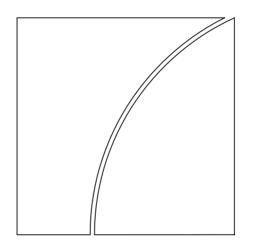
Irving Fisher Committee on Central Bank Statistics



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No 12

Towards monitoring financial innovation in central bank statistics

Prepared by the IFC Working Group on Fintech Data Issues

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Contents

Co	ntribu	tors to the IFC Report	ii
List	t of al	bbreviations	iv
Exe	cutiv	e summary	1
1.	Intro	duction	2
2.	Data	needs	4
3.	Road	Imap for constructing fintech statistics	6
	3.1	Fintech and official statistics	7
	3.2	Towards a classificatory treatment of fintech by identifying fintech market segments	8
	Вох	1: A two-pronged approach to revising statistical classifications	9
	3.3	Identifying fintech firms	10
	3.4	Linking with existing data	12
	3.5	Fostering cooperation	13
	3.6	APIs and AI-assisted web search	14
	3.7	Surveys	15
	3.8	Compulsory reporting requirements and statistics	17
	3.9	Towards the monitoring of new developments	18
4.	Reco	mmendations on the way forward	18
	4.1	Classification of fintech activities	18
	4.2	Methodological treatment of fintech activities	19
	4.3	Monitoring of fintech through adequate statistical frameworks	20
	4.4	Promotion of innovative technological solutions for fintech statistics at the global level	20
Ref	erend	es	22
An	nex 1	Mandate – IFC Working Group on Fintech Data Issues	24
An	nex 2	Members – IFC Working Group on Fintech Data Issues	26
An	nex 3	Countries' or institutions' Case Studies on fintech	28
An	nex 4	IFC letter to the UNSD regarding ISIC Rev 4 issues	104
An	nex 5	Statistics on fintech - bringing together demand and supply to measure its impact: selected central bank contributions	

List of abbreviations

ACPR	Autorité de Contrôle Prudentiel et de Résolution (French Prudential Supervision and Resolution Authority)
AI	Artificial intelligence
API	Application programming interface
B2B	Business-to-business
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
BISIH	BIS Innovation Hub
ВоР	Balance of payments
BOPCOM	IMF Committee on Balance of Payment Statistics
CBRT	Central Bank of the Republic of Turkey
CCAF	Cambridge Centre for Alternative Finance
CEMLA	Center for Latin American Monetary Studies
CIS	Community Innovation Surveys
CNMV	Spanish National Securities Market Commission
CPMI	Committee on Payments and Market Infrastructures
ECB	European Central Bank
FSB	Financial Stability Board
FSCA	Financial Sector Conduct Authority (South Africa)
G20	Group of Twenty
IAG	Inter-Agency Group on Economic and Financial Statistics.
IBS	International Banking Statistics
ICOs	Initial coin offerings
ICT	Information and Communication Technology
IDS	International debt securities
IFC	Irving Fisher Committee on Central Bank Statistics
IIP	International Investment Position
ISIC	International Standard Industrial Classification of all Economic Activities
ISWGNA	UN Intersecretariat Working Group on National Accounts
IT	Information technology
LAC	Latin America and the Caribbean
LEI	Legal Entity Identifier

NACE	Statistical Classification of Economic Activities in the European Community
NAICS	North American Industry Classification System
NSO	National Statistical Office
OeNB	National Bank of the Republic of Austria
OTC	Over-the-counter
P2P	Peer-to-peer
SARB	South African Reserve Bank
SARS	South Africa Revenue Service
SCTECH	Bank of Portugal branch of the Specialised Committee for Financial Supervision and Stability dedicated to fintech
SNA	System of National Accounts
SNB	Swiss National Bank
UN	United Nations
UNSD	United Nations Statistical Division
WG	Working Group

Executive summary

As fintech, or financial innovation and digitalisation, transforms the financial sector, it also opens up data gaps in central bank statistics. It does so by introducing new financial products, and bringing existing services to a larger market. Data gaps are currently prevalent as (internationally comparable) information on fintech is lacking in official statistics. To understand innovation, qualitative information, information on evolving structures, and harmonised time series are needed.

Against this backdrop, the Irving Fisher Committee on Central Bank Statistics (IFC) Working Group on Fintech Data Issues has reviewed the state of affairs and outlined a targeted road-map to construct fintech statistics.

