itself should not *per se* be regarded as an offer but the manner in which access to the platform is structured will be decisive.

- If information on the Financial Instrument can only be accessed by the interested client / investor on an internet-based platform via a search entry (e.g., when searching for ISIN / Valor or product name), no offer within the meaning of FinSA will be deemed to have been made by the FinTech company operating such internet-based platform. The result of the search should not have any other legal consequences than an (oral or written) information on a financial instrument at the request of an interested investor.

- Also, if the client / investor must first log in with his / her password on an internet-based platform, it can be argued that no offer will be made by the FinTech company operating such internet-based platform.

- However, it must be noted that in both scenarios mentioned above, a reverse solicitation constellation will only be at hand if no advertising by the "provider" or one of its representatives in relation to the specific Financial Instrument preceded the actions of the investor.[39]

5.1.2 Financial Institutions Act (FinIA)

FinIA sets out a comprehensive licensing regime for financial institutions. *Financial Institutions* within the meaning of FinIA are: (1) portfolio managers; (2) trustees; (3) managers of collective assets; (4) fund management companies and (5) securities firms (formerly securities dealers).

Instead of a sectorial approach, FinIA provides for a "pyramid approach", implementing a rather light touch regulation for portfolio managers and trustees and increasingly stricter regimes for managers of collective assets, fund management companies and securities firms.

FinIA defines common core requirements that must be met by all Financial Institutions. All Financial Institutions regulated under FinIA must for example implement an appropriate organisation (risk management, effective inter-

[36] Article 77 FinSA.
[37] Article 35 FinSA.
[38] Article 3 let. g FinSA.
[39] Article 3 para. 6 let. a FinSO.

nal control system, etc.) and must be effectively managed in Switzerland. Furthermore, both the Financial Institution itself as well as the persons in charge of their administration and management must meet the regulatory fit and proper test and must therefore have a good reputation and ensure proper business conduct.

For FinTech companies, the key aspects of FinIA are the following:

- *Portfolio managers* (e.g., independent external asset managers) are subject to prudential supervision. Such supervision will be conducted by an independent supervisory organisation (*Aufsichtsorganisation*) that itself will be licensed by *FINMA* for this purpose. In July 2020 *FINMA* authorised the first supervisory organisations for portfolio managers.[40]

- *Securities firms* require a license from *FINMA* and are subject to supervision as well as a series of specific regulations. A FinTech company will qualify as a securities firm within the meaning of FinIA if it engages, on a commercial basis, in either (a) dealing in securities in its own name but for its clients' account, or (b) short-term transactions in securities for its own account and either thereby potentially affects systemic stability of the Swiss financial market, acts as a participant on a trading venue or operates as an organised trading facility, or (c) market making activities by engaging in short-term transactions in securities while setting public bid and ask prices (permanently or on request).[41] Depending on the relevant business model and activities, FinTech companies may in particular qualify as own-account dealers.

As far as regulatory licensing requirements are concerned, the Swiss regime is largely based on the so-called principle of territoriality (*Territorialitätsprinzip*). Therefore, as long as a FinTech company is domiciled abroad and provides Financial Services into Switzerland on a strict cross-border basis, i.e., without establishing a physical presence in Switzerland, such activities (with a few exceptions) will not trigger Swiss regulatory licensing requirements under FinIA. Such activities may, however, be subject to the requirements under FinSA (see Section 5.1.1 above).

[40] See FINMA (online).

[41] Article 41 FinIA.

5.2. Other Key Regulation

This subchapter outlines key elements of the Swiss FinTech Specific Regulation (Section 5.2.1) and provides an overview on select Swiss federal laws (Section 5.2.2), which may – besides FinSA and FinIA (see Section 5.1 above) – be applicable to FinTech related activities.

5.2.1 FinTech Specific Regulation

The Swiss FinTech specific regulation comprises three "pillars": the so-called FinTech license (Section 5.2.1.1), a regulatory innovation area ("sandbox") (Section 5.2.1.2) and the settlement accounts exemption (Section 5.2.1.3).

5.2.1.1 FinTech License

Since 1 January 2019 the Swiss Banking Act ("BA") provides for two licensing categories (i) the regular banking license and (ii) the FinTech license pursuant to Article 1b BA, (also referred to as "banking license light").

Prior to the FinTech license being introduced, only formally licensed banks were permitted to (i) accept deposits from the public on a professional basis or to (ii) recommend themselves for such deposit taking activities. Given that as a general rule all repayment-liabilities vis-à-vis clients qualify as *deposits* and since accepting deposits from more than 20 persons will qualify as acting on a *professional basis* (see Section 5.2.2.1 below), certain business models of FinTech companies would have required a regular banking license under the BA.

With the FinTech license, companies not engaging in the classic banking business (interest rate differential business; *Zinsdifferenzgeschäft*), e.g., by using short-term deposits for long-term lending or investment activities, now have a viable regulatory alternative. The FinTech license is attractive for companies that are mainly active in the financial sector, but which (i) limit their operations to accepting either deposits of less than CHF 100 million or crypto assets (*kryptobasierte Vermögenswerte*)[42] and which (ii) do not invest the accepted funds nor pay interest thereon. Hence, the license may for example be attractive for companies offering payment services or platform funding services.

[42] In the sense of article 5a BO.

However, there are a number of aspects that have to be taken into account when considering applying for a FinTech license. In order to obtain the license from *FINMA*, the company must go through a rather lengthy (depending in particular on the complexity of the business model and the quality of the license application) licensing procedure[43], which is, however, less burdensome than the licensing procedure for a regular banking license. In this process, the company will namely be required to evidence that it meets requirements regarding (i) organisation and financial and regulatory audits, (ii) corporate governance (the board of directors must for example consist of at least three persons) and (iii) capital (e.g., minimum capital of 3 percent of the deposits accepted from the public, i.e., up to CHF 3 million, but at least CHF 300,000).

Furthermore, once the FinTech license has been granted by *FINMA*, any deposits or crypto assets held by the company must be either (i) segregated from the assets of the company or (ii) recorded in the company's books in such a manner that they can be shown separately from the company's own funds at any time (if the company opts for the latter option, a more comprehensive audit is required).[44]

If the maximum deposit threshold of CHF 100 million is exceeded, the company must notify *FINMA* within 10 days and must submit a regular bank license application within 90 days.[45]

Finally, holders of a FinTech license are required to comprehensively inform their clients about the risks of their business model, their services and the utilised technologies. Furthermore, the company's clients must be informed that their deposits with the company are not protected by the Swiss deposit insurance regime (*Einlegerschutz*). Solely mentioning this information in general terms and conditions is insufficient and if the information is made available electronically, it must be ensured that clients may at any time view, download and save such information. Also, the information must be made available *prior* to entering into the agreement with the client and the client must have had enough time to understand the information prior to concluding the contract.[46]

[43] See the FINMA guidelines for FinTech licence applications (FINMA, 2018a) (version of 2 August 2021), which are available in German, French as well as English.

[44] Article 14f BO.

[45] Article 1b para. 6 BA.

[46] Article 7a BO.

5.2.1.2 "Sandbox"

The "sandbox" exemption allows engaging in activities which under former regulation would have triggered bank licensing requirements. Companies accepting deposits from the public are deemed *not* to be acting on a commercial basis, provided:

(i) the deposits or crypto assets accepted do not exceed the threshold of CHF 1 million;

(ii) the company does not engage in the interest rate difference business (*Zinsdifferenzgeschäft*); and

(iii) the clients are informed prior to depositing the funds that the company accepting the funds is not supervised by *FINMA* and that the funds are not protected by the Swiss deposit insurance regime.[47]

Under the current regulation, it is allowed to invest the deposits accepted, provided that the threshold of CHF 1 million is not exceeded and that the company does not engage in the interest rate difference business.

If the deposit or crypto asset threshold of CHF 1 million is exceeded, the company must notify *FINMA* within 10 days and must – in each case depending on the respective activities – either submit a regular bank license application or a FinTech-license application within 30 days. During the interim period between the filing of the license application and *FINMA's* decision on the request, the other conditions still must be met, i.e., no interest may be paid on such deposits and the information duties vis-à-vis depositors must be satisfied. Also, *FINMA* may on a case-by-case basis decide that no further deposits may be accepted until the end of the license application process.[48]

If the company decides to satisfy its regulatory disclosure obligations relating to its supervisory status and the deposit protection via its website, certain additional requirements must be met. First, the information must be displayed separately from other information. Therefore, solely mentioning it in general terms and conditions is insufficient. Second, this information must be displayed in text and in reproducible form. Third, the company's customers need to expressly confirm that they took note of the information.

[47] Article 6 para. 2 BO.

[48] Article 6 para. 4 BO.

Excursus: Update on AI Regulation - Switzerland

Since OpenAI made ChatGPT publicly available in November 2022, the considerable potential of AI in numerous industries has become apparent to the broader public. AI offers vast possibilities, but it also poses significant risks to civil society, law, and government. The pursuit of progress raises important and complex policy and ethical questions. Governments around the world have been racing to catch up with technology's progress and establish plans for the potential regulation of AI - with the European Union recently announcing that the policymakers have reached on an agreement on the key elements of a comprehensive AI Act.[49]

In view of these international developments, in late November 2023, the Federal Council instructed the Federal Department of the Environment, Transport, Energy, and Communication (DETEC) to draft an overview of possible regulatory approaches to AI by the end of 2024. The Federal Council intends to utilise the DETEC's assessment as the basis for issuing a proposal for an AI-related regulatory framework in 2025. Pursuant to the Federal Council's announcement, DETEC's analysis will be based on existing Swiss legal concepts to identify regulatory approaches compatible with the EU's AI Act, the Council of Europe's AI Convention, and fundamental rights.[50]

The "sandbox" exemption is designed to create a regulatory safe harbour, in which FinTech companies are able to test their business ideas and provide certain financial services without becoming a regulated entity under Swiss banking regulation. However, it must be noted that companies engaging in activities within the "sandbox" are still likely to be subject to Swiss anti-money laundering regulations (see Section 5.2.2.4 below) and may therefore nonetheless need to adhere to certain regulatory requirements under Swiss law. Therefore, the "sandbox" should not be misunderstood as a "regulation free" area.

5.2.1.3 Settlement Accounts Exemption

Funds held in customer accounts of securities firms, DLT trading facilities, precious metal dealers, portfolio managers or similar companies which exclusively serve the purpose of settling customer transactions do not qualify as deposits within the meaning of the BA and therefore do not trigger bank licensing requirements, provided the funds are not interest-bearing and are forwarded within 60 days. The exemption, in particular, facilitates the operation of funding platforms.

[49] For more information please refer to Silberstein-Loeb, Romerio, and Dal Molin (2023a).

[50] For more information please refer to Silberstein-Loeb, Romerio, and Dal Molin (2023b).

5.2.2 Selected Federal Laws

The Swiss regulatory framework relevant for FinTech companies also includes, in addition to the FinSA (see Section 5.1.1 above) and FinIA (see Section 5.1.2 above), in particular, the following federal laws and their implementing ordinances:

- the *Banking Act* ("BA"), which regulates banking activities / deposit taking as well as the supervision of banks and of holders of FinTech licenses (see Section 5.2.1.1 above);
- the *Financial Market Infrastructure Act* ("FMIA"), which governs the organisation, supervision and operation of financial market infrastructures (*inter alia*, trading venues and payment systems) and the conduct of financial market participants in securities and derivatives trading;
- the *Anti-Money Laundering Act* ("AMLA"), which regulates the prevention of money laundering and terrorist financing and the due diligence in financial relationships and transactions;
- the *Consumer Credit Act* ("CCA"), which governs consumer credits, i.e., loans granted on a professional basis to individuals for purposes other than business or commercial activities; and

- the *Collective Investment Schemes Act* ("CISA"), which on a product level governs the licensing and supervision of collective investment funds in Switzerland, including the approval requirements and process for the offering of non-Swiss collective investment funds in Switzerland.

The following sub-chapters provide a high-level overview of this regulatory framework applicable to banks (Section 5.2.2.1), trading facilities (Section 5.2.2.2), payment systems (Section 5.2.2.3), anti-money laundering (Section 5.2.2.4), consumer credits (Section 5.2.2.5) and collective investment schemes (Section 5.2.2.6).

5.2.2.1 Banks

In Switzerland, only licensed banks and holders of FinTech licenses (see Section 5.2.1.1 above) are permitted to accept deposits from the public on a professional basis or to recommend themselves for such deposit taking activities.[51] Furthermore, only licensed banks (not holders of a FinTech license) may use or refer to the term "bank" or "banker" in their company name, their company purpose or in their corporate and marketing documentation.[52] Any unauthorised acceptance of deposits or advertising of such services may be subject to criminal sanctions.[53]

Generally, a company is considered to be a bank, if it[54]:

(i) is mainly active in the financial sector; and

(ii) accepts deposits from the public in an amount *higher* than CHF 100 million on a professional basis or recommends itself publicly for such deposit taking activities[55]; or accepts deposits from the public in an amount of *up to* CHF 100 million on a professional basis or recommends itself publicly for this purpose and reinvests these deposits or pays interest thereon.[56]

A company is considered to be *active in the financial sector* if it renders or procures financial services, in particular, by engaging in the deposit taking or lending business, securities trading, investment or portfolio management or accepting crypto assets for itself or for third parties.[57] Deposit taking is generally deemed to be performed on a professional basis (see "sandbox" exemption; Section 5.2.1.2 above), if an individual or legal entity (a) continuously accepts more than 20 deposits from the public or crypto assets in collective custody or (b) recommends itself publicly for such deposit or crypto asset taking activities (regardless of whether the company actually continuously holds more than 20 deposits from the public or crypto assets or not).[58]

Generally, all repayment-*liabilities* via-à-vis clients qualify as deposits within the meaning of the BA.[59] There are, however, a number of exemptions. Amongst others, the following liabilities do not qualify as deposits:[60]

- funds provided in consideration of a contract providing for the transfer of property or the rendering of a service (e.g., prepayments that form part of the consideration for a purchase agreement are exempt, but granting a loan with a duty to repay is not exempt);

- funds which are transferred as a security;

- credit balances on client accounts of securities firms, DLT trading facilities, precious metal dealers, portfolio managers or similar companies which solely serve the purpose of the settlement of client transactions, provided no interest is paid on these funds and provided they are forwarded within 60 days;

- funds that to a small extent are transferred to a payment instrument or a payment system and that are exclusively used for future purchases of goods or

[51] Articles 1a and 1b BA.

[52] Article 1 para. 4 BA.

[53] Articles 46 and 49 BA; Article 44 FINMASA.

[54] Companies are also considered to be banks if they refinance themselves significantly with loans from several banks that do not own any qualified / significant shareholdings in them in order to finance any number of persons or companies with which they do not form an economic unit of their own and in any manner possible; see article 1a let. c BA.

[55] Article 1a let. a BA.

[56] Article 1a let. b BA.

[57] Article 4 para. 1 let. a BO. Furthermore, holding companies owning predominantly participations in companies active in the financial sector are themselves considered active in the financial sector; article 4 para. 1 let. b BO. Finally, significant group companies (Wesentliche Gruppengesellschaften) as defined in article 3a BO are deemed to be active in the financial sector too; article 4 para. 1 let. c BO.

[58] Article 6 para. 1 BO.

[59] Article 5 para. 1 BO; FINMA-Circular 2008/3, para. 10.

[60] Article 5 para. 3 BO.

services, provided no interest is paid on these funds; and

- bonds and other debt instruments that are standardised and issued *en masse* or uncertificated rights with the same function (book-entry securities) if, at the time of the offer, investors are informed in publicly available document form[61] about (1) the name, registered office and the purpose of the issuer as set out in a brief description, (2) the interest rate, issue price, subscription period, payment date, maturity and redemption terms, (3) the most recent annual financial statements and consolidated financial statements together with the audit report and, if more than six months have passed since the balance sheet date, the interim financial statements, if any, of the issuer and the guarantor, (4) the collateral provided and (5) the representation of bondholders, insofar as this is included in the investment conditions.

Furthermore, the following deposits are *not* considered to be deposits *from the public*:[62]

- deposits from domestic and foreign banks or other companies under regulatory supervision;
- deposits from qualified shareholders (owning more than 10 % of the share capital or the voting rights) of the debtor and any parties affiliated or related with such shareholders; and
- deposits from institutional investors with professional treasury operations.

Activities of FinTech companies may include regulated deposit taking within the meaning of the BA (e.g., if a FinTech company accepts funds from investors and subsequently transfers funds to its clients). In order to reduce the risk of becoming subject to a licensing requirement under the BA:

- FinTech companies may decide to refrain from accepting any third party funds in the first place.
- If deposits are involved, the FinTech company may want to stay within the scope of application of the "sandbox" exemption (see Section 5.2.1.2 above) or it may want to avoid accepting more than 20 deposits from the public or crypto assets in collective custody and refrain from recommending itself publicly for this purpose.[63]
- If deposits are involved, the FinTech company can try to ensure that only exempt liabilities are accepted. This would, for example, be the case if credit balances on client accounts solely serve the purpose of the settlement of client transactions and if no interest is paid on these funds.[64]
- FinTech companies can also decide to issue bonds or other debt instruments and, at the time of the offer, to inform investors in compliance with article 5 para. 3 let. b BO as well as article 64 para. 3 FinSA (see above).
- Finally, FinTech companies can consider obtaining a FinTech license (see Section 5.2.1.1 above), which allows them to accept deposits from the public up to CHF 100 million and crypto assets.

5.2.2.2 Trading Facilities

Trading venues, i.e., stock exchanges and multilateral trading facilities, are regulated financial market infrastructures under FMIA.[65] They require a license from *FINMA*[66] and are subject to a series of specific regulations.

- A stock exchange is an institution for multilateral securities trading *where securities are listed* and whose purpose is the simultaneous exchange of bids between several participants and the conclusion of contracts based on non-discretionary rules.[67]
- A multilateral trading facility is an institution for multilateral securities trading whose purpose is the simultaneous exchange of bids between several

[61] See article 64 para. 3 FinSA. E.g., electronically via the issuer's website.

[62] Article 5 para. 2 BO.

[63] Whether for example the mere publication of credit requests via crowdlending platforms constitutes a public recommendation to accept deposits is still open. To our knowledge, FINMA does not seem to be interpreting the law this way.

[64] Article 5 para. 3 let. c BO; See also the FINMA Fact sheet Crowdfunding (2020).

[65] Article 2 let. a sec. 1 and 2 FMIA.

[66] Article 4 para. 1 FMIA.