The road-map consists of six steps. The first one is to formulate a classification of fintech that encompasses the various financial market segments of fintech, as data gaps reflect the fact that fintech companies engaged in financial intermediation are not systematically assigned to the financial sector (as identified by eq the International Standard Industrial Classification of all Economic Activities (ISIC)).² Second, based on this definition, lists of fintech enterprises can be derived from various sources (eg existing studies, registers). Third, linking these lists to existing data in official statistics (eq balance sheet data) will help to answer economic questions about fintech and allow a more comprehensive understanding of its potential development. Fourth, intra- and inter-institutional cooperation shall be fostered, as data from different sources need to be linked, calling for active support of the related international initiatives that are under way (eq to promote global identifiers). Fifth, available data from the internet can be sourced (eq through artificial intelligencesupported web search). Sixth, the resulting information set can usefully be complemented by surveys or compulsory reporting requirements on aspects for which data of sufficient quality are not available from other reliable sources; indeed, the working group (WG) notes that the information available varies from country to country, which can call for flexibly adjusting the various national strategies to construct fintech statistics.

Based on these observations, the WG recommends that central banks should:

- 1. Promote the global adoption of a revised classification of economic activities that better takes into consideration fintech service providers, in particular by actively supporting the IFC recommendation to revise the ISIC at the United Nations (UN) level. Fintech activities should be assigned to section K (financial services) as part of the value chain of financial products, and specific categories should be established. Central banks could consider ways to implement a revised classification in specific data collection exercises, including payment transactions data and the international banking and financial statistics already compiled by the Bank for International Settlements (BIS) on behalf of central bank committees.
- 2. Ensure that statistical methodologies used to measure fintech activities adhere to sound professional and scientific standards, in line with the Fundamental Principles for the production of appropriate and reliable official

² Adjustments to the ISIC Rev. 4 are currently possible, as this standard is now being revised under the umbrella of the United Nations Statistical Division (UNSD).

statistics. Specifically, ensure that fintech is considered in the context of the already launched international consultations for the preparation of the next versions of the System of National Accounts (SNA) and Balance of Payments/International Investment Positions (BoP/IIP) standards.

- 3. Develop a comprehensive process to continuously monitor the situation and address fintech-related data issues that may arise. To compile fintech statistics, central banks could implement the various steps described in this report, which cover the classification of fintech firms, links with existing data, cooperation with other data-providing agencies, and the use of surveys or Alsupported web search.
- 4. Leverage existing IT innovation and accelerate it, by promoting technological solutions to facilitate the compilation of fintech statistics; cooperating with other domestic and international stakeholders, and making resources available internationally, for instance, by sharing IT tools through the BIS Innovation Hub (BISIH).

1. Introduction

Fintech, or innovation and digitalisation in the financial sector, is expanding rapidly.³ New fintech firms are particularly active in the provision of payments, clearing, settlement services and credit.⁴ To defend their market share, incumbent financial institutions are (i) cooperating with or acquiring fintech firms; (ii) producing in-house technological solutions; and (iii) developing new business models (eg setting up bank affiliates with no physical branches, or promoting mobile banking).

These innovations can benefit final users by reducing the cost of financial services, or easing financial access. One of the main advantages is greater competition, as fintech lowers the barriers to entry and hence could expand the variety of services and reduce prices to end users. Separately, fintech could boost financial inclusion in emerging and developing countries, as it may help hitherto unbanked people gain access to financial services through mobile devices.⁵ In more advanced countries, the share of households with a deposit account is higher, but fintech also eases financial access in these countries, as it helps to provide a wider range of financial services to more underserved, often low-income, households. Lending and equity-based crowdfunding are another positive innovation, both in emerging and advanced economies.⁶ Last, but not least, fintechs also open up new channels for small and medium-sized enterprises (SMEs) financing and facilitate the

⁵ According to the World Bank "financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance", <u>www.worldbank.org/en/topic/financialinclusion/overview.</u>

³ Fintech firms offer innovations such as peer-to-peer lending, crowdfunding, alternative mobile payments, cryptoassets (virtual currencies) and initial coin or security token offerings, which could potentially transform the business models for existing financial products and services. Despite this rapid growth, their market share remains small (See Avila as well as Gauthier, both in Annex 3 of this report).

⁴ See Tunc as well as Daseman et al, both in Annex 3 of this report.

⁶ See Devys as well as Abarca, both in Annex 3 of this report.

access of such firms to cross-border and business-to-business payments, lending, working capital, cash flow management, invoicing and accounting, among other services.⁷

But fintech can create challenges for central banks, as it may impact on core tasks such as monetary policy implementation, financial stability monitoring or payment systems surveillance. For example, the monetary policy transmission mechanism may be changing as a result of the growth in digital currencies. Financial stability risks can arise due to peer-to-peer (P2P) lending platforms, or the interconnectedness between traditional intermediaries and fintech firms. Innovations in payment systems can complicate the monitoring of money laundering activities and terrorism financing.

Central banks therefore need information on fintechs, and their activities, to properly assess the benefits and risks and pursue their own policy objectives.⁸ The Covid-19 crisis has thrown into sharp relief the importance of this monitoring, as much of the potential cost advantages of fintech activity results from replacing physical interactions by novel IT solutions. Consequently, fintech approaches are particularly appropriate for pandemic times and may help to soften the economic and financial impact of this crisis. Yet, in terms of overall market conditions, fintech may be affected by the crisis in much the same way as the rest of the financial industry, and its growth prospects will need to be reconsidered.

As a result, measuring fintech has become a key objective for central banks (IFC (2020)). It feeds into any empirical work on financial stability, economic, markets, and payments analysis. Unfortunately, there are currently no internationally harmonised official statistics to track such developments. Against this backdrop, the IFC has launched a Working Group to analyse the data issues raised by the development of fintech and derive possible recommendations for central bank statistics. ⁹ In line with this mandate, the WG has:

- Assessed central banks' additional needs for fintech data and potential use cases;
- Taken stock of existing official data sources, their actual uses and existing fintech data-gathering initiatives;
- Identified key data gaps, and assessed the costs and benefits of initiatives to address them;
- Clarified the roles and responsibilities of the various parties that could be tasked to design, collect, collate and maintain statistics on fintech; and
- Provided guidance for developing adequate statistical definitions for collecting comprehensive information on fintech from a global perspective.

This report summarises the main conclusions, and sets out some key steps towards the development of fintech statistics. A first requirement is to agree on a statistical classification of fintech and fintech firms. This will help to develop a

- ⁸ See D'Aguiar et al as well as Avila et al, both in Annex 3 of this report.
- ⁹ IFC Working Group on Fintech Data Issues Mandate (2018), see Annex 1.

⁷ SMEs make up a large part of the global economy, but they face barriers to financing from traditional lending institutions and receive a disproportionately small share of credit from the financial system that perceive SMEs' financing needs as complex and risky, but small-scale. Examples of fintech services to SMEs include digital platforms that standardise invoices for funding accounts receivables, which could usefully improve the working capital situation for SMEs in a global supply chain (Van Wersch (2019), World Economic Forum (2015a)).

comprehensive list of fintech firms, on the basis of existing lists compiled by private, official or academic sources. To further enhance insights on the fintech sector, existing statistical information (eg balance sheet data) can be combined with the list. National and international cooperation is needed to expand fintech data in this way, as many important data sets are produced by a variety of statistical, supervisory, academic and commercial agents. The use of innovative IT tools and techniques such as Al-supported web search may provide complementary information in the statistical compilation process, as they may ease the reporting burden on fintech firms, which are often SMEs, or start-ups. Surveys are another useful tool. Ultimately, new statistics can be produced through additional and proportional reporting requirements. All these action points aim at helping users to monitor the fintech market. The report concludes with recommendations for building up internationally harmonised fintech statistics.

The rest of the report is structured as follows. Section 2 discusses data needs. Section 3 covers initiatives to build fintech statistics. Section 4 provides policy recommendations.

2. Data needs

During the mandate of the working group, the Irving Fisher Committee surveyed central banks on fintech data use and data needs. This section builds on the key results from the resulting report (IFC (2020)), which underscores that demand for fintech data among central bank users is strongest in jurisdictions with higher fintech development and in the areas working on payment systems and financial stability issues.