[67] Article 26 let. b FMIA.

participants and the conclusion of contracts based on non-discretionary rules *without listing securities*.[68]

Under Swiss law, "securities" (*Effekten*) are instruments, which are:

(i) standardised;

(ii) suitable for mass trading and;

(iii) either certificated securities (*Wertpapiere*), uncertificated securities (*einfache Wertrechte*), ledger-based securities (*Registerwertrechte*), derivatives[69] or intermediated securities (*Bucheffekten*).[70]

Typical examples of securities include not only shares, bonds, notes and other debt instruments, but may for example also include participations and / or sub-participations in a loan if such participations and / or sub-participations are standardised and suitable for mass trading.

An instrument is deemed to be standardised and suitable for mass trading if it is (a) either publicly offered and has the same structure (interest, maturity) and denomination (amount) or (b) if it is placed with more than 20 investors and has not been specifically created for a particular counterparty / investor.[71] It is important to note that not only listed instruments but also unlisted instruments qualify as securities.

Even if no securities are traded, an institution or trading platform can still qualify as a so-called organised trading facility ("OTF"). OTFs[72] within the meaning of FMIA are establishments for:

- multilateral trading in securities or other financial instruments whose purpose is the exchange of bids and the conclusion of contracts based on discretionary rules;
- multilateral trading in financial instruments other than securities whose purpose is the exchange of bids and the conclusion of contracts based on non-discretionary rules;[73] and
- bilateral trading in securities or other financial instruments whose purpose is the exchange of bids.

FinTech companies operating a platform that allows for trading of shares, standardised debt instruments or other financial instruments, including securities issued in the form of tokens (see Section 5.3 below), may qualify as regulated trading venues. Should a particular business model include such activities, the main question will often be whether the relevant FinTech company qualifies as an MTF (if securities are involved) or as an OTF, and hence requires a license as a bank, securities firm, DLT trading facility or trading venue.[74]

5.2.2.3 Payment Systems

Payment systems are regulated financial market infrastructures under FMIA.[75] A payment system is "an entity that clears and settles payment obligations based on uniform rules and procedures".[76]

Specific duties of payment systems (e.g., regarding settlement and liquidity) have been set out in the implementing ordinance of the FMIA.[77] A payment system requires a license from *FINMA*[78] if (a) this is necessary for the proper functioning of the financial market or the protection of financial market participants and (b) if the payment system is not operated by a bank.

Operating a payment system may involve deposit taking. However, there is a "safe harbour rule"[79] which may be applicable to FinTech companies in this context. Funds that to a small extent are transferred into a payment instrument or a payment system and that are exclusively being used for future purchases of goods or services may not

[68] Article 26 let. c FMIA.

[69] Derivatives are "financial contracts whose value depends on one or several underlying assets and which are not cash transactions". See article 2 let. c FMIA and article 2 paras. 2 to 4 of the Financial Market Infrastructure Ordinance ("FMIO").

[70] Article 2 let. b FMIA and article 3 let. b FinSA.

[71] See article 2 para. 1 FMIO.

[72] Article 42 FMIA.

[73] The term "non-discretionary rules" means that the operator of the trading facility has no discretion as to how interests may interact. Hence, the operator of the trading facility does not have discretion over how a transaction is to be executed.

[74] Article 43 para. 1 FMIA.

[75] Article 2 let. a sec. 6 FMIA.

[76] Article 81 FMIA.

[77] Article 82 FMIA i.c.w. article 66 et seqq. FMIO.

[78] Article 4 para. 2 FMIA.

[79] Article 5 para. 3 let. e BO.

qualify as deposits, provided no interest is paid thereon. The following requirements must be met:[80]

(i) the funds may only be used for future purchases of goods or services;

(ii) the maximum account balance per customer may not exceed CHF 3,000 at any time; and

(iii) no interest may be paid thereon.

If these requirements are met, the liabilities involved do not qualify as deposits and hence no banking license is required.

5.2.2.4 Anti-Money Laundering

Ensuring compliance with anti-money laundering regulation, i.e., the Anti-Money Laundering Act ("AMLA") and implementing regulations, often constitutes one of the key regulatory challenges for FinTech companies, both from an organisational and financial perspective. Swiss anti-money laundering regulation is based on three key elements:

- supervision of financial intermediaries either directly by *FINMA* or by self-regulatory organisations, which are themselves *FINMA*-supervised;
- due diligence, reporting, identification and record-keeping requirements applying to all financial intermediaries; and
- sanctions in case of non-compliance.

Article 305bis of the Swiss Criminal Code ("SCC") contains the criminal provision that prohibits all forms of money laundering. It stipulates that "any person that carries out an act that is aimed at preventing the identification of the origin, the tracing or the forfeiture of assets which he knows or must assume originate from a felony or aggravated tax misdemeanour is liable to a custodial sentence not exceeding three years or to a monetary penalty".

Financial intermediaries are divided into two groups:

- Financial intermediaries belonging to the "*banking sector*" if they are subject to comprehensive, prudential regulation under special legislation covering the whole range of their activities. Under these specific laws, a financial intermediary is supervised by the appropriate regulatory authority designated in each of these laws. Such financial intermediaries are for example banks, holders of a FinTech license, portfolio managers, trustees, securities firms, DLT trading facilities, insurance companies or licensed payment systems.[81]
- Financial intermediaries belonging to the "*non-banking sector*" if they "on a professional basis accept or hold on deposit assets belonging to third parties or assist in the investment or transfer of such assets".[82] This definition covers, in particular, persons who: (i) carry out credit transactions (in particular in relation to consumer loans or mortgages, factoring, commercial financing or financial leasing), (ii) provide services related to payment transactions, in particular by executing electronic transfers on behalf of other persons, or who issue or manage means of payment such as credit cards, (iii) trade for their own account or for the account of others in banknotes and coins, money market instruments, foreign exchange, precious metals, commodities and securities (stocks and shares and value rights) as well as derivatives relating thereto, (iv) make investments as investment advisers or (v) hold securities on deposit or manage securities.[83] Before engaging in business activities, such financial intermediaries must join a self-regulatory organisation recognised by *FINMA*.[84]

Many activities typically conducted by FinTech companies, as for example business models involving holding or depositing assets on behalf of clients, are subject to the anti-money laundering regulation. FinTech companies should namely take into account that the assistance provided in connection with the transfer of virtual currencies are services related to payment transactions subject to AMLA, if such services are provided in the context of a permanent business relationship. In principle, there are four approaches for FinTech companies to ensure compliance with anti-money laundering laws:

[80] FINMA-Circular 2008/3, para. 18.1.

[81] Article 2 para. 2 AMLA.

[82] Article 2 para. 3 AMLA.

[83] The Anti-Money Laundering Ordinance ("AMLO") and FINMA-Circular 2011/1 set out further details as to when the professional practice of financial intermediation is subject to supervision.

[84] Article 14 para. 1 AMLA.

(i) they can completely refrain from financial intermediation activities;

(ii) they can cooperate with a regulated financial intermediary, such as a bank, as far as financial intermediation activities are required;

(iii) they can join a self-regulatory organisation and comply with anti-money laundering regulations; or

(iv) if they are financial intermediaries belonging to the "*non-banking sector*"[85], they can structure their business model in such way that they provide their services only to financial intermediaries belonging to the "*banking sector*"[86] or to foreign financial intermediaries that are subject to equivalent supervision.

Apart from a limited number of exceptions[87], all *professional* financial intermediaries are subject to the AMLA and the requirements set-out thereunder. A financial intermediary is generally deemed to be engaging in financial intermediation on a professional basis if:[88]

- its activity generates a gross revenue of more than CHF 50,000 per calendar year;
- it enters into business relationships with more than 20 contracting parties per calendar year that are not limited to a one-time activity or if it maintains at least 20 such relationships per calendar year;
- it has unlimited power to dispose over assets belonging to others exceeding CHF 5 million at any point in time; or
- it executes transactions of a total volume exceeding CHF 2 million per calendar year.

The financial intermediaries' duties are set out under AMLA[89] and the implementing ordinances and regulations.[90] The key duties are:

- duty to personally identify the client, i.e., the contracting party;
- duty to identify the beneficial owner / economic beneficiary of the assets;[91]
- duty to re-identify the beneficial owner / economic beneficiary of the assets in certain circumstances;
- specific clarification / verification duties amongst others with regard to transactions or business relationships with heightened risks;
- duties relating to documentation of transactions and verifications as well as relating to record keeping;
- duty to implement organisational measures, e.g., regarding training of employees and controls; and
- duty to report cases of suspicions of money laundering to the *Money Laundering Reporting Office Switzerland* ("MROS").

Under certain circumstances and provided that specific requirements are met reduced duties may apply.

5.2.2.5 Consumer Credits

The Consumer Credit Act ("CCA") applies to consumer credits, i.e., loans granted to individuals on a professional basis for purposes other than business or commercial activities. Further, loans granted on a non-professional basis are subject to the CCA, provided they are granted in cooperation with a crowdlending broker (*Schwarmkredit-Vermittler*), e.g., an operator of a crowdlending platform.[92]

Therefore, FinTech companies may be subject to the regulations relating to consumer credits. The following duties / rights under the CCA may be of particular importance:

- duty to obtain a license in order to be permitted to grant or broker loans to consumers on a professional basis;[93]

[85] Article 2 para. 3 AMLA.

[86] Article 2 para. 2 AMLA.

[87] Article 2 para. 4 AMLA.

[88] Article 7 para. 1 AMLO.

[89] See article 3 et seqq. AMLA.

[90] The agreement relating to the Swiss banks' code of conduct with regard to the exercise of due diligence (VSB 16) is of particular importance. It contains a detailed set of rules in connection with the identification of clients and beneficial owners.

[91] Pursuant to the revised AMLA (that is expected to enter into force mid 2022) the financial intermediary will not only have to establish the identity but also have to verify the identity of the beneficial owner (article 4 para. 1 revised AMLA).

[92] Article 2 let. b CCA.

[93] Article 39 CCA.

- restrictions relating to the advertisement for consumer credits;[94]
- requirements regarding the form and content of consumer credit agreements;[95]
- duty not to exceed the maximum effective annual interest rate set by the *Swiss Federal Council*;[96] and
- duty to assess the consumer's creditworthiness[97] as well as the right to access the information made available by the Credit Information Office (*Informationsstelle für Konsumkredit*).[98]

FinTech companies should take into account that the CCA applies to all consumer credits granted to consumers domiciled in Switzerland, irrespective of whether the lender and/or lending platform has a physical presence in Switzerland. The CCA provides for significant sanctions in case of a breach, namely a loss of the claim to interest payments and repayment claim in case of a serious violation of the duty to conduct credit-checks.

5.2.2.6 Collective Investment Schemes

Collective investment schemes are "funds raised from investors for the purpose of collective investment, and which are managed for the account of such investors".[99] Generally, collective investment schemes regulation must be considered whenever a particular business model of a FinTech company entails the pooling of funds or risks in connection with an investment.

An entity or a financial product qualifies as a collective investment scheme if the following criteria are met: (1) funds (2) that are raised from (more than one) investors (3) for the purpose of being collectively managed (4) for the account of such investors, (5) whereby the investors' investment needs are met on an equal basis.

The licensing requirements as well as the supervision of fund management companies and managers of collective assets is governed by FinIA. Furthermore, the rules regarding the acquisition or disposal of units in collective investment schemes as well as the offering of such financial instruments will, subject to phase-in periods, be governed by FinSA. It must be noted, however, that units in collective investment schemes are the only Financial Instrument covered by the FinSA that will be subject to additional product-specific supervisory rules under CISA.

5.3. DLT and Blockchain – Swiss Regulatory Framework

Recently, Switzerland saw remarkable developments in distributed ledger technology ("DLT") and blockchain related business activities:

- In August 2018, *FINMA* granted the first asset manager of collective investment schemes license to a company focusing on investment management in the area of crypto assets (*Crypto Fund AG*).
- In November 2018, the world's first exchange traded product for investments in crypto assets was launched on the *Swiss stock exchange SIX* (by *21Shares AG* (f.k.a. *Amun AG*)).
- In August 2019, *FINMA* granted banking as well as securities dealer licenses to two companies focusing on products and services relating to digital assets (*Sygnum Bank AG* and *SEBA Bank AG*).
- In October 2019, the *Swiss stock exchange SIX* announced a cooperation with the *Swiss National Bank*, which aims at exploring technological options to make *digital central bank money* available for the trading and settlement of tokenised assets.[100]
- In September 2021, *SIX Digital Exchange AG (SDX)*, an affiliate of the *Swiss securities exchange SIX Swiss Exchange*, formally received the regulatory approval as a central securities depository from *FINMA*, while the associated company *SDX Trading AG* was approved to act as a securities exchange.[101] The obtained licenses enabled *SDX* to go live with a "fully regulated, integrated trading, settlement, and custody infrastructure" based on the blockchain technology.[102]

[94] Article 36 et seqq. CCA.
[95] Article 9 et seqq. CCA.
[96] Article 14 CCA.
[97] Article 22 CCA, article 28 et seqq. CCA.
[98] Article 23 et seqq. CCA.
[99] Article 7 CISA.
[100] See SIX Media Release of 8 October 2019 (SIX, 2019).
[101] See FINMA Press Release of 10 September 2021 (FINMA, 2021a).
[102] See SIX Media Release of 10 September 2021 (SIX, 2021a).

- Later in September, *FINMA* has approved the first crypto fund (*Crypto Market Index Fund*) under Swiss law.[103]

- Finally, in November 2021, *SDX* was launched by issuing the world's first digital bond in a fully regulated environment.[104]

The attitude of Switzerland's federal government, the *Federal Council*, and *FINMA* towards developments such as DLT and blockchain remains positive. However, these novel technologies have paved the way for the emergence of Decentralised Finance (DeFi), which increasingly challenges the current financial market regulation - also in Switzerland.

In December 2018, the *Federal Council* published a detailed report covering the legal framework for DLT and blockchain in Switzerland. The report concluded that the existing Swiss legal framework is, in principle, "fit" for technical developments such as DLT and blockchain. Nonetheless, a need for selective improvements was identified.

Only a few months later, the *Federal Council* had an initial draft law prepared, which then went through a comprehensive public consultation process. Based on feedback received, the *Federal Council* published the finalised draft law concerning DLT and blockchain on 27 November 2019.

In September 2020, the draft of the DLT Law was approved by the *Swiss Parliament* and partly entered into force on 1 February 2021. The second part of the DLT Law as well as the associated blanket ordinance (DLT Ordinance) entered into force on 1 August 2021. The DLT Ordinance sets out the necessary adjustments to ten existing ordinances.

This subchapter first discusses certain aspects of the *FINMA* categorisation of tokens (Section 5.3.1). Then the cornerstones of the DLT Law are summarised (Section 5.3.2).

5.3.1 *FINMA* Categorisation of Tokens

A key element of the Swiss regulatory framework applicable to DLT and blockchain is the categorisation of tokens introduced by *FINMA* in its "ICO Guidelines" of 16 February 2018.[105] *FINMA* distinguishes the following categories of tokens:

- *Payment tokens* (according to *FINMA*, synonymous with "pure" cryptocurrencies), are tokens which are intended to be used, now or in the future, as a means of payment for acquiring goods or services or as a means of money or value transfer. Such cryptocurrencies do not give rise to a claim against an issuer or a third party. Consequently, according to the prevailing view, these tokens are "purely factual intangible assets". Examples of such cryptocurrencies are bitcoin (including numerous "altcoins" built upon the basic technical framework used for bitcoin) or Ether.

- *Utility tokens* are tokens that are intended to provide digital access to an application or service by means of a DLT-based infrastructure.

- *Asset tokens* represent assets such as a debt or equity claim against the issuer. Asset tokens promise, for example, a share in future company earnings or future capital flows. In terms of their economic function, such tokens may therefore qualify as equities, bonds or derivatives. Tokens which enable physical assets to be traded on a DLT-infrastructure also fall into this category according to *FINMA*.

FINMA has clarified that tokens may fall into more than one of these three basic categories: such *hybrid* tokens are, for example, asset tokens or utility tokens, which at the same time qualify as payment tokens.

On 11 September 2019, *FINMA* published a supplement to its "ICO Guidelines", which focused exclusively on "stable coins" ("Stable Coins Guidelines").[106] The Stable Coins Guidelines were published against the background of a request of the *Libra Association*, i.e., a not-for-profit entity domiciled in Switzerland, which fostered the development of the planned global currency Libra.[107] The *Libra Association* had asked *FINMA* for an assessment of how the Libra

[103] See FINMA Press Release of 29 September 2021 (FINMA, 2021b).

[104] See SIX Media Release of 18 November 2021 (SIX, 2021b).

[105] See Guidelines for enquiries regarding the regulatory framework for initial coin offerings (ICO's), published 16 February 2018 (FINMA, 2018b).

[106] See FINMA media release of 11 September 2019 (FINMA, 2019).

[107] See the Libra White Paper (The Libra Association, 2019). In April 2020, the Libra Association applied to FINMA for a payment system license. However, the focus of the project was shifted to the USA, whereupon the Diem Association (the former Libra Association) suspended the license application in May 2021; see FINMA Press Release of 12 May 2021 (FINMA, 2021c).

project, in particular the issuance of the Libra "stable coin", would likely be treated under Swiss financial market laws. *FINMA* took this opportunity to not only provide its initial views on Libra, but to publish the comprehensive Stable Coins Guidelines, which indicate how *FINMA* will assess projects involving tokens linked to an underlying asset.

FINMA stated that it will continue to apply a "substance over form" approach as a general principle, also with regard to "stable coins", just as it did and still does with regard to any other kind of token. *FINMA* furthermore mentioned that the design and the technical details of "stable coins" vary substantially. Nonetheless, according to *FINMA*, "stable coins" may on a high-level be categorised based on (i) the type of "underlying" or asset underlying the coin and (ii) the rights which holders of such coins have:

- *Currency backed coins*: If a stable coin is backed by currencies and the holders of such a coin have a redemption claim against the issuer at a fixed price (e.g., 1 coin for 1 CHF), such issuer may be deemed to be engaging in regulated deposit taking subject to a licensing requirement under the BA (see Section 5.2.2.1 above). If a coin is backed by a *basket* of currencies and if the holders of such coin have a redemption claim against the issuer at the current value of such a basket (net asset value), such coin may qualify as a unit in a collective investment scheme and hence trigger licensing requirements under the CISA (see Section 5.2.2.6 above). Also, such currency backed stable coins might constitute a payment system (see Section 5.2.2.3 above).