Central bank users in financial stability departments have a particular need for lists of fintech entities and data on credit volumes and lending rates. Currently there is insufficient information on fintechs to calculate basic regulatory metrics, such as the leverage or liquidity ratio (FSB (2017)). Other examples of fundamental data needs in financial stability analysis are fintech credit volume as a share of total credit, the number of fintech firms per jurisdiction, information on major financial innovations, or the main target end users (EBA (2017)).

By the same token, central bank staff in the payments area report a greater need for data in high-fintech jurisdictions than those in low-fintech jurisdictions,¹⁰ and adequate definitions and concepts are required in order to develop a fintech data-reporting framework. The BIS Red Book statistics¹¹ are a focal point here, and already cover some fintech developments. Yet significant enhancements could be considered to complement current Red Book statistics, by collecting data on: breakdowns by legal status of non-banks for category "Overnight deposits by other than banks";

¹⁰ Countries are classified as high- or low-fintech following the Cambridge Centre for Alternative Finance (CCAF (2018)) index. Consequently, high-fintech countries are Australia, Brazil, Canada, France, Germany, Ireland, Israel, India, Japan, Germany, Singapore, Korea, Switzerland, the United Kingdom and the United States. All other countries are in the low-fintech group.

¹¹ The BIS Committee on Payments and Market Infrastructures (CPMI) periodically publishes reference works on payment, clearing and settlement systems in the CPMI member countries. These reports, which are regularly revised, are widely known as Red Books.

breakdowns concerning fintech categories; breakdown of "total gross volumes/values" by instrument type; and "Instant credit transfer".

Turning to banking supervisory units, they appear so far less interested in fintech data. This may reflect the small scale of fintech credit relative to banking credit, as well as the fact that the subset of fintech firms offering credit using a balance-sheet model are already supervised by banking supervisory units or authorities (BCBS (2018)).¹² Besides, many central banks are not directly in charge of banking supervision. Nevertheless, there is a reported demand for having a clear definition of fintech and a recognition of the lack of robust databases on fintechs for banking supervisory purposes.

As regards central bank monetary policy and research units, information needs are reported to be limited, suggesting that the developments in fintech do not yet have a material impact on their work, for instance as regards the monitoring of inflation, the economy and the transmission channels of monetary policy.

In general across central bank units, statisticians are clearly interested in understanding the size of fintech businesses, measuring their concentration in financial instruments, and having at their disposal a working fintech industry definition according to the IFC survey. These needs reflect the fact that they have to face questions such as: should some IT services be considered part of fintech? How should fintech activities be measured when integrated within traditional financial institutions? Should development undertaken by fintech firms be reported as research and development? How should cryptocurrencies be classified? The data that can help to address these issues can be quite large, including the full financial statements of fintechs, their financial flows and stocks, as well as the financial relationships among fintech firms and with institutional sectors. Clearer guidance on an appropriate statistical treatment of this various information would be most helpful.

In practice, four main types of information appear key to central bank users working on fintech-related issues: lists of specific fintech entities, fintech credit items, cryptoasset items and financial service usage. First, concerning the list of fintech firms, there is a particular need to cover the various payment service providers, and also credit platforms (peer-to-peer lenders). Comparatively, there is less demand for lists of neobanks; this may reflect the fact that, as neobanks are regulated from their incorporation, they are more readily covered by banking statistics. Second, on fintech credit items data needs particularly relate to information on credit scoring (eg to compare banks and P2P lender activities), and balance sheet data. Third, in terms of cryptocurrencies, data needs concern respective market capitalisation, number of trading platforms, flows of funds between crypto and fiat currency (and vice versa), trading volumes, types/number of cryptoassets traded and the number of customers. Finally, operational interlinkages between financial institutions and technology companies providing them services (eg bigtechs) are also of interest – not least because they can be a source of operational risks.