- *Commodities backed coins*: If a stable coin is backed by commodities, the regulatory consequences depend on the type of commodity and whether the holders of such a coin have only (i) a contractual claim against an issuer or (ii) whether they have a right *in rem* with regard to the underlying commodity. In the latter case, financial market regulation does generally not apply and the stable coin does, in particular, not qualify as a security, if certain requirements are met. If the coin only grants a contractual claim, however, this likely triggers requirements under the BA (if the commodities are precious metals) or the coin may qualify as a security or a derivative (if the commodities are other commodities than precious metals). Furthermore, such commodity backed stable coins may possibly also constitute units in collective investment schemes.

- *Real estate backed coins*: If a stable coin is backed by real estate, such coin will likely be qualified as a unit in a collective investment scheme, hence triggering a licensing requirement under CISA (see Section 5.2.2.6 above).

- *Securities backed coins*: If a stable coin is backed by a single security (e.g., shares of a particular company), the coin as such will likely qualify as a security, and may, depending on the specifics of the individual case, constitute a derivative or even a structured product. If the coin is backed by a *basket* of securities, however, it will in most cases constitute a unit in a collective investment scheme within the meaning of CISA (see Section 5.2.2.6 above).

It must be noted that these *FINMA* guidelines are of an indicative nature only and not legally binding. In any case, however, the specifics of each "stable coin" project will need to be assessed based on the relevant details of the envisaged design of the token and the legal relationships between the parties involved.

With regard to the questions, whether a particular token (or coin) is a Financial Instrument (see Section 5.1.1.1 above) for the purposes of the FinSA, the following must be noted:

- Whether a token qualifies as a Financial Instrument or not depends on its economic function and, derived from this, which rights are represented by or linked to such particular token. Consequently, it must be assessed on a case-by-case basis whether a token qualifies a Financial Instrument or not.

- *Asset tokens*, *hybrid tokens* and *stable coins* granting their holders for example participation and voting rights in a corporation or rights to the repayment of debt are likely to qualify as Financial Instruments within the meaning of FinSA.

- *Payment tokens* are to date not treated as securities by *FINMA* and are generally[108] not deemed to be Financial Instruments within the meaning of FinSA.

- *Utility tokens* are currently also not treated as securities by *FINMA*, provided (i) their sole purpose is to confer digital access rights to an application or service and (ii) the tokens can actually already be used in this manner when they are issued. Such "pure" utility tokens, which neither partially nor exclusively function as an investment in economic terms, are also no Financial Instruments for the purposes of the FinSA.

5.3.2 DLT Law

The cornerstones of the DLT Law of 25 September 2020 are the introduction (i) of so-called Uncertificated Register Securities (*Registerwertrechte*) (Section 5.3.2.1), (ii) of a new license category for operators of DLT trading facilities (*DLT Handelsplattformen*) (Section 5.3.2.2) and (iii) of rules governing the segregation of crypto assets and data in insolvency proceedings (Section 5.3.2.3).

The DLT Law was approved by Swiss Parliament in September 2020. Whilst the provisions allowing for a creation of Uncertificated Register Securities were enacted 1 February 2021 (see Section 5.3.2.1), the additional aspects of the DLT Law entered into force on 1 August 2021.

5.3.2.1 Uncertificated Register Securities

The DLT Law introduced a new concept of so-called "Uncertificated Register Securities" (*Registerwertrechte*), which aims at increasing legal certainty in connection with the "tokenisation" of rights and financial instruments. Based on the DLT Law, Swiss law now provides for the possibility of an electronic registration of rights and claims that has the same functionality and entails the same protection as a negotiable security.

Legal positions admissible as underlying rights of such Uncertificated Register Securities include rights against issuers, such as contractual claims or membership rights (e.g., shares in a corporation). Consequently, asset tokens, utility tokens, hybrid tokens as well as "stable coins" (see Section 5.3.1 above) may be issued in the form of Uncertificated Register Securities. Payment tokens, i.e., cryptocurrencies can, however, not be issued in the form of Uncertificated Register Securities since they do not give rise to any claims, which could serve as an underlying right.

In order to create Uncertificated Register Securities, the involved parties (e.g., the issuer of an instrument as debtor and the holders of the instrument as creditors) must enter into a registration agreement (*Registrierungsvereinbarung*). Based on this agreement the relevant right (i) is entered into the so-called "Register of Uncertificated Securities" (*Wertrechteregister*) and (ii) may exclusively be asserted based on and transferred via this register.[109]

The register must meet certain minimum requirements in order to qualify as a Register of Uncertificated Securities within the meaning of the DLT Law:

(i) the register must, by means of technical procedures, grant the creditors, but not the debtor, actual power of disposal (*Verfügungsmacht*) over their rights;

(ii) the register's integrity must be ensured by implementing the appropriate technical and organisational protective measures that prevent unauthorised changes to the register (e.g., joint administration by several independent parties);

(iii) the content of the registered rights, the functioning of the register itself and the registration agreement must be recorded either directly in the register itself or in accompanying data linked to the register; and

(iv) creditors must be able to view the information and data relating to themselves and they must be able to verify, without third party support or intervention, the integrity of the content of the register relating to themselves.[110]

In its dispatch of the DLT Law, the *Federal Council* mentions certain existing DLT-systems that are currently deemed suitable to fulfil the statutory minimum requirements. Both permissionless (e.g., Ethereum) as well as permissioned (e.g., Corda, Hyperledger Fabric) systems are mentioned in this (non-exhaustive) list.

[108] Payment tokens may constitute deposits (Einlagen) and could therefore potentially be in scope of article 3 let. a ciph. 6 FinSA: "Financial Instruments are (…) deposits whose redemption value or interest is risk- or price-dependent, (…)".

[109] Article 973d para. 1 CO.

[110] Article 973d para. 2 CO.

Excursus: FINMA Guidance on Staking of Crypto Assets

General Remarks

On December 20, 2023, the Swiss Financial Market Supervisory Authority **(FINMA)** issued guidance no. 08/2023 on the treatment of staking services under Swiss financial market regulatory laws (the **Guidance**[111]) The Guidance provides for certain clarifications regarding regulatory treatment of staking services. Pursuant to the Guidance, the regulatory requirements applicable to the relevant staking services differ depending on whether the relevant service provider is engaging in deposit taking or merely acting on a fiduciary basis when accepting crypto assets from its clients. In constellations in which the service provider is engaging in deposit taking, the following will apply:

- The clients' claims for the return of staked crypto assets are merely contractual claims against the staking service provider, and as a result
  - such claims may be treated as deposits under the Banking Act, and the staking service provider may therefore be considered to be engaging in a regulated activity permitted only to licensed banks; and
  - in the event of the insolvency of the staking service provider, clients are treated as general unsecured creditors; and
- if the staking service provider is a licensed bank, the staked crypto assets would be included in its risk-weighted assets for capital adequacy purposes.

In contrast, in constellation in which the staking service provider is acting on a fiduciary basis within the meaning of the Guidance in relation to the crypto assets accepted from its clients, the following will apply:

- they may not be considered to be engaging in an activity permitted only to licensed banks (but may nevertheless become subject to anti-money laundering regulations);
- in the event of the insolvency of the staking service provider, the staked crypto assets received from clients do not form part of the insolvency estate[112]; and
- if the staking service provider is a licensed bank, the staked crypto assets are not included in its risk-weighted assets for capital adequacy purposes (but may be subject to restrictions imposed by FINMA).

The Custodian's Obligation to Ensure the Crypto Assets' "Immediate Availability" Remains Key

The Guidance's approach to determining whether the staking service provider is engaging in regulated deposit taking or is merely acting on a fiduciary basis is based on the three tiers of crypto asset custody that were introduced under the DLT Act:

1. If crypto assets are held in custody (i) individually segregated on a client level and (ii) subject to the custodian's obligation to ensure their immediate availability, the staked crypto assets will be segregated in hypothetical bankruptcy proceedings and the relevant service provider will be deemed to be acting on a fiduciary basis.
2. If crypto assets are held in custody (i) in an omnibus account but with records of each client's fractional share and (ii) subject to the custodian's obligation to ensure their immediate availability, the fiduciary treatment applies. If the crypto assets so held are payment tokens, this form of custody requires an "Article 1b" license (or fintech license) under the Banking Act.
3. If crypto assets are held in custody (a) in an omnibus account and with no records of each client's fractional share or (b) not subject to the custodian's obligation to ensure their immediate availability,

[111] For more information please refer to Kramer, Leisinger, Wherlock, Eckert, and Baschung (2023).

[112] If the staking service provider is a licensed bank, such assets will qualify as custody assets within the meaning of art. 16(1bis) Banking Act. If the staking service provider is not a licensed financial institution, this follows from a corresponding provision in the Debt Enforcement and Bankruptcy Act (art. 242a). Both provisions were enacted as part of the DLT Act.

the staking service provider will be deemed to be engaging in regulated deposit taking activities, as the respective crypto assets will not be segregated in hypothetical bankruptcy proceedings.

As the main requirement for determining which of the two analyses applies to Swiss staking service providers, the Guidance focuses on the obligation to ensure the immediate availability of the crypto assets and how such an obligation may be affected by different staking arrangements in constellations under which staking involves the possibility of lock-ups or slashing.

What the Guidance Sets out as Relevant Criteria

Direct Staking by Licensed and Unlicensed Staking Service Providers

For the fiduciary analysis to apply to a Swiss provider of staking services that controls the withdrawal keys of the staked crypto assets, the following conditions must be met according to the new Guidance:

- the client has provided specific instructions as to the type and number of crypto assets to be staked;
- appropriate measures have been taken to ensure that the crypto assets staked to a particular validator address and, after staking, to a particular payout address can be unambiguously attributed to the client;
- the client is transparently and clearly informed of all risks;
- appropriate steps are taken to mitigate the operational risks of operating a validator node (including business continuity management) to avoid slashing and other penalties; and
- a Digital Assets Resolution Package (DARP) is prepared to ensure appropriate risk management.

For the fiduciary analysis to apply to Swiss non-bank staking service providers engaged in direct staking of payment tokens, the Guidance requires that the staked payment tokens continue to be held in individual custody, with a separate and assignable blockchain address for each client (at the level of the original custody address, the staking address, and the withdrawal address).

Delegation by a Licensed Bank or Securities Firm to a Third-Party Provider of Staking Services

For the fiduciary analysis to apply with respect to a Swiss bank or securities firm that appoints a third-party staking service provider to provide staking services to the institution's clients, the following conditions must be met according to the Guidance:

The bank or securities firm must enter into a fiduciary agreement with the client that contains a specific fiduciary mandate from the client, including the selection of crypto assets and the amount. In FINMA's view, the bank acquires a contractual claim against the third-party staking service provider for the return of the staked crypto assets, and the fiduciary agreement is intended to ensure that the fiduciary analysis applies to this contractual claim. The fiduciary arrangement must include a comprehensive risk disclosure to the client and adhere to requirements broadly analogous to those set out in the Swiss Bankers Association's 2016 Directives on Fiduciary Investments. In particular, the bank or securities firm must:

- limit counterparty risks by selecting an institution subject to prudential supervision with a good credit rating;
- ensure, by means of specific due diligence, that the third-party provider itself holds, inter alia, the relevant withdrawal keys; records the validator addresses and has taken all necessary measures to mitigate operational risks associated with the operation of the validator node; and is based in a jurisdiction offering equivalent protection to clients; and
- establish a DARP to ensure appropriate risk management.

The DLT Law also allows to bridge the new framework with the "traditional" book-entry securities (*Bucheffekten*) concept. In particular, it is possible to register Uncertificated Register Securities with a "*traditional*" *custodian* (e.g., *a bank*) and to subsequently book them into a "traditional" securities account. Hence, Uncertificated Register Securities can easily be transferred to the "old world" of book-entry securities, if desired.

5.3.2.2 DLT Trading Facilities

Under former Swiss law, there were only three categories of trading facilities: stock exchanges, multilateral trading facilities and organised trading facilities (see Section 5.2.2.2 above). For a number of reasons, these categories were deemed unsuitable for trading of crypto assets, e.g., because retail clients do not have direct access to regulated stock exchanges and multilateral trading facilities. Instead, these trading venues are only open to holders of a securities firm license and certain other regulated participants.[113]

Under the DLT Law, a new license category for (centralised) financial market infrastructures was introduced. These so-called "DLT Trading Facilities" (*DLT-Handelssysteme*) may offer services in the areas of trading, clearing, settlement and custody of DLT-based assets not only to regulated financial market participants but also to unregulated corporates as well as individuals, potentially including retail clients.

A license as a DLT Trading Facility can be obtained by trading venues that allow for the simultaneous exchange of offers between several participants and the conclusion of contracts based on non-discretionary rules and, in addition, provide for: (1) the admission of unregulated corporates or individuals; (2) the custody of DLT Securities based on uniform rules and procedures; or (3) the clearing and settlement of trades in DLT Securities based on uniform rules and procedures.[114]

"DLT Securities" (*DLT-Effekten*) are securities that are suitable for mass trading and are issued in the form of Uncertificated Register Securities (*Registerwertrechte*) and which, by means of technical procedures, grant the creditors, but not the debtor, the actual power of disposal over the uncertificated securities.[115]

Payment tokens as well as (mere) utility tokens that do not serve an investment purpose do not constitute DLT Securities. However, a DLT Trading Facility may also permit the trading of payment and utility tokens that do not qualify as DLT Securities.

The licensing requirements for DLT Trading Facilities are largely modelled on the requirements for traditional trading venues (i.e., stock exchanges and multilateral trading facilities). However, specific rules with respect to the admission of participants and the admission of DLT Securities have been added.[116] Furthermore, additional requirements for certain types of DLT Trading Facilities have been established, e.g., for DLT Trading Facilities that admit retail investors as participants and therefore require higher standards of customer protection.[117] On the other hand, relief from certain requirements applicable to DLT Trading Facilities that are considered "small" in terms of number of participants or trading and custody volume, respectively, have been granted.[118]

5.3.2.3 Insolvency

Crypto assets such as cryptocurrencies and tokenised financial instruments are often stored with third party custodians, such as exchanges or wallet providers.

Under former Swiss law it was unclear whether crypto assets held by a custodian on behalf of a client would be segregated in the bankruptcy of the custodian, especially if the creditor or investor did not hold (any) private key(s). The DLT Law therefore introduced a new segregation regime that allows the segregation of crypto assets for the benefit of the relevant creditors or investors in the bankruptcy of the custodian, if certain requirements are met, including, in particular, the following:

- First, the relevant custodian must have an obligation vis-à-vis the relevant creditor or investor to hold

[113] Article 34 para. 2 FMIA.

[114] Article 73a FMIA.

[115] Article 2 let. b^{bis} FMIA.

[116] For an overview see FINMA guidelines for applications concerning licensing as a DLT trading facility (FINMA, 2021d) (version of 2 August 2021), which are available in German, French as well as English.

[117] Article 58i et seq. FMIO.

[118] Article 58l FMIO.

the crypto assets available for him at all times. This means that the custodian may, for example, not use such crypto assets for proprietary business or own-account transactions.

- Second, the crypto assets are only segregated if they can be either (i) unambiguously allocated to the individual creditor or investor (however, there is no need that such allocation occurs directly on the relevant DLT-system itself) or (ii) allocated to a group of investors or creditors and it is evident what share of the joint holdings belongs to a given creditor or investor. The latter option allows a pooling of crypto assets held for several creditors or investors.

In addition, the access to data in insolvency in general is governed by the DLT Law. Under ancient Swiss law it was not clear whether digital data stored by a third party custodian (e.g., a cloud provider) could be segregated from the bankruptcy estate of such custodian. The DLT Law introduced a right to request segregation of digital data regardless of whether such data has any (market) value or not (e.g., a holiday picture) in the bankruptcy proceedings of a custodian. The person requesting such segregation must show that it has a specific entitlement to the data for which the segregation is being requested (e.g., a statutory or contractual claim). Furthermore, the person requesting segregation may be required to pay a fee in advance, which will then be used to cover the costs of the data retrieval and segregation.

6. Banks and FinTech

By Thomas Ankenbrand, Denis Bieri & Levin Reichmuth, Institute of Financial Services Zug IFZ

The implementation of FinTech solutions holds promising potential for traditional banks. In this context, this chapter analyses the development of productivity indicators of Swiss banks in Section 6.1 and concepts regarding the integration of financial services in third parties in Section 6.2.

6.1. Benefits of FinTech for Banks

As in previous years, this section examines aggregated productivity indicators of Swiss banks. The development of the indicators might hint at certain influences of FinTech companies as service providers of the Swiss banking sector.

Figure 6.1 displays costs and income figures of Swiss banks and aggregated business volumes, i.e., balance sheet total and assets under management, indexed to 100 in 2010 and up to 2022.[1] The left-hand graph shows that the aggregated total operating expenses have remained rather constant since 2018. However, a comparison of the individual components shows that salary expenses are stagnating, while administrative costs have been trending upward since 2020. More precisely, the administrative expenses have grown by two percent in 2021 and 2022, according to a year-over-year comparison. Regarding the aggregated business volumes, i.e., balance sheet total and assets under management, it is striking that both indicators show a peak as of the end of the year 2021 and a decline for 2022. The (former) two big Swiss banks have been responsible for roughly 80 percent of the seven-percent decline in the aggregated balance sheet. The decline in assets under management of 14 percent is particularly driven by the negative equity market development in 2022 (Swiss Bankers Association, 2023b).

The right-hand graph of Figure 6.1 illustrates the aggregated total income of Swiss banks, consisting of the net result from interest operations and commission income

[1] Note that the figures for the year 2023 were not available at the time of writing.

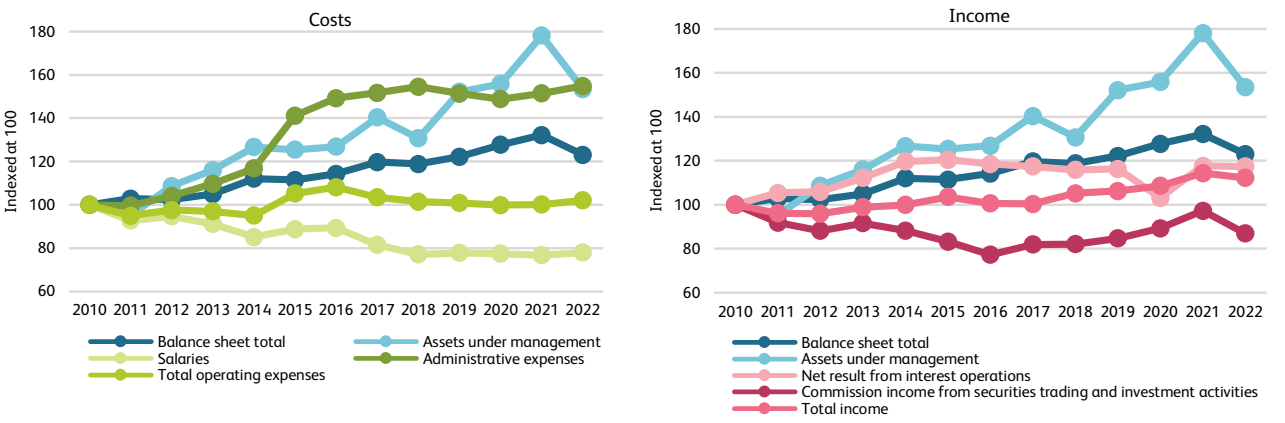

Figure 6.1: Size, costs, and income indicators for Swiss banks indexed at 100 in 2010 (source: Swiss National Bank (online-a))

from securities trading and investment activities. The total income as of the end of 2022 is two percent lower than in the previous year, mainly due to the eleven percent lower commission income from securities trading and investment activities. This decline in commission income can be explained by the negative development of the assets under management. In comparison, the interest income is developing steadily in 2022, after significant value adjustments in the lending business concerning default risks in 2020 (Swiss National Bank, online-a).