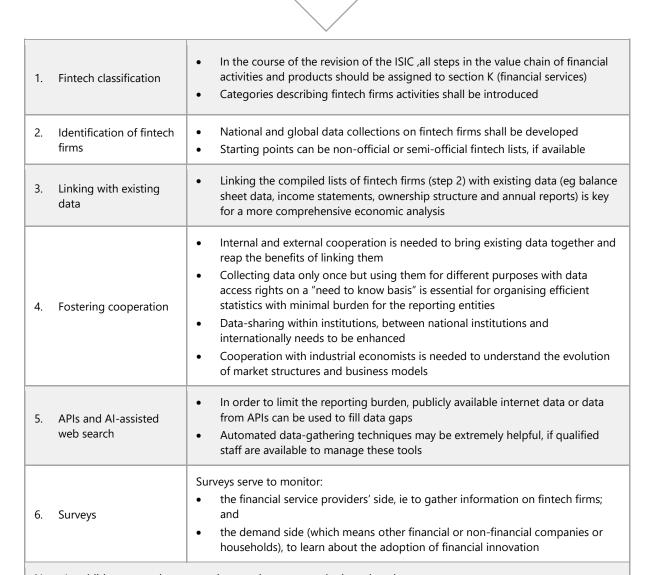
¹² See CGFS-FSB (2017). This may not be the case if fintechs use other business models, ie if they are only a lending platform.

3. Roadmap for constructing fintech statistics

This section outlines the steps needed to develop official statistics and meet central bank users' fintech data requirements, building on the experiences of the WG members.

Integrating fintech in official statistics – A Roadmap

Rapid digital financial innovation creates data gaps. Many central banks have launched initiatives to address them. To understand innovation, qualitative information, information on evolving structures, and harmonised time series are important. A road map on the way towards internationally harmonised fintech statistics is needed.



Note: In addition, compulsory reporting requirements can be introduced

3.1 Fintech and official statistics

No internationally comparable, regularly published data on fintech are currently available in official statistics, in particular in the SNA. Yet some insights into the importance of fintech can nonetheless be derived from the so-called SNA use tables. These suggest that rapid digital financial innovation can create data gaps in official statistics.

For instance, Table 1 below shows the share of Information and Communication Technology (ICT) products and services in total intermediate consumption for financial industries for 2012–17.¹³ The data indicate that the level of ICT intensity varies considerably between countries. Although there is no clear pattern, cross-country differences are large, pointing to a varying importance of fintech or different economic structures. Moreover, the absence of a clear upward trend in most jurisdictions suggests that the data are incomplete, for instance because they do not include ICT development in fintech outside the financial area (eg fintech services provided by IT firms) and in-house activities within financial institutions themselves (since the data include only outsourced ICT activities).

Share of intermediate con	sumption on ICT	products a	nd services	(percent)		Table 1
	2012	2013	2014	2015	2016	2017
Australia	20,9	22,4	22,3	22,6	22,9	23,2
France	9,6	9,6	9,5	9,3	-	-
Germany	6,1	7,7	8,0	7,8	-	-
Netherlands	5,5	5,4	5,3	5,2	6,4	6,0
Singapore	11,1	12,5	11,9	10,1	-	-
United Kingdom	13,8	13,7	14,6	14,5	14,2	-
United States	4,6	4,8	4,8	4,6	4,7	4,8
Source: Chaudron, in Annex 3	of this report.					

ICT intensity of finance

Many central banks have launched initiatives to address the data gaps that rapid digital financial innovation can easily create given their existing, "legacy" statistical infrastructure. In most instances, they collect data from financial service providers. Specifically, central banks report that they are updating lists of financial entities, collecting financial statements, and adjusting reporting requirements. Concerning data sources, so far central banks have been collecting data from regulatory reports, industry associations, or business registries. Initiatives to collect fintech data from users (eq household financial surveys) are scarce.¹⁴

¹³ For further details see Chaudron, in Annex 3 of this report.

¹⁴ For more details, see IFC (2020).

3.2 Towards a classificatory treatment of fintech by identifying fintech market segments

Many of the gaps in financial statistics reflect the fact that the fintech firms engaged in financial intermediation are not systematically classified in the financial sector. This calls for further work on a formal classification of fintech activities. From a statistical point of view, fintech is currently not recognised as a sector or an activity (as identified by eg ISIC or NACE), nor is it defined in combination with a certain usage or purchase of a product/service. Central banks are therefore classifying fintech firms on a caseby-case basis, sometimes in cooperation with other national authorities (eg the ministry of finance or a national statistical institute).