In summary, the aggregated productivity indicators have been dominated in 2022 by decreasing assets under management and contracted balance sheets. It will be interesting to see whether the ratios between assets under management and total assets to costs as an efficiency indicator will return to the long-term trend in the future, i.e., whether efficiency will increase again. In a highly competitive and saturated market such as the Swiss banking sector, the implementation of FinTech solutions in particular could be a lever for achieving such efficiency gains.

6.2. Embedded Finance

In recent years, various concepts related to the opening of financial service providers to third parties have emerged and, in some cases, have begun to materialise. The terminologies prevalent in this context include "open banking"[2] and "open finance"[3]. In broad terms, open banking focuses on the sharing of banking data and services with third-party providers, while open finance encompasses a broader range of financial data and services, including areas such as insurance (Ankenbrand, Bieri, Kronenberger, & Reichmuth, 2023).

A related concept to open banking and open finance that is receiving increasing attention in the financial services industry is "embedded finance", a market that is projected to reach USD 623 billion globally by the year 2032 (Pradeep et al., 2023). The potential of embedded finance is also evidenced by a study by Ernst & Young, which shows that the majority of financial services are likely to be provided via non-financial services platforms in the near future (Byrne, 2023).

6.2.1 Definition of Embedded Finance

Despite the significant assumed potential and the increasing attention from the financial industry, there is no generally recognised definition for the term "embedded finance", as is the case with many newly emerging terms in the financial sector. However, to provide clarity and direction for the present study, the following definition is adopted:

Embedded finance is the **integration of financial solutions into value chains** with the goal of streamlining financial services for clients.

Therefore, despite potential differences in their design or scope, open banking, open finance, and embedded finance share the common goal of (partially) opening up the financial industry to increased collaboration, innovation, and customer-centric products and services. Embedded finance can be considered as a leveraged form of the other two concepts, as it seamlessly integrates the services and products of financial service providers into the customer journeys of other solutions through open interfaces.

One term that is often equated with embedded finance is "Banking-as-a-Service" (BaaS). While BaaS takes the backend perspective, i.e., the bank acts as a provider of interfaces to its financial products and services for third-party providers, including the required licences to operate within the financial market, embedded finance takes the frontend perspective of the end customer, who ultimately obtains integrated financial solutions.

A visualisation of the concept of embedded finance in a general framework of financial ecosystems[4] can be found in Figure 6.2. The visualisation is structured in layers that cover different aspects of open financial ecosystems, i.e., *Infrastructure*, *Data*, *Execution & Custody*, and *Frontend*, in addition to the representation of the end client

[2] For an introduction to open banking, refer to Ankenbrand et al. (2021).

[3] For an introduction to open finance, refer to Ankenbrand, Bieri, Kronenberger, and Reichmuth (2023).

[4] Note that an in-depth discussion of the architecture for open financial ecosystems is provided in Ankenbrand et al. (2021).

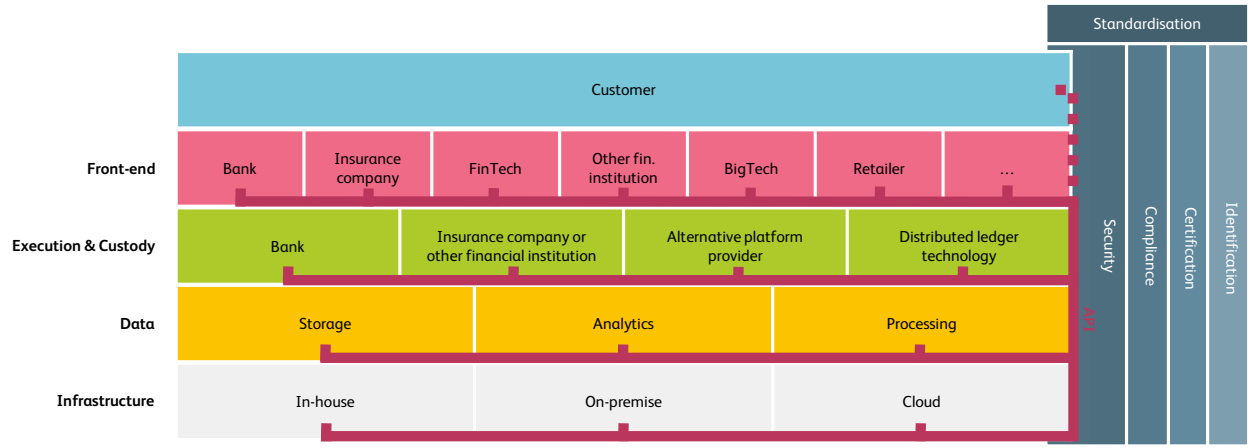

Figure 6.2: Embedded finance in a generalist financial ecosystem framework

on top of the architecture. The necessary technical interconnectivity of the elements is achieved using application programming interfaces (APIs), which again are characterised by standardisation, security, compliance, certification, and identification features.

The figure reveals that in an embedded finance context, the consumer uses financial products or services directly via the front-ends of another company's platform or application. The companies embedding financial services into their offerings can come from both non-financial and financial domains. Non-financial companies, such as BigTech companies or retailers, may integrate financial services to enhance their overall product or service offering and provide a more comprehensive solution to their customers. However, financial service providers such as FinTech companies can also serve as a front-end, for example, to seamlessly integrate products and services from established financial institutions into their applications. In embedded finance, the companies providing the primary solution to the client often still rely on financial service providers, such as banks and insurers, in the back office to perform the execution and custody of the financial services and products integrated into their platforms or applications. Alternative platform providers, exemplified by entities like Visa and Mastercard within traditional payment networks and emerging technologies like distributed ledger technology (DLT) in the context of blockchain-based embedded finance, can also take on this role. In terms of data storage, analysis, and processing, as well as the underlying technological infrastructure, embedded finance is not necessarily fundamentally different from other forms of open financial ecosystems.

In other words, in embedded finance, banks and insurance companies act mainly as the balance sheet and licence provider for financial solutions seamlessly integrated into the value chain of other platforms or applications. In this role, they do not have a direct touchpoint with the end client. However, it should be noted that this does not always have to be the case, as financial products can also be integrated into other financial ecosystems.

6.2.2 Relevance at Swiss Banks

According to the CIO Barometer conducted as part of last year's edition of the present study, the IT priorities of Swiss banks show that banks have given little priority to the topic of embedded finance in recent years. Figure 6.3 shows that the priority score measured at the end of 2021 and 2022 is around 2 on a scale of 1 (very low priority) to 4 (very high priority).

This contrasts with the majority of international financial institutions, which, according to a survey by IBM, consider embedded finance as either core or complementary to their business strategy (IBM, 2023). However, although Swiss banks do currently not give high priority to embedded finance, they assume that it will play a more signifi-

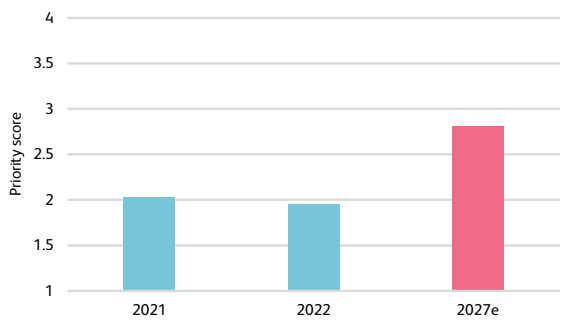

Figure 6.3: Priority of embedded finance at Swiss banks (n_{2021}=48; $n_{2022,2027e}$=61)

cant role in the future. Based on the participating banks in the CIO Barometer, a score for the estimated priority of integrating financial services into the value chain of (non-) financial companies for the year 2027 is 2.8, which is 44 percent higher than the priority as of the end of 2022.

In general, it can be assumed that the importance of embedded finance in the Swiss banking sector is not or will not be the same for all institutions. This variance in acceptance is already reflected in the current landscape, in which only a limited number of banks are actively positioning themselves on the embedded finance market. The reasons for this selective engagement are complex and include factors such as the individual bank's strategic vision, technological readiness, and the adaptability of its existing infrastructure.

A general increase in the relevance of and interest in the topic among Swiss banks can also be linked to the growing market size for embedded finance solutions. According to research reports, the embedded finance industry in Switzerland reached approximately USD 1.3 billion in revenues as of the end of 2023. Assuming a compound growth rate (CAGR) of 22 percent, the industry's revenues are expected to grow steadily up to USD 3.3 billion by 2029 (Research and Markets, 2023a), making it a relevant market also for local banks. In relation to the aggregated revenues of the European embedded finance industry, estimated at USD 47 billion in 2023, Switzerland is currently generating roughly three percent. Furthermore, Switzerland's share is even expected to decrease until 2029, as the European industry's CAGR is higher, at 25 percent (Research and Markets, 2023b). From a wider perspective, the embedded finance market established in Europe accounts for roughly 25 percent of the revenues generated in the global market (Future Market Insights, 2023). However, due to different definitions of the embedded finance industry and target markets, a straightforward comparison of the studies mentioned is not directly possible.

6.2.3 Exemplary Use Cases of Embedded Finance

The financial products and services that can be seamlessly integrated into third-party platforms and applications using embedded finance can generally be found in all areas of finance. In the following sections, two exemplary use cases are explored and structured using the general framework for embedded finance in Figure 6.2 to provide a standardised approach that streamlines understanding of the concept. While the first use case is centred around payments, the second use case revolves around lending.

6.2.3.1 Embedded Payments

Embedded payments describe the offering of payment services directly in the value chain of a third-party platform or application, enabling a frictionless transactional experience and fostering convenience and efficiency for both users and businesses.

One exemplary use case in this context is park-and-pay, a convenient method of handling parking fees via digital technologies that allow drivers to pay for parking using digital payment methods. Drivers can use a mobile app to find available parking spaces, select the desired parking time, and make the payment directly via the app. Such a system might also use sensors or cameras to monitor the occupancy of car parks and allow automatic billing based on the length of time a vehicle is parked in a space. This method simplifies the parking process by eliminating the need for physical tickets or coins and often offers additional features, such as reminders when parking time is about to expire or the ability to extend parking time remotely via the app.

In Figure 6.4, a potential design for a park-and-pay solution is depicted. This solution is developed as an independent application for parking services, encompassing functionalities such as locating available parking spaces

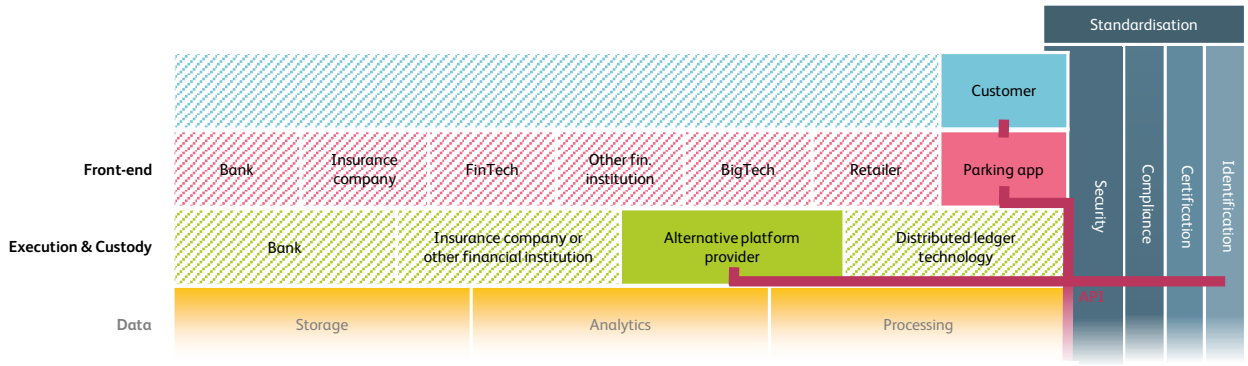

Figure 6.4: Use cases of embedded finance: Park-and-pay

and facilitating integrated payment processes. Note that such services could also be included in other ecosystems, such as the parking services offered by TWINT (TWINT, online). In that case, the front-end provider would be a FinTech company, and the user's connected house bank would make the payments via the user's bank account.

In the solution described in Figure 6.4, users engage with a mobile app to manage their parking requirements and can conveniently settle parking fees directly through a stored credit card, utilising an alternative platform provider, such as Mastercard or Visa. The solution could be designed in such a way that such payments are triggered without any direct action by the user. For instance, if the parking facility utilises a licence plate recognition system, it can automatically identify the customer and track necessary payment details, like the duration of parking, without requiring user intervention. It should be noted that, in this scenario, banks could still play a role as issuer or acquiring service provider, but the settlement and clearing of transactions is being done by the credit card schemes. Yet, also in this scenario, the processing is often outsourced to specialised service providers, which could be banks themselves.

In an expanded service ecosystem for cars, the manufacturer of a vehicle and other third-party service providers could also be integrated, in addition to the car park operator. For example, services such as refuelling at an authorised gas station, optional seat heating, or situational insurance for driving other people's cars could be provided for a seamless payment. Furthermore, the degree of involvement by banks may increase based on the application's available payment options. Such an increase is the case, for example, if direct authorised payments through bank accounts, such as direct debits, are feasible.

6.2.3.2 Embedded Lending

Embedded lending refers to financial services that are integrated into platforms or applications beyond the traditional banking environment and provide users with access to lending functions within the same interface they use for their primary activities like shopping or conducting business transactions.

One example of this is buy-now-pay-later (BNPL), a payment model that allows consumers to make purchases and pay for them in instalments over time. BNPL services not only facilitate instalment payments but often include lending elements as well. Users who opt for BNPL might effectively be borrowing money from the BNPL provider or its partnering financial institutions to make the purchase. For the customer, such a solution can provide increased purchasing power and flexibility in (re)payments, besides a more convenient lending process due to seamless integration into the retailer's platform.

Figure 6.5 shows a potential design of a BNPL solution. In this example, a retailer, such as an e-commerce platform, provides a BNPL option for its customers. This option allows customers to purchase products or services and defer payment, essentially borrowing funds via the BNPL service

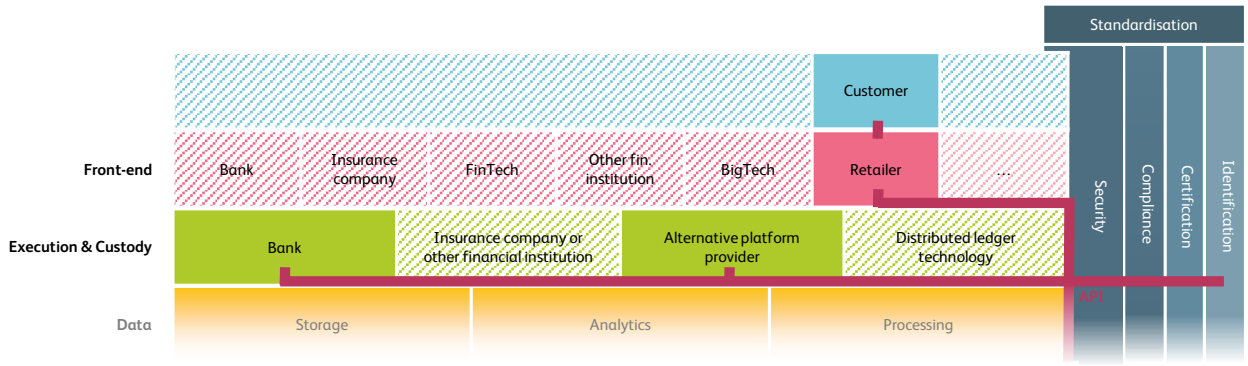

Figure 6.5: Use cases of embedded finance: Buy-now-pay-later

company, who, in this setup, acts as an alternative platform provider.[5] In the design shown, the funds to be lent are provided by banks, either directly for the customer or as a credit line for the BNPL provider. Furthermore, banks could also act as credit underwriters. By engaging in both funding the BNPL service and evaluating the creditworthiness of consumers, banks play a dual role, which can expose banks to various risks associated with consumer behaviour and economic fluctuations, requiring effective risk management strategies to mitigate potential losses. In principle, BNPL models in which no bank needs to be involved at all are also conceivable. This is the case, for example, when crowdfunding platforms serve as a financing vehicle or when the debtor sells (part of) its invoices to a third party at a discount through factoring.

From a customer perspective, a customer opting for a BNPL checkout for the first time typically needs to register with the relevant BNPL provider, a process that can be integrated directly into the merchant's front-end. For subsequent BNPL payments, the API-based exchange between the BNPL provider and the merchant enables seamless identification of the customer through shared data, further streamlining the payment and lending process.

[5] Note that while the BNPL service is integrated into the front-end of various online platforms or retail sites, the actual provider of the BNPL solution is typically a specialised entity, such as a FinTech company.

6.2.4 Conclusion

Although embedded finance is assumed to have a significant potential for the financial sector, it is not (yet) a high priority for the Swiss financial industry in general. However, some Swiss banks have positioned themselves in this market, and there are already some use cases where financial services have been seamlessly integrated into other platforms and applications in order to improve the customer journey for the end client. Exemplary use cases include park-and-pay and BNPL services.

Besides the general developments in the field of open banking and open finance, a catalyst for the development of embedded finance could be the introduction of an e-ID system in Switzerland, planned for 2026 at the earliest (Federal Council, 2023), by strengthening security through robust authentication, ensuring better compliance with strict regulations, such as KYC and AML, and simplifying identification processes. Government-backed verification streamlines onboarding, increases trust, and mitigates the risk of fraud. It provides a standardised, secure, and credible foundation on which application and platform providers can better integrate a range of financial services seamlessly across different digital platforms and, with that, promotes the widespread adoption and integration of embedded financial solutions.