In practice, many fintech services are not provided by established financial companies such as banks or insurers. Often, they may be offered by firms classified as business service providers or IT enterprises under the current classification scheme (eg robo-advisors may be classified as software providers). A large part of these companies' businesses clearly consists in financial intermediation and should be integrated into the financial sector statistics. In addition, new types of financial service (eg crowdfunding or peer-to-peer lending) are emerging. Only in some cases are they offered by affiliates directly controlled by traditional financial intermediaries – implying that, more often than not, their activities are blurred within the reports of consolidated groups. Another example of the current limits of statistics concerns new types of entity such as internet banks offering mobile and digital banking services ("neobanks"), which are merged together in the general group of credit institutions.¹⁵

All in all, fintech services, products and firms create a need to revise official business classification systems. Such revisions are the key to ensuring that (central bank) statistics remain activity-based and that classification issues can be addressed based on harmonised and coherent rules. There is currently an opportunity to implement adjustments, as the ISIC maintained under the umbrella of the UN is being revised. Specifically, some new types of entity engaged in crowdfunding, robo-advising or payment service provision have not yet been classified as a type of financial service provider in section K. Regional and national examples underline the need to adjust several other classification systems. Even though fintech is usually taken to refer to the financial industry, in Canada, for example, the majority of these companies are classified in the professional, scientific and technical services (NAICS 54), which is part of the non-financial industries.^{16, 17} The treatment of such entities is similar in Germany.¹⁸

- ¹⁷ Gauthier, in Annex 3 of this report.
- ¹⁸ von Kalckreuth and Wilson, in Annex 5 of this report.

¹⁵ For a more detailed exposition, see von Kalckreuth and Wilson, in Annex 5 of this report.

¹⁶ The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analysing, and publishing statistical data related to the US economy. Under the auspices of the Office of Management and Budget (OMB), it was developed in 1997 jointly by the US Economic Classification Policy Committee (ECPC), Statistics Canada, and Mexico's Instituto Nacional de Estadistica y Geografia, to allow for a high level of comparability in business statistics among the North American countries.

Box 1: A two-pronged approach to revising statistical classifications

Two approaches need to be simultaneously followed when defining statistical classifications if they are to remain meaningful and time-invariant: the "top-down" and the "bottom-up" approach.

As regards first the analytical ("top-down") approach, the following steps can help statisticians to classify financial activities in the economy in a time-invariant way: identify the key processes necessary to produce financial services and classify those activities and products as "financial", whether or not they are provided by a traditional financial institution or by an IT company specialised in one link of the financial value chain. This will make statistical measurement independent of outsourcing from, and specialisation within, the financial industry and at the same time robust to rapid technological progress in the future.

The alternative synthetic, or "bottom-up", approach is also frequently followed in empirical studies on fintech activities. Researchers often start from clusters of activities that they deem to be "fintech" and collect data on that basis (see Table 2). Frequently these taxonomies contain the following business segments on a first level: (i) financing: credit, deposit and capital-raising services; (ii) investment services or investment management services; (iii) payment, clearing and settlement services; and (iv) other financial related services. In order to identify the fintech activities most relevant for the financial system – along with more traditional businesses of the same kind – segments (i) to (iii) are indispensable, although a residual segment will always also be necessary. As in Daseman et al (2020), one may add as separate segments key activities such as insurance, regtech and B2B tech provision.

Other approaches can also be followed, for instance by applying a purely analytical definition of fintech. This may help to describe the nature of fintech and to illuminate its economic and financial implications, but it is not very useful for statistical purposes.¹ The reason is that analytical definitions rely on terms such as "innovation" and "new", which cannot be time-invariant. A firm that is fintech today will not be fintech a decade from now if it continues to provide exactly the same services, since its technology or business model will no longer be regarded as innovative. Statistical classification needs to be based on the kind of service provided, and not on whether it is produced using a technology that is considered as "new" at some point of time. Thus, an activity-based classification system will have to include firms that are considered fintech alongside other, more traditional types of firm, provided that they are involved in the same type of business.

(1) The Financial Stability Board (FSB) definition of fintech is an example of an analytical definition. It defines fintech as a "technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services".

To highlight these problems, the IFC has sent a letter to the UNSD proposing that the current classification of economic activities should be modified.¹⁹ The ultimate objective is to ensure that activities that form an integral part of the value chain leading to financial products and services are classified as part of the financial sector, whether or not they are carried out by traditional financial institutes. Since a large share of fintech enterprises are classified as IT firms in many countries, the IFC believes that the services offered by fintech companies should be classified under section K on a functional basis. For instance, this could be done by adding them to groups and classes in division 66 or creating new structures.