For banks, it is important not only to perceive embedded finance as a risk due to the potential loss of the customer interface but also to seize the opportunities that arise from it. Studies indicate that within this concept, banks

can indeed capture value. However, this depends on the banking services offered. According to a McKinsey study, in particular, value can be generated by banks in lending since they bear the counterparty risk for such services. In the payment sector, however, the provider of the customer interface tends to benefit more (McKinsey, 2022). Hence, especially in embedded finance solutions for which a risk-taker is required, banks may still retain an essential position in the financial industry, allowing them to generate revenues by leveraging their expertise in risk and compliance management and term transformation (i.e., aligning short-term liabilities, like deposits, with longer-term assets, such as loans).

In essence, banks must position themselves strategically within the growing embedded finance market and adapt their offerings accordingly. Failing to do so exposes them to the risk of losing market share to competitors such as companies from the insurance industry, an industry that is already comparatively more involved in this topic (i.e., embedded insurance). Over time, there is a potential scenario where non-financial companies may opt to provide financial solutions directly instead of relying on established financial institutions. Therefore, it becomes imperative for banks to adapt and proactively engage in this evolving landscape to maintain their market standing.

7. Large Language Models for Financial Advice

By Thomas Ankenbrand, Denis Bieri, Levin Reichmuth & Ege Yilmaz, Institute of Financial Services Zug IFZ; Cornelia Stengel & Stephanie Wickihalder, Swiss Fintech Innovations

In recent years, developments in the field of artificial intelligence (AI) have progressed rapidly, including in the field of "generative AI" (GenAI), which summarises the generation of text, images, audio, and video. Products of GenAI can look human-made, in particular, as the pattern and structure of training data are learned to generate output with similar characteristics. Therefore, it is not astounding that experts are discussing when so-called "artificial general intelligence" (AGI) may become part of reality (Tamim, 2023).

With the launch of ChatGPT by OpenAI in November 2022 (OpenAI, 2022) and Bard by Google in February 2023 (Google, 2023), especially large language models (LLMs) have gathered attention due to their technological potential for a wide range of applications and domains. Furthermore, as LLMs like ChatGPT learn to speak, hear, and see, it seems that AGI is becoming more and more part of the life of its users (OpenAI, 2023).

The banking industry, like most industries, is expected to be increasingly influenced by such AI solutions. By enhancing customer experience, automatisation, and improving decision-making, LLMs are expected to play an important role in reshaping the banking value chain (Tomych, 2023). However, due to the typically probabilistic nature of LLMs, their suitability for banking and finance has to be evaluated with care.

The present chapter describes LLMs and the possible combinations of their conversational abilities with rule-based investment advisory and is based on the report "GPT for Financial Advice", published by the Lucerne University of Applied Sciences and Arts in May 2023.[1] In particular, an initial prototype that uses prompt engineering to trigger a rule-based system is discussed. At this point, it should be noted that an analysis from a legal perspective or, in particular, an examination of the possibilities of complying with the regulatory requirements for the use of such a system in investment advice is not part of the current chapter or the presented prototype.

7.1. Description of Large Language Models

An LLM is based on a neural network with billions of parameters trained on large amounts of unlabelled data. The model usually self-supervises its learning process and may be used, e.g., to predict and generate text and other content (Sejnowski, 2023). The design of a frequently used type of LLMs, called "generative pretrained transformer" (GPT), relying on multiple decoders at its core, is illustrated in Figure 7.1. Each decoder consists of multiple "Self-Attention" and "Feed-Forward Neural Network" layers. Self-attention layers allow the model to weigh the importance of input words and sentences (encoded as numerical embeddings), whereas the feed-forward neural network aims to reproduce non-linear relationships between input data and the model's output. The insights of the neural network are then passed to the "Next Word Prediction Head", which produces a probability distribution of the relevant vocabulary to identify the most likely next word. This word is then added to the input prompt, and the procedure starts all over again.[2] Due to the ability to also capture complex non-linear relationships, GPTs are not classified as explainable AI as input-output relationships can not be easily interpreted (Basu et al., 2021). In simple terms, GPTs are not necessarily output consistent, as the model's responses can be sensitive to details in the input instructions due to their probabilistic nature (Bubeck et al., 2023). Furthermore, depending on the probability distribution of words and phrases of the model's training data set, it can also produce nonsensical or untrue responses, often referred to as "hallucination" (Manakul et al., 2023).

[1] See Ankenbrand, Bieri, Reichmuth, Stengel, et al. (2023) for the full report.

[2] See Vaswani et al. (2017) for a more technical description of GPTs.

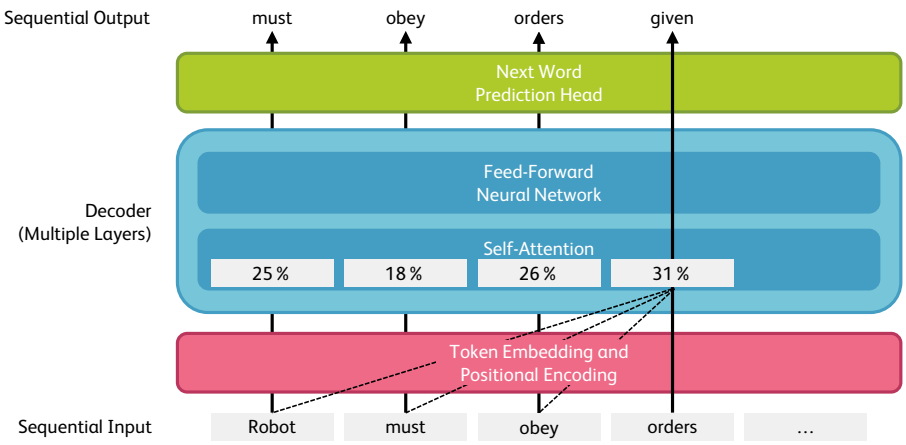

Figure 7.1: Simplified architecture of a generative pretrained transformer (GPT) (source: based on Alammar (2019))

7.2. A Prototype for Financial Advice

Besides the mentioned prompt engineering, self-trained LLMs, fine-tuning of existing models, and plug-ins provide opportunities to use generalist LLMs for specific use cases in the financial sector. However, training an independent LLM requires extensive amounts of data and computation power and is therefore a resource-intensive process. In comparison, only domain-specific data is needed to fine-tune existing models, but such data needs to be arranged and cleaned appropriately too. Plug-ins seem to be a promising solution for using the power of LLMs for a specific use case, but as they implicate the combination of an existing LLM with a self-deployed API, which provides domain-specific information and recommendations, it most likely involves higher infrastructure costs. Due to the mentioned challenges, prompt engineering, which uses mainly the existing interface of an LLM, is a relatively efficient starting solution to develop a prototype, although it may not be as performant as other approaches (Ankenbrand, Bieri, Reichmuth, Stengel, et al., 2023).

Prompt engineering relies on the context-learning abilities of LLMs. Essentially, as it aims to assign a role to the LLM in a specific context, including instructions and goals, it can be used to automate processes, such as in the area of investment advice. Specifically for deterministic investment advice, this function has the potential to create a chatbot that asks a client for the information necessary for investment recommendations, such as age, income, and risk tolerance. This information can then be fed into the investment adviser's rule-based system to generate the customised recommendation of a model portfolio, which in turn is communicated and explained to the client via chatbot.

The implementation of such a prototype described in the following paragraphs is based on OpenAI's GPT 3.5 turbo model and the use of the corresponding APIs. For the prototype, a highly simplified investment advice process is assumed, and its decision matrix can be seen in Table 7.1.

Table 7.1: Rule-based decision matrix

Age	Income	Risk appetite	Portfolio
0 – 50	0 – 100k	High	1
0 – 50	0 – 100k	Low	2
0 – 50	100k+	High	1
0 – 50	100k+	Low	1
50+	0 – 100k	High	2
50+	0 – 100k	Low	2
50+	100k+	High	1
50+	100k+	Low	2

Essentially, the variables age, income, and risk tolerance are used as inputs for recommending one of two model portfolios. A client who is 35 years old, earns CHF 120,000

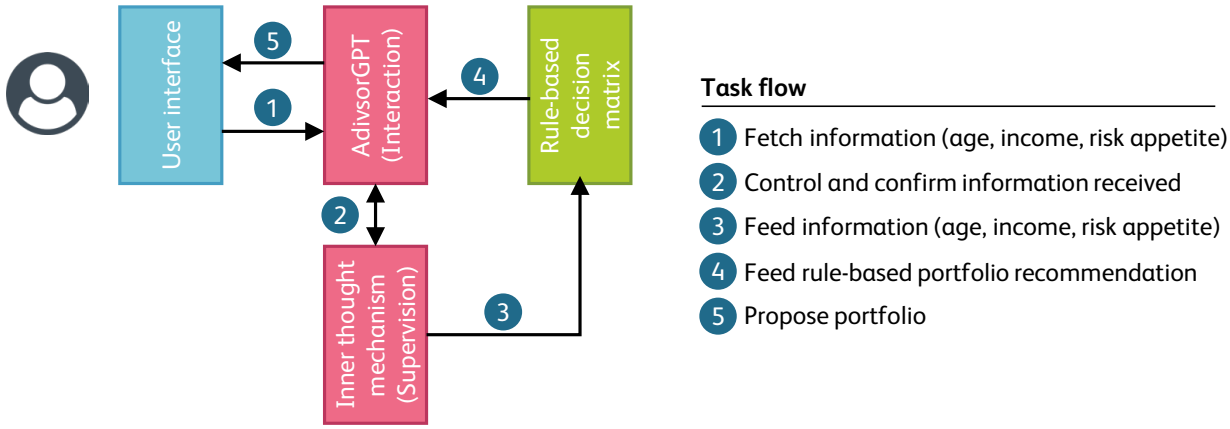

Figure 7.2: General architecture of the prototype and corresponding task flow

a year, and is risk-averse should thus be recommended model portfolio 1 based on the decision rules presented.

The main challenge in prototyping is to combine the conversational advantages of probabilistic LLMs with the rule-based requirements of deterministic investment advice. To address this, the prototype is designed and implemented using the structure shown in Figure 7.2. The prototype basically comprises the rule-based decision matrix, which recommends one of two model portfolios based on three characteristics of the user, i.e., age, annual income, and risk appetite, as well as a GPT-based system, which assumes the following two roles defined by prompt engineering:

- **AdviserGPT:** Used for direct interaction with users. It is designed to act as an interviewer and collects the relevant user information on age, income, and risk tolerance (Task 1 in Figure 7.2) without limiting the general conversational capabilities of the underlying LLM. In addition, it also acts as a channel for the final investment recommendation (Task 5) coming from the rule-based system (Task 4).

- **Inner thought mechanism:** Monitors the interaction between the AdviserGPT and the user and ensures that all relevant information is received (Task 2). After each customer input, the system asks itself whether it has already received the relevant information and responds accordingly. Once all the required information has been received, the data is fed into the rule-based system (Task 3) and used to generate rule-based portfolio recommendations.

Based on these two roles, the prototype is able to perform simple, rule-based investment advice enhanced by the conversational abilities of the LLM.[3] Although such an implementation mostly works fine, there are cases where the system deviates from the aimed investment advice. Such cases can be triggered by information which is not interpreted correctly by the LLM and its (simple) inner thought mechanism. For example, “zero income” entered by a user instead of a numerical “0” leads the prototype to still miss the information about a client’s income. Thus, in this case, the inner thought mechanism would incorrectly assume that the user has not yet reported his income and instruct the AdviserGPT to ask for it again.

7.3. Summary

The integration of LLMs and rule-based systems is technically possible and combines the best of both worlds. In addition to technical feasibility and regulatory requirements, which are excluded from this chapter, the user acceptance is the key success factor. LLMs will only succeed if customers are convinced of their added value and aspects such as privacy and data protection are guaranteed. However, with independent LLMs, fine-tuning of existing models, plug-ins, and prompt engineering, a wide range of different use cases become possible.

[3] A corresponding Python implementation and additional technical details can be found in a public GitHub repository (see here).

8. Crypto Assets Market in Switzerland

By Thomas Ankenbrand, Denis Bieri & Levin Reichmuth, Institute of Financial Services Zug IFZ

In view of the dynamic development in the area of crypto assets investments and the new product offerings emerging worldwide, the question arises as to how the Swiss ecosystem for crypto assets is developing. Therefore, this chapter first provides an update on market turnovers in the corresponding investment ecosystem in Section 8.1, building on the "Crypto Assets Study 2023" published by the Lucerne University of Applied Sciences and Arts in August 2023.[1] Second, Section 8.2 analyses the implications of crypto assets for Swiss investors from the perspective of portfolio management.

8.1. Market Volumes

This section focuses on the trading of crypto assets and corresponding indirect investment products. These activities are discussed in detail, as they can be used to gauge the general activity in the Swiss investment ecosystem for crypto assets. Furthermore, unlike other processes in the value chain, Switzerland-related figures are available or can be estimated. A general distinction is made between indirect (Section 8.1.1) and direct (Section 8.1.2) investments.

8.1.1 Indirect Investments

Trading indirect financial instruments on crypto assets presents an opportunity for certain types of investors, as it offers several advantages over direct investments. For example, the corresponding trading occurs on regulated exchanges, and blockchain-based custody is not required because the corresponding financial products can be seamlessly integrated into traditional securities accounts. However, this approach entails counterparty risk and may incur corresponding custody fees.

Exchange-traded products (ETPs) and structured products are important indirect investment vehicles within the Swiss ecosystem for crypto assets investments, as shown in Figure 8.1. The left-hand graph reveals the number of indirect investment products traded on SIX and / or BX Swiss by product type. It can be observed that the total number of indirect products at Swiss exchanges has increased substantially from March 2021 to May 2022.

[1] See the full report at Ankenbrand, Bieri, and Reichmuth (2023).

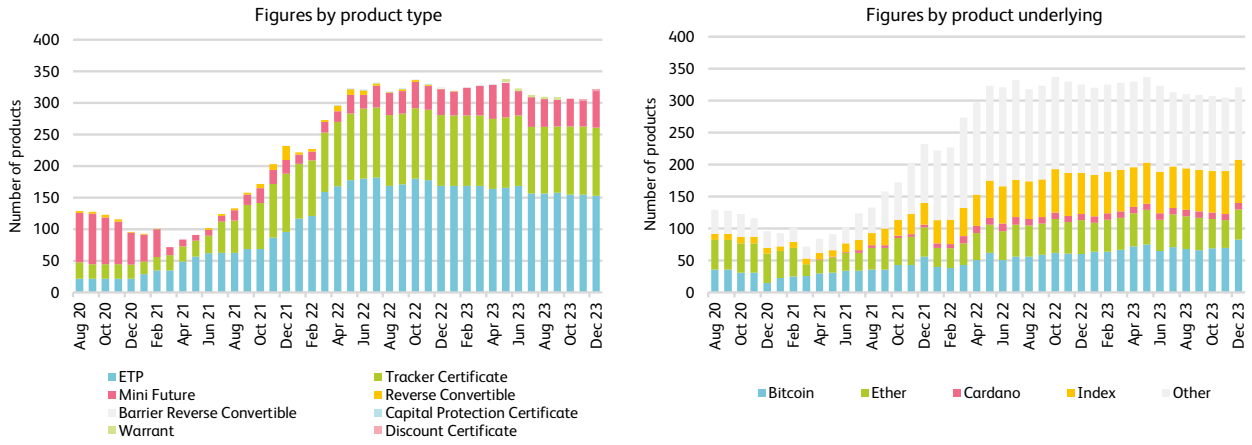

Figure 8.1: Number of crypto-related financial products traded in Switzerland per month by product type (left-hand graph) and the underlying asset (right-hand graph) (sources: BX Swiss, SIX)

However, between May 2022 and May 2023 the number of products has stagnated, with around 330 products. Afterwards, up until November 2023, the sum of indirect investment products has even decreased to 305. In December 2023, a range of new mini futures was issued, compensating for declines in other categories. In addition, two discount certificates were launched in November 2023. This is noteworthy because this is the first time this product category has been listed for crypto assets on a Swiss stock exchange, indicating further diversification of the investment ecosystem.

The right-hand graph in Figure 8.1 shows the number of indirect investment products by underlying crypto asset or index. As of the end of 2023, the products issued on Bitcoin show an increase of 23 products (+38 %) in a year-over-year comparison. Indices-based products increased slightly, by five percent, whereas the number of products issued for Cardano has remained constant within the last year. Ether and the category "Other", which includes all other crypto assets, show declines of eleven and 17 percent on a year-over-year comparison, respectively.

The development of the trading volume in CHF million (left-hand graph) and the number of transactions (right-hand graph) for crypto asset-related ETPs and structured products on the SIX Swiss Exchange is displayed in Figure 8.2. Both the volume and transaction data show that the highest trading activity was recorded in 2021. The figures are significantly lower for the year 2023. More precisely, roughly 85,000 crypto asset-related transactions took place on the SIX Swiss Exchange in 2023, 88 percent of which were attributable to ETPs. These transactions comprised a volume of CHF 1.24 billion, with ETPs again accounting for the larger share, at 79 percent. Consequently, the average size per trade totalled roughly CHF 14,500. In general, a slight increase in trading activity can be observed towards the end of the year 2023. In December 2023, a volume of roughly CHF 180 million was recorded, and a total of over 15,500 transactions were counted, which represents a more than threefold increase compared to December 2022.

The increase in trading activity in late 2023 is likely to be related to the positive price trend for many crypto assets, including Bitcoin. This is underlined by Figure 8.3 which shows the trading volume measured in points of the SIX Crypto Market Index 10[2], in contrast to the CHF-denominated data in the left-hand graph of Figure 8.2.

Figure 8.3 shows a similar pattern to the volume figures denominated in CHF but with comparably less pronounced fluctuations. The year 2021 clearly continues to have the highest trading activity, and a slight increase in volume can be observed towards the end of 2023. However, the increase in volume in December 2023 compared

[2] The SIX Crypto Market Index 10 (CMI10) is an index that aims to track the performance of up to ten of the largest and most liquid crypto assets (SIX, 2023).