The revision of the ISIC and associated classifications could be implemented using a two-pronged approach (see Box 1):

1) Top-down (analytical): this ensures that the most important steps in the value chain of financial products are assigned to a category in section K (financial services) when offered as separate services.

¹⁹ See Annex 4: IFC letter to the UNSD regarding ISIC Rev 4 issues.

2) Bottom-up (synthetic): based on empirical studies such as EBA (2017) or Daseman et al (2020), this ensures that the clusters empirically identified can be assigned to a category in section K, provided that they are financial in nature.

Following such an approach would help to keep official statistics relevant in the age of financial digitalisation. Strategies that rely on a purely a priori understanding of the economic and financial implications of fintech are insufficient, as the terms they rely on (eg "innovative firms" or "new entrants") may change over time. In other words, a firm that is fintech today may not be so in a decade if its technology is no longer be regarded as innovative while it continues to provide exactly the same services.

Fintech market segments	Table 2
Payments	Entities that perform part or all of the functions required to send and/or receive value from one party to another via any digital channel, including parties in the value chain that facilitate and perform settlement and clearing.
Lending	Entities that facilitate the borrowing of money or finance the assets of individual consumers and/or small businesses with traditional and non-traditional financiers through internet, cloud or app-based platforms.
Savings and deposits	Deposit-taking entities that provide digital banking services (including banking as a platform) as well as savings products using mobile technology.
Insurance	Entities that provide part or all of the insurance value chain functions (eg communication, risk analysis, distribution) through the use of specific technologies (eg artificial intelligence, robotics) instead of traditional methods.
Investments	Entities that provide digital platforms for investment and/or trading activity (including cryptocurrency) or enable individuals to trade on traditional exchanges/platforms from their own device(s).
Financial planning and advisory	Entities that use artificial intelligence and/or robotics to provide financial advice to individuals or small businesses by recommending suitable savings, investment or credit products, and by managing financial resources.
Capital raising	Equity or debt-funding platforms that allow businesses or individuals to raise funds for investment purposes or charitable causes, including digital due diligence service providers.
B2B tech providers	Entities that create or support platforms and/or products provided by other financial services providers for use by other fintechs but do not provide financial services to the public under their own brand name.

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3.3 Identifying fintech firms

Given that there is as yet no internationally agreed official statistical definition of fintech, it is difficult to create official fintech registers or lists of fintech firms that are either comprehensive or comparable. Consequently, many countries have no official registers for fintech firms. Two further problems are that some fintech activities do not require registration with a supervisory authority, and that the speed of fintech

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innovation hinders any census of fintech firms.²⁰ Central banks therefore need to take an innovative approach to identifying fintech firms, which is arguably the first step in building up fintech statistics. As a result of these efforts, a variety of unofficial or semiofficial fintech lists exists.²¹

- A non-exhaustive list of 542 fintech companies or services was made based on the members of the "France Fintech" association and of the Swave incubation platform, and drawn from the list of projects labelled under "Finance Innovation" and the list of fintech companies that contacted the French prudential authority (ACPR).
- The South African Fintech Data Hub will operationalise a fintech institutional registry. The registry will give a dynamic overview of active and emerging fintech firms in South Africa, including initial operational information for an assessment of the business model and risk.
- An initial characterisation of fintech firms' demographics in Spain was carried out by building a database, drawing on information available from various public and private sources: the Spanish National Securities Market Commission (CNMV); industry associations (such as the Spanish Fintech and Insurtech Association and the Spanish Crowdlending Association); and private consultancy firms (Finnovating).²²
- The National Bank of the Republic of Austria (OeNB) refers to the list "Fintech Directory Austria" provided by Fintech Austria²³ as the basis for analysing the structure of the Austrian fintech market – in terms of both the firms that are included into the sample and their segmentation into different business models. The internal activities of incumbents and foreign firms operating in Austria are not part of the list.
- Some 433 German firms were identified as fintechs by a major independent report commissioned by the German Ministry of Finance (Dorfleitner et al (2017)).
- Some 2,800 fintech entities were identified in the euro area in 2018. This number could represent around 23% of all the fintech companies around the world (Kochanska et al (2020)).