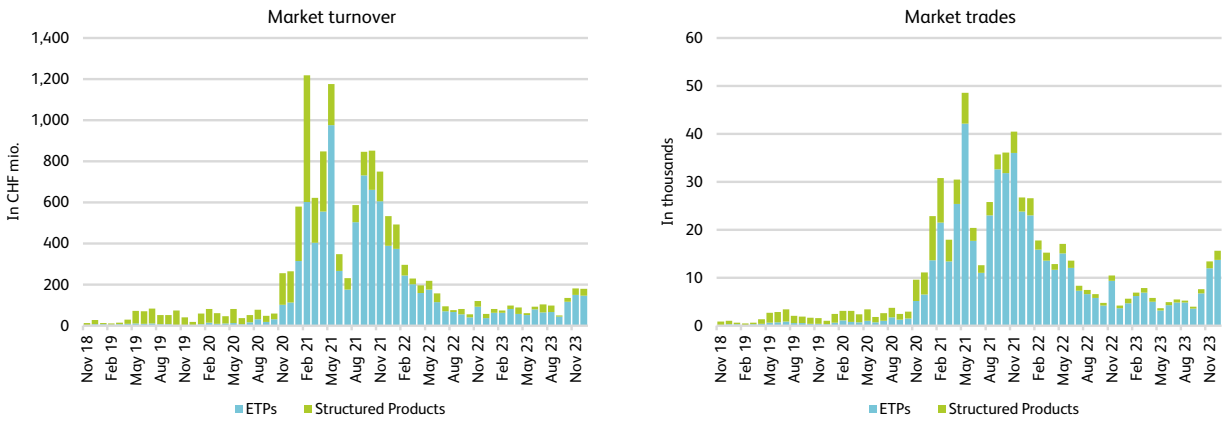

Figure 8.2: Market turnover and trades by month (source: SIX)

to the same month of the previous year is only 39 percent, compared to 219 percent for volumes denominated in CHF. This indicates that although actual trading activity in CHF has increased year-over-year, this is significantly due to a price effect.

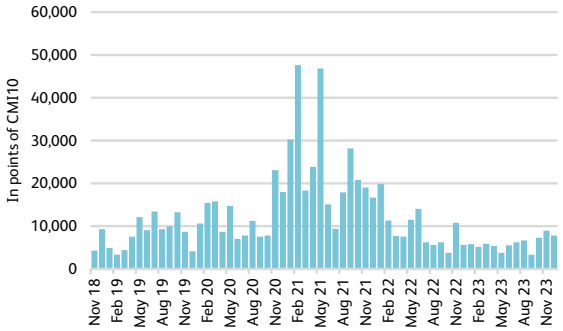

Figure 8.3: Total turnover in points of the SIX Crypto Market Index 10 (source: SIX)

8.1.2 Direct Investments

In comparison to the indirect investment products, crypto assets can also be traded directly at dedicated exchanges. Therefore, this section aims to provide an overview of the trading volumes at centralised, decentralised, and derivatives crypto exchanges. Specifically, the period from January 2020 to December 2023 is examined, relying on data using a subscription-based API of CoinGecko (online-a). The daily spot trading volumes of all centralised, decentralised, and derivatives crypto exchanges available via the API were retrieved in the first step. In the second step, daily trading volumes denominated in Bitcoin were multiplied by the corresponding day's Bitcoin / CHF exchange rate. For each month, the 20 largest exchanges per exchange type were selected for further analysis. For centralised exchanges, only those with a CoinGecko trust score greater than five out of ten were considered. The trust score focuses on liquidity, scale of operations, API coverage, and further criteria (CoinGecko, online-b) and is used to only include comparatively more reputable exchanges in the analyses. To estimate the volume originating from Switzerland, the corresponding monthly web traffic share of each exchange was collected using the platform of the search engine marketing company Semrush (online) and multiplied by the aggregated monthly total trading volume of the exchange. As some exchanges are frequently accessed via mobile applications, Swiss market shares should be treated with care. Furthermore, estimations of Swiss market shares might be rather moderate, given that Switzerland is a wealthy country and Swiss investors likely hold a disproportionately large amount of crypto assets compared to their web traffic.

The estimated monthly spot trading volumes of Swiss investors at centralised crypto exchanges (CEXes) are displayed in Figure 8.4. The trading volumes peaked in May 2021 at roughly CHF 17.5 billion, after a rapid increase since October 2020. In general, after May 2021, the CEXes show decreasing trading volumes originating from Switzerland. Since October 2023, however, the aggregated trading volumes have risen again, in line with increasing market prices of popular crypto assets, such as Bitcoin and Ether. Moreover, Bitcoin has regained all the losses since the onset of the so-called crypto winter in May 2022. The positive price development has been fuelled by exchange-traded fund (ETF) applications of major financial institutions at the US Securities and Exchange Commission (SEC), associated with potentially higher future market demand (Forbes Advisor, 2023). As of January 2023, the SEC approved eleven applications for Bitcoin spot ETFs; however, the products are in principle only available to US investors (NZZ, 2024).

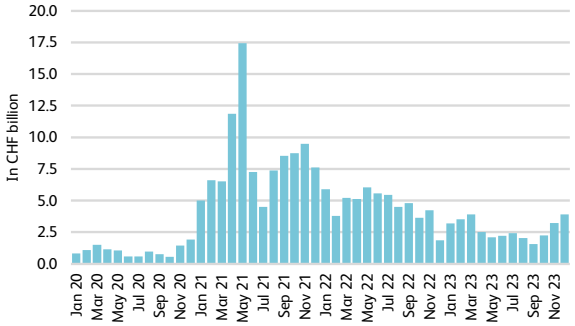

Figure 8.4: Monthly spot trading volume on CEXes from Switzerland (sources: CoinGecko (online-a), Semrush (online))

Similar trading volume patterns can be observed at decentralised crypto exchanges (DEXes), of which the aggregated monthly Swiss trading volumes are illustrated in

Figure 8.5. DEXes showed two defined peaks in May 2021 and December 2021, with CHF 1.11 billion and CHF 1.35 billion, respectively. After declining monthly trading volumes during the crypto winter, the volumes at DEXes have slowly been growing since October 2023.

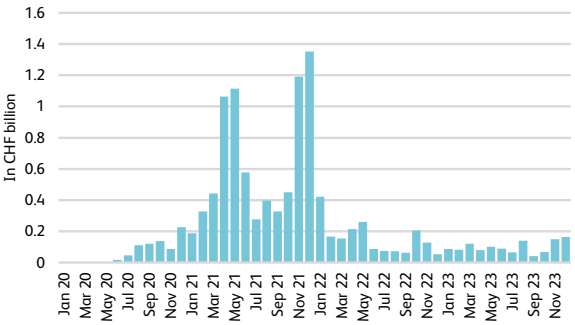

Figure 8.5: Monthly spot trading volume on DEXes from Switzerland (sources: CoinGecko (online-a), Semrush (online))

However, as peer-to-peer marketplaces, DEXes likely remain interesting for investors looking for anonymity, increased security, and high-potential new crypto assets (Coinbase, online). Due to that, investors might condone the potentially higher transaction fees and longer trade execution times in comparison to centralised crypto exchanges (Barbon & Ranaldo, 2021). For new investors, it might be challenging that most DEXes allow only trading of crypto asset pairs and not trading of crypto assets against fiat money (Gemini, 2023).

[3] Swiss population data was obtained from the Federal Statistical Office (2023) and refers to the end of the year 2022.

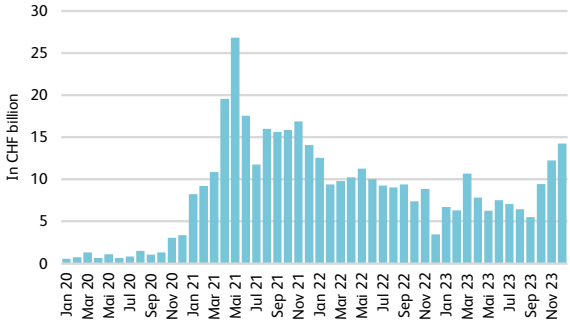

Figure 8.6: Monthly trading volume on derivatives crypto exchanges from Switzerland (sources: CoinGecko (online-a), Semrush (online))

Profiting from increased market demand are derivatives crypto exchanges, whose monthly trading volumes are displayed in Figure 8.6. Overall, trading volumes from perpetual futures and options on crypto assets seem to develop similar to volumes traded at CEXes and DEXes, also showing increasing volumes since October 2023, albeit to a greater extent. Reasons for the comparably larger trading volumes on derivatives crypto exchanges include the possibilities for leveraging and short selling, which makes these trading venues suitable to manage crypto assets' exposure risks.

When comparing the global trading volumes of the different types of crypto exchanges for the year 2023 in Table 8.1 differences in magnitude become apparent. Derivatives crypto exchanges display by far the largest trading volumes with CHF 48,069 billion notional value - indicating the absolute value of crypto assets these securities theoretically comprise. It should be mentioned that the corresponding market value is expected to be smaller

Table 8.1: Volume comparison of different crypto exchange types, 2023

	Centralised exchanges	Decentralised exchanges	Derivatives exchanges
Global volume	CHF 12,149 bn	CHF 813 bn	CHF 48,069 bn
Swiss traffic share	0.27 %	0.14 %	0.21 %
Swiss volume	CHF 33 bn	CHF 1.2 bn	CHF 100 bn
Swiss volume per capita[3]	CHF 3,725	CHF 136	CHF 11,378

due to the impact of the leverage effect of derivative products. In comparison, CEXes show an aggregated global trading volume of CHF 12,149 billion in 2023, followed by DEXes with CHF 813 billion, accounting for roughly seven percent of the former volume.

Regarding website traffic from Switzerland in 2023, CEXes show the largest visitor share with 0.27 percent, followed by derivatives crypto exchanges with 0.21 percent. DEXes show a share of 0.14 percent of Swiss visitors. Accordingly, Swiss investors seem to prefer simpler access to crypto assets offered by CEXes and derivatives crypto exchanges, which also allow trading against fiat currencies.

When multiplying the website traffic shares by the derived global trading volumes in 2023, it can be estimated that CHF 100 billion of trading volume at derivatives crypto exchanges originates from Switzerland. CEXes rank second with CHF 33 billion, and DEXes display CHF 1.2 billion. This translates to per capita trading volumes of CHF 11,378 for derivatives crypto exchanges. CEXes and DEXes show a smaller trading volume per capita of CHF 3,725 and CHF 136, respectively.

8.2. Crypto Assets as an Investment

This section discusses the suitability of crypto assets for a traditional Swiss investor from the perspective of portfolio theory. A corresponding analysis is justified by the increasing adoption of crypto assets in Switzerland (Statista, online) and the historically comparatively low return correlation of the asset class with traditional investments, such as equities and bonds, which creates diversification potential (Ankenbrand, Bieri, Kronenberger, & Reichmuth, 2023).

In the following, the potential of the crypto assets market for Swiss investors is derived. The following basic assumptions are made:

1. The market for crypto assets is proxied by Bitcoin (denominated in CHF). This is justified by the fluctuating but consistently significant market share of Bitcoin in the overall market (CoinMarketCap, online). Bitcoin price data was retrieved from finanzen.net (online).
2. The traditional investment universe of a Swiss investor consists of stocks, bonds, and real estate. These asset classes are proxied by the Swiss Performance Index® (SPI), the Swiss Bond Index® TR (SBI), and the CH Real Estate® Shares TR (SXI), respectively. Corresponding data was retrieved from SIX (online).
3. The portfolio allocation of a traditional investor is based on the overall investment strategy of Swiss pension funds according to the Occupational Pension Supervisory Commission and serves as a benchmark. Using this strategy, 40 percent is invested in bonds, 35 percent in equities, and 25 percent in real estate (OPSC, 2021).[4]
4. The observation period is between the beginning of 2018 and the end of 2023. The starting point is based on the initial availability of corresponding indirect investment products for crypto assets, which also made the asset class easily accessible to traditional investors.

The data on which the analysis is based is visualised in Figure 8.7, showing the indexed price development of the individual assets and indexes. In other terms, the figure shows how much cumulative return could have been achieved by investing CHF 1 in the individual asset at the beginning of 2018.

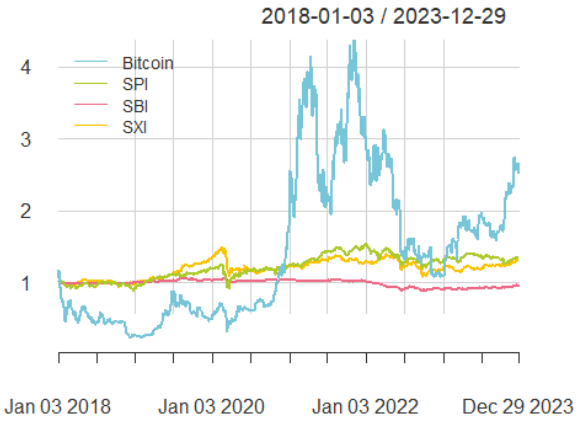

Figure 8.7: Development of individual assets and indexes, indexed at 1 in 2018

Figure 8.7 reveals that the market performance of Bitcoin differs from traditional asset classes. In particular, the price increase for Bitcoin is the highest over the observa-

[4] In this analysis, alternative investments are not included in the asset universe.

tion period, albeit with large fluctuations. While the SPI and the SXI also reveal a positive cumulative return over the observation period, this metric is slightly negative for the SBI. In terms of return correlations, Bitcoin shows the strongest correlation with the SPI (0.19), followed by the SXI (0.12) and the SBI (0.03). This indicates a certain diversification potential through Bitcoin in a traditional portfolio. It should be mentioned at this point that the average correlation coefficient is a simplification, as there were fluctuations in this metric over the observation period.

In order to evaluate the effect of the inclusion of Bitcoin into a traditional portfolio, the investment allocation in the benchmark portfolio is reduced by one percentage point in each of the three asset classes and invested in Bitcoin. Hence, the following analysis compares the two asset allocations as defined as follows:

1. **Benchmark portfolio**: 40 percent SBI, 35 percent SPI, 25 percent SXI
2. **Alternative portfolio**: 39 percent SBI, 34 percent SPI, 24 percent SXI, 3 percent Bitcoin

Note that a three percent investment in Bitcoin is smaller than the (retrospective) market portfolio according to the Modern Portfolio Theory by Markowitz (1952).

The cumulative return of the two portfolios is visualised in Figure 8.8, together with an evaluation of the corresponding maximum drawdowns[5]. It should be noted that yearly rebalancing of portfolio weights is conducted for both portfolio allocations.

The figure displays that the portfolio including a small Bitcoin exposure of three percent performed better in the past than the traditional benchmark portfolio, as the cumulative return is higher. Specifically, the portfolio including Bitcoin achieves a cumulative return of roughly 32 percent over the observation period, while the one for the traditional portfolio is lower at 19 percent. The outperformance is primarily attributable to the second half of the observation period, when the Bitcoin price rose sig-

[5] The maximum drawdown represents the most significant observed decline in the value of a portfolio from its highest point to the subsequent lowest point, prior to achieving a new peak. It serves as an indicator of the potential downside risk within a designated time frame (Hayes, 2022).

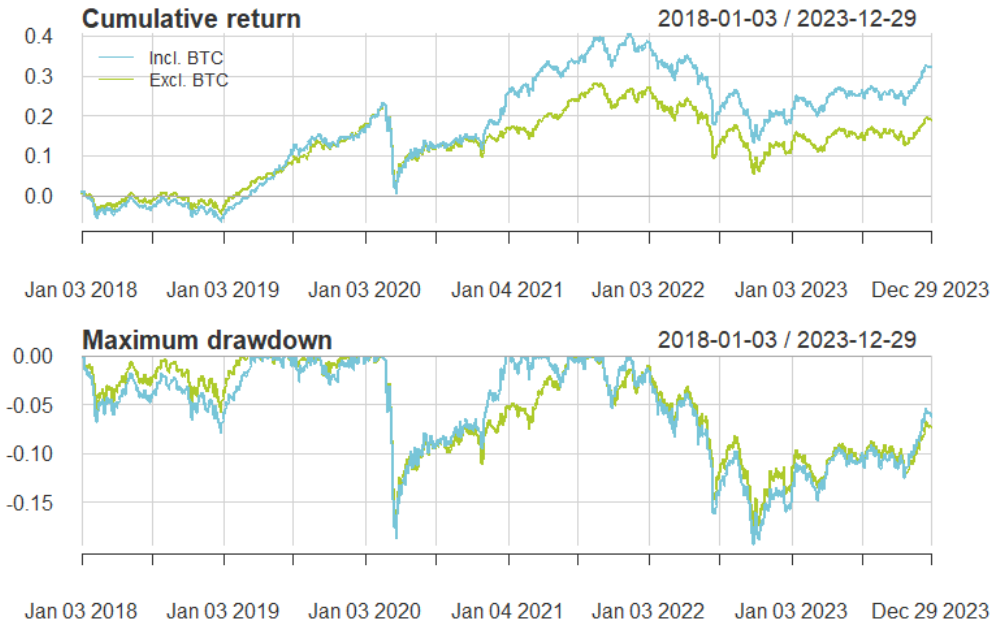

Figure 8.8: Portfolio performances in- and excluding Bitcoin

Table 8.2: Comparison of the annualised performance of the two asset allocations

Portfolios	Metric	2018	2019	2020	2021	2022	2023	Total
Portfolio excl. BTC	*Return*	-3.6 %	21.5 %	0.0 %	8.5 %	-12.8 %	7.8 %	3.0 %
	Standard dev.	6.5 %	4.8 %	11.7 %	5.9 %	9.7 %	6.3 %	7.9 %
	Sharpe ratio	-0.55	4.55	0.05	1.50	-1.39	1.06	0.36
Portfolio incl. BTC	*Return*	-5.6 %	23.3 %	7.9 %	10.3 %	-14.3 %	11.5 %	4.7 %
	Standard dev.	6.6 %	6.0 %	12.7 %	6.9 %	9.9 %	6.5 %	8.5 %
	Sharpe ratio	-0.86	3.95	0.66	1.54	-1.52	1.58	0.54

nificantly (see Figure 8.7). The analysis of the maximum drawdown, as an alternative risk indicator to the standard deviation of the portfolio returns, shows that the downside risks of both portfolio allocations are similar. At the worst point in time, the traditional portfolio lost around 18 percent of its previous high, while this figure is marginally higher for the portfolio with Bitcoin at 19 percent.

A comparison of the annualised performance of the two asset allocations is shown in Table 8.2 for the entire observation period (last column) and for each annual subperiod. The metrics shown for both portfolio allocations are the annualised return, the annualised standard deviation as a measure of risk, and the Sharpe ratio[6] as a measure of risk-adjusted performance.

A comparison of the metrics over the entire observation period shows that the portfolio with Bitcoin achieved an annualised return of 4.7 percent, which is 1.7 percentage points higher than the traditional portfolio without Bitcoin. The standard deviation is also higher, but only by around 0.6 percentage points. This results in a higher Sharpe ratio for the portfolio including Bitcoin, or in other words, a higher excess return per unit of risk, i.e., standard deviation, involved. Hence, the inclusion of Bitcoin led to an increase in the risk-adjusted performance of a traditional investor's performance over the total observation period.

The assessment of the performance of the two portfolio allocations across individual years, as depicted in Table 8.2, reveals a more nuanced perspective. In essence, in the years with negative portfolio returns, i.e., 2018 and 2021, the downside for the portfolio with Bitcoin was more pronounced than for the portfolio without Bitcoin. In years with positive portfolio returns for both allocations, the situation is reversed. At this point, it should be noted that past performance is no guarantee of future performance. The evaluations shown are also not to be understood as any kind of investment recommendation.

The year 2024 could, in any case, become comparably eventful due to developments such as the approval of spot Bitcoin exchange-traded products in the US (SEC, 2024) or the anticipated halving scheduled for the second quarter of 2024 (CoinDesk, online). How the performance of the two portfolio allocations discussed will develop in this environment remains to be seen in the future.

[6] The spot rate of the ten-year Swiss Confederation bond was used as a proxy for the risk-free interest rate. Corresponding data was retrieved from the Swiss National Bank (online-b).

9. Quantum Computing and Artificial Intelligence in Finance

By Thomas Ankenbrand & Ege Yilmaz, Institute of Financial Services Zug IFZ; Urs Rhyner, Inventx Lab AG

Quantum computing is changing the foundations of traditional computer science, just as quantum physics has changed the foundations of physics. The potential power of quantum computers opens up new possibilities in computer science, especially in the field of artificial intelligence (AI). The following chapter provides an overview of the potential and applications of quantum computing in the field of artificial intelligence in finance. The chapter is based on the report "Quantum Computing and Artificial Intelligence in Finance", published by the Lucerne University of Applied Sciences and Arts in December 2023, whereby various updates and extensions have been made.[1]

9.1. Fundamentals of Quantum Computing and Artificial Intelligence

In the wake of groundbreaking revelations in twentieth-century physics, the potential for a superior form of computation rooted in the principles of quantum mechanics, commonly known as "quantum computing", became apparent. Classical computers employ a binary system composed of binary digits, known as "bits", represented as 0s and 1s. These bits serve as the fundamental units of digital information. In quantum computing, quantum bits, or "qubits", are unique in that they can exist in a state of superposition, simultaneously representing both 0 and 1. This implies that there is a known probability of finding a qubit to be either 0 or 1, but the actual outcome depends on the act of measurement. It is akin to a quantum coin, where the coin looks like a blend of both heads and tails, as opposed to a classical coin unambiguously showing either heads or tails. The crucial point is that the act of observing or measuring the quantum coin forces it to collapse into one of the states, either heads or tails. The superposition principle is intimately linked to quantum computing capabilities, such as representing exponentially large feature spaces with respect to the number of qubits and manipulating them in parallel to achieve desired probabilities of measurement outcomes. This capability is rooted in quantum interference, which serves as a foundational element for crucial quantum algorithms.

Another aspect that quantum computing leverages for computational power is entanglement, a phenomenon absent in classical computing. In an entangled two-qubit system, a measurement of a physical property of a qubit instantaneously reveals the corresponding property of the other, regardless of the physical distance separating them (Nobel Prize Outreach AB, 2023). This can be illustrated by considering the scenario of sending a pair of gloves to two individuals. When one person opens their box, it immediately provides knowledge about the handedness of the glove the other person received, forming a direct and instantaneous connection.

Technically, quantum computers can be constructed out of any quantum technology that allows for defining qubits and can implement single- and multi-qubit gate operations with high fidelity (Qiskit Development Team, 2023). Today's gate-based devices' qubits are based on photons, trapped atoms, nuclear magnetic resonance, quantum dots, and superconductors (Albareti et al., 2022). Additionally, specialised devices called quantum annealers employ quantum annealing, which is a type of quantum technology that can be used to find the best-fit solution for optimisation problems (West, 2023).

The term AI describes the intelligence of machines which can perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and language translation (Zeytin Bildirici, 2023). In 1950, Alan Turing transformed the question "Can machines think?" into the renowned "imitation game", which is commonly known as the "Turing test". The test is considered successful when a human interrogator, after asking a series of written questions, cannot discern whether the written responses originate

[1] See the full report at Ankenbrand, Rhyner, and Yilmaz (2023).

from a human or a computer. The computer would need to be able to communicate successfully in a human language (natural language processing), store what it knows or hears (knowledge representation), answer questions and draw new conclusions (automated reasoning), and adapt to new circumstances and detect and extrapolate patterns (machine learning). While Turing did not consider the physical simulation of a person as essential for showcasing intelligence, other researchers have put forth the concept of a "total Turing test", which necessitates interaction with real-world objects and individuals. To pass the total Turing test, a robot will need speech recognition to perceive the world (computer vision) and to manipulate objects and move about (robotics). These six disciplines compose most of AI (Russell & Norvig, 2010).

In recent years, the application of AI has become increasingly popular with the large language models (LLMs). LLMs such as OpenAI's GPTs or Google's Gemini are the latest developments in natural language processing. They are currently used and explored in a wide range of applications, from chatbots to machine translation. In simple terms, LLMs are computer programs that generate text word by word based on what they have learned from large datasets. The program predicts the most likely next word (token) based on the previous words (tokens) in the conversation. Such LLMs are also increasingly prevalent in the financial sector (Ankenbrand, Bieri, Reichmuth, Stengel, et al., 2023) (see Chapter 7). However, the LLMs require large computer capacities. This is reflected on the one hand in the success of Nvidia, which produces special processors (GPUs) for AI, and on the other hand in the large cloud data centres and their energy consumption (CB Insights, 2024b). This is where quantum computers, with their great potential, can offer new solutions for AI and machine learning (ML).

9.2. Potential Applications

The integration of quantum computing and ML, quantum machine learning (QML), is motivated by the linear algebraic nature of quantum mechanics' postulates and the calculations in ML, with the aspiration of achieving faster execution of the corresponding linear algebra subroutines (Prakash, 2014; Biamonte et al., 2017). A lot of QML applications for the financial sector have been suggested in the literature (see, e.g., Orús et al. (2019); Egger et al. (2020); Bouland et al. (2020); Pistoia et al. (2021); Albareti et al. (2022); Jacquier et al. (2022); Gujju et al. (2023)). However, these applications differ in how they are executed and the benefits they expect. These differences make it difficult to compare them directly. To address this issue, Figure 9.1 introduces a layered framework, which facilitates the comparison of QML applications in the finance industry. The framework divides each proposal into four layers. The top layers are closely related to the specific financial tasks that need to be solved, while the bottom layers deal with the technical aspects of QML implementation. The first layer describes the use case in finance, and the second layer contains the corresponding ML approach, such as supervised learning, unsupervised learning, and reinforcement learning. Most applications in the literature are based on a small set of existing quantum algorithms and use their speed-up to improve the optimisation part of the ML approach for the chosen use case in the finance sector. This is shown in the third layer. The last layer focuses on the quantum hardware that the algorithm is designed to run on.

The wide range of financial use cases found in the QML literature encompasses theoretical findings as well as experimental results. The summary of our selected literature and its stratification within our framework is depicted in Figure 9.1. The theoretical and experimental results are shown with blue and magenta lines, respectively. We highlight that our illustration of the results is qualitative rather than quantitative. It portrays a picture of the performance benefits obtained in different ML settings supported by the quantum computational paradigms, as well as its reflection on the financial industry. It also illuminates the applicability of quantum annealing to ML in finance, which is limited to adiabatic optimisation. On the quantitative side, we stress that the majority of the literature deals with theoretical improvements of ML algorithms that are designed to be efficiently executed on quantum computers but are not necessarily implementable using the noisy intermediate scale quantum devices of today. Hence, there are only a handful of literature sources in QML for finance that provide empirical data on how theory and experiment compare.

The financial use cases implemented on actual quantum hardware include derivative pricing, detecting phishing attacks in financial transaction networks, credit-worthiness estimation, and hedging. For the task of derivative pricing, the usage of unsupervised methods is seen. In this regard, quantum principal component analysis (qPCA) for

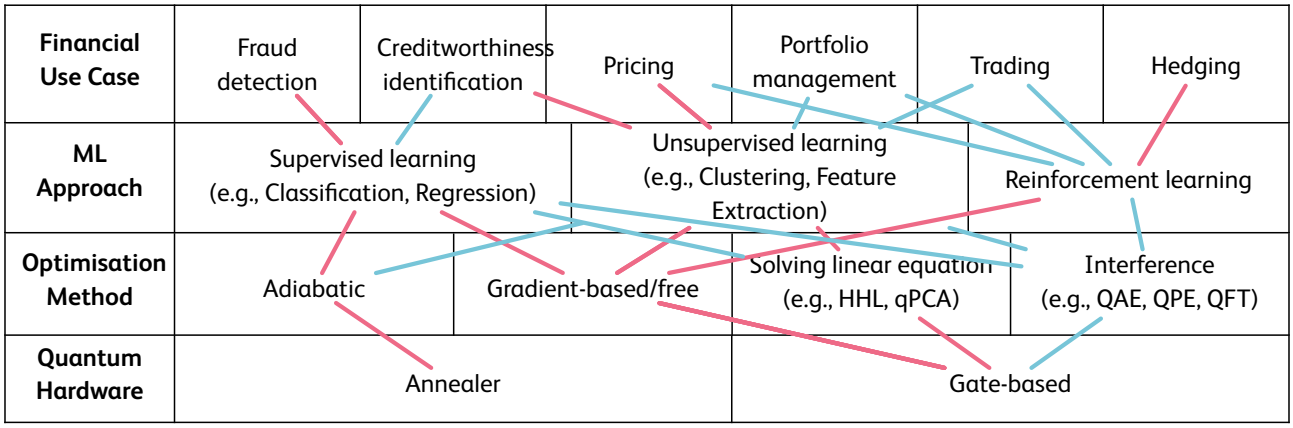

Figure 9.1: Morphological box representing the QML literature reviewed in our report Ankenbrand, Rhyner, and Yilmaz (2023). The box contains specific elements or options for each layer, creating a matrix where different combinations can be examined. While the magenta lines describe the works with implementation on real hardware, the blue lines describe the proposed algorithms with theoretical results.

feature extraction and data loading achieved by quantum generative adversarial networks are utilised, where the latter enables efficient loading of generic distributions (Martin et al., 2021; Zoufal et al., 2019). Quantum support vector machines (QSVM) and quantum neural networks (QNN) are used for the classification of phishing attacks, where gate-based QSVMs are reported to consistently yield lower false positives compared to other classical and quantum models (Ray et al., 2022). For the identification of the creditworthiness of customers, QNNs are used to select useful features from data, leading to results that are competitive with state-of-the-art classical methods, while in some experiments, outperforming them (Zoufal et al., 2023). Last, a reinforcement learning setting for finance, in the absence of frictionless and complete market assumptions, is implemented in a quantum-native setup to learn hedging, where the QNN-based strategies significantly outperform the traditional Black-Scholes delta hedge model (Cherrat et al., 2023).

It is important to mention that some of the subroutines of the proposed algorithms utilise classical hardware, such as the usage of classical optimisers. In terms of quantum hardware, most of the applications use gate-based quantum computers with the number of qubits falling between five and 27. Here, IBM's superconducting devices are used exclusively, with the exception of the reinforcement learning example using Quantinuum's trapped ions. In the implementation of QSVMs, D-Wave's annealers with 5,617 qubits are also used. Note that a direct comparison of quantum annealers to gate-based quantum computers in terms of qubit count is challenging since annealers are specialised devices designed for optimisation tasks.

9.3. Implementation Paths

The potential of achieving a tangible end-to-end quantum advantage with the proposed QML approaches remains unclear. In the financial sector, where computational time and accuracy significantly impact business profits, the industry could benefit from any actual acceleration and improvement in model performance resulting from new computing methods. As a result, the financial sector is strategically positioned to embrace early adoption, making full use of quantum computing in the field of computational finance (Herman et al., 2023).

In 1996, physicist David DiVincenzo outlined five criteria for a quantum computer, known as the DiVincenzo criteria (DiVincenzo, 1996):

- Scalable physical system with well-characterised qubits

- Ability to initialise qubits to a simple fiducial state
- Long relevant decoherence times
- "Universal" set of quantum gates
- Qubit-specific measurement capability

While these criteria are not fully met today, a significant development in recent years, marked by increased business activities and investments, is evident. However, challenges remain for widespread adoption, primarily in scalability and reliability.

A) Scalability: Practical applications of quantum computers demand a substantial number of qubits, where the qubit count is an important parameter of the performance metrics. The industry is actively progressing in developing scalable hardware, anticipating a future milestone termed "Q-Day", which is the day when quantum computers will be able to break current security standards, potentially compromising the encryption algorithms that protect our digital world. Although the current state of quantum computing is complex and less user-friendly, ongoing efforts are expected to enhance user experience through innovations in quantum-related software.

B) Reliability: Quantum computers face the challenge of decoherence, causing errors in quantum information and impacting algorithm run time. Decoherence effects arise when a quantum system interacts with its environment, and the superposition is lost (Schlosshauer, 2005). Therefore, error-correcting quantum codes and protecting quantum information are crucial for fully operational quantum computers. Efforts to delay decoherence involve cooling some quantum systems to a few millikelvins above absolute zero.

Only a portion of the business application landscape will benefit from quantum computers. Therefore, there is no motivation to migrate traditional workloads to quantum computers, as today's cloud provider with highly scalable infrastructure and platform services (IaaS/PaaS) based on CPU and GPU provide a very cost-effective and stable solution. Quantum Computing will mainly be consumed as a cloud service and integrated into multi-cloud strategies. Figure 9.2 illustrates potential components in a wide area network of a corporation.

Nonetheless, the advent of quantum computers introduces a tangible threat. Their capability to potentially crack widely used asymmetric encryption methods (Kumar, 2022) poses a substantial cybersecurity risk. Consequently, the financial industry is compelled to confront the challenges of quantum computing today and initiate the transition to quantum-safe cryptography.

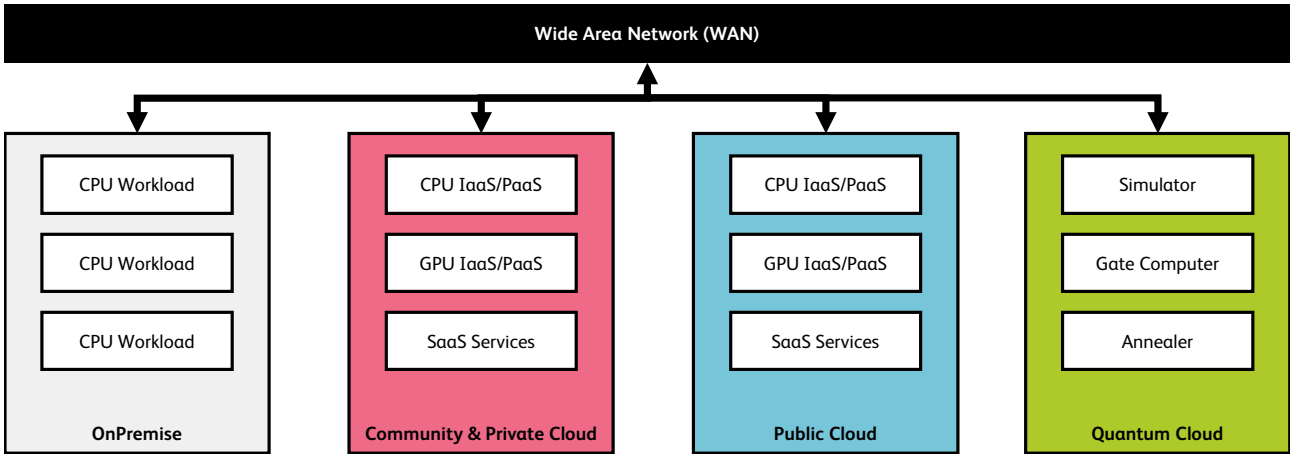

Figure 9.2: Quantum computing as part of a multi-cloud platform

10. Conclusion and Outlook

The IFZ FinTech Study 2024 presents the contemporary status and advancements within the Swiss FinTech sector. The essential findings are succinctly articulated in the following statements and theses:

Swiss FinTech sets a new record. In 2023, the Swiss FinTech sector counted an increase in the number of companies from 437 to 483, or eleven percent in relative terms. In addition, a first-time assessment shows that the Principality of Liechtenstein is home to 22 FinTech companies. Compared to previous years, it is evident that the number of companies offering comparatively more innovative technologies in the categories of analytics, big data, artificial intelligence (AI), and distributed ledger technology has grown the most.

Sustainable FinTech is on the rise. Although only around ten percent of all companies in the Swiss and Liechtenstein FinTech sector are considered sustainable FinTech companies, their growth rate is significant. More precisely, their growth amounted to over 50 percent last year and is therefore substantially higher than that of the FinTech sector as a whole. In addition, the majority of sustainable FinTech companies offer solutions to improve the decision-making process by providing data and analytical insights for sustainability assessments in the financial sector or aim to have a direct, real positive impact on the environment.

Switzerland continues to lose attractiveness for FinTech companies in relative terms. Despite the growth of the local FinTech sector, the results of the analysis of the environmental factors of various international locations show the tendency of the Swiss cities of Zurich and Geneva to lose some of their competitiveness. In concrete terms, this was reflected in the FinTech hub ranking, in which Zurich and Geneva lost their second and third places behind Singapore to Stockholm this year.

AI regulation is an opportunity to create a further locational advantage. Although Switzerland is in a relatively good position internationally in terms of regulatory quality, dynamic adaptation to new technological developments is of great importance for the local FinTech sector. With the emergence of large language models and their potential for the financial sector, clear and pragmatic regulation of these and other concepts in the field of AI could represent a further growth driver for Switzerland.

Venture capital and M&A activities have cooled down. In the Swiss FinTech sector, venture capital amounting to CHF 457 million was raised in 68 financing rounds in 2023, which represents a decrease in both figures compared to 2022. On a global scale, a decline was also observed in divestment strategies, such as company sales or IPOs. The coming years will show whether this is a structural slowdown or whether it is driven by a temporary interest rate effect.

The stock market performance of globally listed FinTech companies is mixed. Although the globally listed FinTech companies outperformed the general equity market in 2023, their risk-adjusted performance has been worse since 2015. A closer examination shows that in terms of its risk and return profile, the FinTech sector is positioned between the two sectors it intersects. Notably, its risk-adjusted performance tends to lean more strongly towards the banking industry, which contrasts with the higher stock market performance of the IT sector during the observed period.

The technological potential in the financial sector has not yet been exhausted. Although FinTech has developed from a niche market into a significant provider of innovations for traditional financial service providers, new technological concepts are opening up ever more potential for optimising the financial services value chain. Solutions like in the area of embedded finance, for example, have already been implemented in isolated cases in the financial services industry. Even though new technologies like large language models offer further potential in the area of efficiency, for example, adoption has so far been rather slow, potentially also driven by limited customer acceptance.

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Appendix A

Appendix A lists the legal names of the identified FinTech companies or brands in Switzerland and, for the first time, Liechtenstein in 2023 that fall under the definition of FinTech in Chapter 1. In total, the Swiss and Liechtenstein FinTech sectors together counted a total of 505 companies at the end of 2023.

Companies

21 Analytics AG
21.finance AG
21e6 Capital AG
21Shares AG
3circlefunding GmbH
3rd-eyes Analytics AG
4bridges GmbH
4finance AG
Abrantix AG
Acatis Service GmbH
Accointing AG
Accounto AG
Acredius AG
Adaptivv Financial Technologies AG
Additiv AG
AdNovum AG
Advice Online AG
Adviscent AG
Aequitec AG
AgAu AG
Aionite Capital AG
Aisot Technologies AG
Aixigo (Schweiz) AG
Aktionariat AG
Allindex AG
Allocare Holding AG
Alphasys AG
Alpian SA
Alquant AG
Altcoinomy SA
Altoo AG
Amina Bank AG
Amnis Treasury Services AG
AM-One AG
Anapaya Systems AG
Anchored Coins AG
Anova Partners AG
Apiax AG
Araneum Technologies GmbH
Arf Financial GmbH
Ariadne Business Analytics AG
Ascentys Sàrl
Assetmax AG
Atfinity AG
Atpar AG
Auditchain Labs AG
Aumico AG
Avaloq Group AG
Avance Pay AG
Aviita Establishment
Avobis Invest AG
Axedras Group AG
Base58 Capital AG
Beedoo SA
Believe. Partners AG
Billte AG
Bitclear Aktiengesellschaft
Bitcoin Capital AG
Bitcoin Suisse AG
BitsaboutMe AG
Bity SA
Block Green AG
Bloomio AG
BLP Digital AG
Blue Code International AG
Blueyellow AG

Companies

Bmpi AG
BPC AG
Bprotocol Stiftung
Brainbot Labs Establishment
Braingroup AG
BrickMark Group AG
BridgeTower Capital GmbH
B-Sharpe SA
BTSE AG
BX Swiss AG
Caeleste AG
Calidris Technology AG
Callirius AG
CAM Schweiz AG
Canopia Sàrl
Canopy Europe AG
Capnovum (Switzerland) GmbH
Cashare AG
CashSentinel SA
CAT Financial Products AG
CembraPay AG
Centi AG
Cerchia AG
CG24 Group AG
Check Your Customer GmbH
ChooseSmart GmbH
Chorus One AG
Clanq AG
Climada Technologies AG
Cofex AG
Coinstrategy Capital AG
Colb Asset SA
Conda.ch GmbH
Confinale AG
Conser - ESG verifier SA
Copper Markets (Switzerland) AG
Copula GmbH
CoreLedger Aktiengesellschaft
Correntics AG
Cortex AG
Counteo SA
Covalence SA
Cow Level AG
Crealogix Holding AG
Credit Exchange AG
Creditfolio AG
Creditworld AG
Criptonite Asset Management SA
Crowd Solutions AG
Crowdhouse AG
Crowdli AG
Crowdlitoken AG
Crypto Finance AG
CryptoEasy AG
CSL Corporate Services Ltd.
Curio Capital AG
Cutting edge GmbH
Cybera Global AG
Cynos AG
Datacie SA
Datalevel AG
Datatrans AG
Daura AG
DCAP AG
DCM Systematic SA
DecentAge AG
Decom Switzerland AG
DeFi Suisse AG
Delega Treasury AG
DeltaconX AG
Deon Digital AG
DePay AG
Derizone AG
Descartes Finance AG
DIA
Diamond Digital AG
Digital Assets Technologies AG (DAT)
Divizend Suisse GmbH
Dloop AG
Dsent AG

Companies

DSwiss AG
Dublin IT GmbH
Dufour Capital AG
Dydon AG
DYdX Stiftung
E24 AG
EAM.Technology AG
EasyReg Sàrl
EBOP SA
ECare AG
Ecofin Software and Technology AG
ECollect AG
EconSight AG
Ecoo AG
Edge Lab SA
Efficient.capital AG
Element36 AG
Elephants SAGL
Eligamo AG
ElleXX universe AG
Elysium Lab Sagl
EM Exchange Market GmbH
Enso Labs AG
Enterprise Bot GmbH
Eny Finance AG
Equanimity AG
ERI Etudes et Réalisation en Informatique bancaire SA
E-swissolar AG
Eternalyst AG
Etops Group AG
Evahomes SA
Everon AG
Evooq SA
Evorest AG
Exeon Analytics AG
Faessler Finance AG
FANtium AG
FE Swiss Financial AG
Fea Money Switzerland GmbH
Ficas AG
Fidectus AG
Fidentity AG
Fides Treasury Services AG
Fin.cube AG
FinConTec AG
Findependent AG
Finetoken AG
FinFinder.ch AG
Finform AG
Finhorizon AG
Finnova AG Bankware
Finpact AG
Finpeers SA
Finpension AG
Finrate AG
Fintama AG
Fintex AG
Flov Technologies AG
FlowBank SA
FNZ Switzerland SA
Forctis AG
Foxstone SA
Frigg.eco AG
FumeX AG
Fundof SA
Futurae Technologies AG
G-20 Advisors AG
Genius Yield Association
GenTwo AG
GenTwo Digital AG
Globalance Bank AG
Go4balance AG
Graypes GmbH
Greenmatch AG
Grizzly Development AG
GTF Gesellschaft für technologiebasierte Finanzdienstleistungen AG
GWAP Financial Sàrl
HackGroup SA

Companies

Halo Investing Europe AG
Haqq Association
Hashdex AG
Heidi Pay AG
Hodlr GmbH
Honesto AG
Honesto AG (Liechtenstein)
Hyphen Global AG
Hypodossier AG
I2 invest AG
I2i Logic (Switzerland) AG
IAccess Partners AG
Ibani SA
IFinity AG
IMburse AG
Immocando AG
ImmoZins AG
Impaakt SA
Inapay AG
Indagia AG
Indigita SA
Inpher Sàrl
Instimatch Global AG
Integration Alpha GmbH
Interaction Partners AG
Invemo Capital AG
Inventx AG
Investart AG
InvestGlass SA
Investment By Objectives (IBO) SA
Investment Navigator AG
Inyova AG
IODD SA
Iquant GmbH
Jibrel AG
K51 AG
Kashet Group AG
Kasparund AG
KeeSystem S.A.
Kemiex AG
Kinesis AG
Klara Business AG
Klarpay AG
KomGo SA
Kontera GmbH
Kore Technologies AG
KYC Spider AG
Laevitas SA
Lamassu Industries AG
Laser Digital Holdings AG
LCX AG
LeaseTeq AG
Ledgy AG
Lendiron Group AG
Lendity AG
Lendora SA
Leonteq AG
Leva Capital Partners AG
LibertyGreen 3a Vorsorgestiftung
Lightning Payment Services AG
LiquidChain AG
Liquineq AG
Liquity AG
Lirium AG
Liti Capital SA
Lourens Systems GmbH
LumRisk SA
Lykke Corp
Lynceus Partners (Switzerland) GmbH
M2Wealth AG
Management Joint Trust SA
Mark Investment Holding AG
Marmot Investment Office AG
Masttro Switzerland AG
Mesoneer AG
Metaco SA
MetaOne AG
MetaSwiss Group AG
Midfunder AG
MoneyPark AG

Companies

Moribono AG
Move Digital AG
Mt Pelerin Group SA
MyBit Stiftung
Mydesq AG
MyDio SA
Mympact AG
Myso Finance Association
NBK Labs AG
Nectar Digital Wealth AG
Neocredit.ch AG
Neon Exchange Aktiengesellschaft
Neon Switzerland AG
Netcetera Group AG
NetGuardians SA
Neur.on AI Solutions SA
Neuronomics AG
Newbridge SA
Nexo AG
Nimbo AG
Nomiks Sàrl
Norsia SA
Noteworthy AG
Numarics AG
Numas SA
Numbrs Personal Finance AG
Numeus Research AG
Obligate AG
Ondefy SA
One PM AG
OneVisage SA
Onloan GmbH
Oomnium AG
Open Forest GmbH
Open Mineral AG
Oper Credits AG
Optiml AG
Orca AG
OrientSwiss SA
Oxygen.org AG
Pando Asset AG
Parashift AG
PayGreen AG
Paymash AG
Payrexx AG
Pelt8 AG
Pexapark AG
PI Digital AG
Pillar Project AG
Pocket App GmbH
Polixis Sàrl
Portofino Technologies AG
Privatam AG
Private Alpha Switzerland AG
Prodaft Sàrl
Protos Asset Management GmbH
Purpose Group SA
PWN AG
Qashqade AG
Quantex AG
Radicant Bank AG
Radynamics Reto Steimen
Raized.AI AG
Raizers SA
Relai AG
Relio AG
RepRisk AG
Resolve SA
Retreeb SA
Rigo Investment Sagl
Rivero AG
Robotic Ledger AG
Rockon Digital Evolution AG
Rofinuar AG
Rulematch AG
Run my Accounts AG
S2I (Swiss Innovative Investment) SA
Safe Ökosystem Stiftung
Sanostro AG
Santiment GmbH

Companies

Savedroid FL GmbH
Scandes GmbH
ScenarioX SA
Schlossberg&Co Technologies AG
Scrypt Digital Trading AG
Securosys SA
Selma Finance AG
ShapeShift AG
Shift Crypto AG
Siebenberge GmbH
Silex Investment Partners SA
Simplewealth AG
SIX Group AG
Smart Valor AG
SMAT SA
Sobaco Solutions AG
Solarsplit SA
Sonect AG
Sparkbase AG
Sparta Commodities SA
SPitch AG
SquaredData GmbH
Squirro AG
SR Saphirstein AG
Stableton Financial AG
Stairlin SA
Starbase Platform GmbH
Staxe AG
SteelHedge SA
SuperVX AG
Sustainaccount AG
Sway Finance SA
SweePay AG
SWIC Digital Gateway AG
Swise AG
Swiss Bitcoin Pay Sàrl
Swiss Crypto Advisors SA
Swiss Fin Lab GmbH
Swiss Fintech AG
Swiss Stablecoin AG
Swiss Stake AG
Swiss4.0 SA
Swissbilling SA
Swissblock Technologies AG
SwissBorg Invest SA
SwissLending SA
SwissMetrics GmbH
SwissOne Capital AG
Swisspeers AG
SwissQuant Group AG
Swissquote Group Holding SA
Switzerlend AG
Sygnum Bank AG
Symbiotics Asset Management SA
SynoFin Risikomanagement Service AG
Syntheticus AG
SyntiFi GmbH
Systemcredit AG
Tacans AG
Tangem AG
Tastier AG
Tatoshi AG
Taurus SA
Tavis Digital GmbH
Teamwork Management S.A.
Temenos AG
Teylor AG
The Ark Network AG
The Finest Token AG
The Pay Company AG
TheScreener Investor Services AG
Ti&m AG
Tibc Sàrl
Tilbago AG
Tindeco Financial Services AG
Tiun AG
Token Flow Insights SA
Topaz Digital AG
Toucan Protocol Association
Tradeplus24 AG

Companies

Trechter.ch GmbH
Tree Project AG
Trendrating SA
Tresio AG
True Wealth AG
Trustwise.io AG
Twenty Pay SA
Twint AG
Ubinetic AG
UMushroom AG
Unblu Inc.
Unique AG
Utluna Solutions SA
Valora Schweiz AG
Värdex Suisse AG
Verified AG
Veritic AG
Verve Capital Partners AG
Vestr AG
Vestun GmbH
Vetri Foundation
VIAC AG
VNX Commodities AG
Wallee AG
WealthArc AG
Wearonize AG
WebAccountPlus (Holding) AG
WeCanGroup SA
Woolsocks AG
Wyden AG
Xdcteq AG
Xentum AG
Xilva AG
Yapeal AG
Yeekatee AG
Yeldo SA
Yokoy Schweiz AG
YouHodler SA
Yourasset AG
Yuh SA
Z22 Technologies AG

Appendix B

Appendix B lists the source and affiliation to one of the four PEST dimensions for each indicator of the FinTech hub ranking.

Publisher	Factor	Source	Dimension
2THINKNOW	Innovation Cities	Innovation Cities Index	Technological
App Annie Intelligence, International Monetary Fund	Mobile App Creation	World Economic Outlook Database October	Technological
AT Kearney	Global Cities Report	Global Cities Report	Social
Clarivante Analytics	Scientific and Technical Publications	World Economic Outlook Database October	Technological
GitHub	GitHub Commits	GitHub; United Nations, World Population Prospects	Technological
Global Entrepreneurship Research Association	Entrepreneurship Policies and Culture	Global Entrepreneurship Monitor	Economic
Henley & Partners	Passport Acceptance	Henley & Partners Passport Index	Political/legal
IHS Markit	Political and Operational Stability	Country Risk Scores	Political/legal
	Software Spendings	Information and Communication Technology Database	Technological
IMD	Digital Competitiveness	IMD World Digital Competitivess Ranking	Technological
	Smart City	Smart City Index	Technological
	Talent Competitiveness	IMD World Talent Ranking	Social
InterNations	Expat Ranking	Expat Insider Survey	Social
Insead, The Adecco Group, Google	Global Talent Competitiveness	Global Talent Competitiveness Index	Social
Institute for Economics and Peace	Global Peace	Vision of Humanity Global Peace Index	Political/legal
International Labour Organization	Female Employment Advanced Degree	ILOSTAT Annual Indicators	Social
	Knowledge-Intense Employment	ILOSTAT Database of Labour Statistics	Social

Publisher	Factor	Source	Dimension
International Monetary Fund	Foreign Direct Investments	International Financial Statistics and Balance of Payments databases	Economic
	Domestic Credit to Private Sector	International Financial Statistics and Balance of Payments databases	Economic
International Telecommunication Union	Mobile Cellular Subscriptions	International Telcommunication Union, World Telecommunication/ICT Development Report and database	Technological
	ICT Access	World Telecommunication/ICT Indicators Database	Technological
	ICT Use	World Telecommunication/ICT Indicators Database	Technological
	Cybersecurity	Global Cybersecurity Index	Technological
Mercer	Cost of Living	Mercer's Cost of Living Ranking	Social
Mesopartner & Analyticar	Infrastructure Quality	Global Quality Infrastructure Index Report	Political/Social
NUMBEO	Prices by City of Average Monthly Net Salary	Average Monthly Net Salary Index (After Tax) (Salaries And Financing) by City	Economic
	Purchasing Power	Local Purchasing Power Index by City	Economic
	Quality of Life	Quality of Life Index by City	Social
OECD	PISA Ranking	PISA Results	Social
Portulans Institute	Network Readiness	Network Readiness Index	Economic
QS Quacquarelli Symonds Ltd	University Ranking	QS World Universtiy Ranking, Top Universities	Social
Reporters without Borders	Press Freedom	World Press Freedom Index	Political/legal
Tax Justics Network Limited	Financial Secrecy	Financial Secrecy Index	Economic
The Heritage Foundation	Investment Restriction	Index of Economic Freedom	Political/legal
	Financial Restriction	Index of Economic Freedom	Political/legal

Publisher	Factor	Source	Dimension
The World Bank	Value of Stocks Traded	World Federation of Exchanges Database	Economic
	Domestic Market Scale	World Economic Outlook Database	Economic
	Cost of Redundancy Dismissal	Doing Business Report	Political/legal
	Ease of Getting Credit	Doing Business Report	Economic
	Ease of Protecting Minority Investors	Doing Business Report	Economic
	Ease of Resolving Insolvency	Doing Business Report	Economic
	Starting a Business	Doing Business Report	Economic
	Applied Tariff Rates	World Development Indicators Database	Economic
	Gov. Effectiveness	Worldwide Governance Indicators	Political/legal
	Regulatory Quality	Worldwide Governance Indicators	Political/legal
The World Bank and Turku School of Economics	Logistics Performance	Logistics Performance Index	Social
Thomson Reuters	Joint Venture Deals	Thomson One Banker Private Equity, SDC Platinum Database	Economic
	Venture Capital Deals	Thomson One Banker Private Equity, SDC Platinum Database	Economic
Trading Economics	Corporate Tax Rates	List of Countries by Corporate Tax Rate	Political/legal
Transparency International	Corruption Perception	Corruption Perceptions Index	Political/legal
UNESCO Institute for Statistics	Expenditure on Education	UIS Online Database	Social
	R&D Expenditure	UIS Online Database Eurostat, Eurostat Database	Technological
	Government Funding per Secondary Student	UIS Online Database	Social
UN Habitat	Cities Economic Competitiveness	Global Economic Competitiveness Report	Economic

Publisher	Factor	Source	Dimension
UNESCO Institute for Statistics	Graduates in Science and Engineering	UIS Online Database	Social
	Tertiary Inbound Mobility	UIS Online Database	Social
	Pupil-Teacher Ratio	UIS Online Database	Social
	Research Talents in Businesses	UIS Online Database Eurostat, Eurostat Database	Technological
	Researchers	UIS Online Database Eurostat, Eurostat Database	Technological
	School Life Expectancy	UIS Online Database	Social
	Tertiary Enrolment	UIS Online Database	Social
United Nations Public Administration Network	E-Participation	e-Government Survey	Technological
	Gov. Online Services	e-Government Survey	Technological
Wiley	Digital Skills	Digital Skills Gap Index	Social
World Economic Forum	Cluster Development	Executive Opinon Survey	Social
	University-Industry Collaboration	Executive Opinon Survey	Technological
World Federation of Exchanges	Market Capitalisation	World Bank's World Development Indicators Database	Economic
World Intellectual Property Organization	Patents by Origin	World Economic Outlook Database	Technological
World Trade Organization	ICT Services Imports	Trade in Commercial Services Database	Technological
	IP Payments	Trade in Commercial Services Database	Technological
World Trade Organization and United Nations	High-Tech Imports	Comtrade Database	Technological
Z/Yen Group, China Development Institute	Global Financial Centres	Global Financial Centers Index	Economic

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