The exchange of views with some fintech entities provides an opportunity to examine the fintech market structure, and design plans for further data collections. In Costa Rica, for example, an exchange of views has helped to get information on the size and type of business models in the national fintech market, and to subsequently start a communication process with fintech firms. Given that there is no formal method of identifying fintech firms, this communication helps to identify key stakeholders. Once a list of fintechs has been compiled, it may also be advisable to divide the fintech industry's activities into market segments (or categories) as described in Section 3.2.

- ²⁰ Maza and Moreno, in Annex 3 of this report.
- ²¹ For details, see the respective country case studies in Annex 3 of this report.

²³ <u>http://austrianfintech.directory/.</u>

For the list of crowdfunding platforms, see <u>www.cnmv.es/Portal/Consultas/Plataforma/Financiacion-Participativa-Listado.aspx?lang=en</u>. For further information, see also <u>http://asociacionFinTech.es/#</u>, <u>http://acle.es/</u>, and <u>https://www.finnovating.com/</u>.

Fintech firms could also be identified using the strategy used in Spain.²⁴ The identification criteria must be clearly defined by experts, including details of the type of fintech firm that should be identified and what criteria they should meet. For this, it is also possible to use various existing studies, bearing in mind that during the process the target might have to be adjusted. If, for example, specific company names or activities have been identified, one can search the net for websites of fintech firms. Furthermore, the websites of identified fintechs can be scraped for commercial information or for information on major changes in the product profile. Sometimes, fintech firms are no longer active, which is not unusual given the low survival rate of start-ups in their early years of operation.

3.4 Linking with existing data

Linking a list of fintech firms with existing data in official statistics (eg balance sheet data) is the key to gaining a more comprehensive understanding of fintech activities. As the Spanish example shows, firm-level annual financial statements filed in business registers can provide useful insights. Once data on firms' balance sheet data, income statements, ownership structure and annual reports are accessible, a more comprehensive economic analysis can be conducted. Additionally, linking certain fintech firm attributes (eg their business models) to the conventional macroeconomic statistical framework can be useful. Table 3 shows possible relationships between fintech activity, business model, and the corresponding conventional financial product.²⁵ Combining the fintech list with certain macroeconomic statistics requires accurate sectoral classifications as these are often aggregated on a sectoral basis eg in the national accounts.²⁶

Fintech activity	Business model	Conventional instrument
Savings and deposits	Ranges from digital banks to community-pooled savings such as informal credit unions (eg South African stokvels)	Deposits
Lending	Lending brokers (facilitator) and alternative lenders (own balance sheet)	Loans
Capital raising	Equity or debt funding platforms that Debt securities/equity allow businesses or individuals to raise funds for investment purposes	
Virtual currencies	Cryptographic assets are transferable digital representations (assets), designed to prohibit their duplication	Non-financial assets (financial asset if there is a financial liability)

Relationship between fintech activities and financial instruments

Business models and the macroeconomic statistical framework

- 24 Maza and Moreno, in Annex 3 of this report.
- 25 Daseman et al, in Annex 3 of this report.
- 26 Tunç, in Annex 3 of this report.

Table 3

3.5 Fostering cooperation

Internal and external cooperation is needed to bring existing data together and reap the benefits of linking them, as data-sharing requires agreement on access rights to preserve confidentiality.²⁷ Moreover, collecting data only once but using them for different purposes with access rights on a "need to know basis" is essential for organising efficient statistics while keeping the reporting burden to a minimum; central banks have been particularly active in trying to find ways to facilitate information-sharing both within and across jurisdictions (IFC (2015)), especially as regards micro-level data sets (IFC (2016b)). As regards fintechs, coordination across multiple regulatory authorities to ensure an adequate exchange of information is particularly important, as financial innovations are relevant not only to financial regulators, but also to authorities responsible for consumer protection, cyber security, data protection etc.

To ensure a timely monitoring of technological developments in the financial sector, the Bank of Portugal set up in 2017 a dedicated group focused on digital innovation and fintech within its Specialised Committee for Financial Supervision and Stability. Knowledge production (eg a market structure investigation based on a fintech survey and fintech analysis from a financial stability perspective) is one of its main objectives.²⁸ For its part, the Bank of Mexico cooperates regularly with the National Banking and Securities Commission and the Ministry of Finance on fintech issues. Similarly, the Central Bank of Chile shares knowledge on fintech issues with the other national authorities, such as, the Financial Market Commission, the Ministry of Finance and the Ministry of Economy, Development and Tourism, and the Financial Stability Council.²⁹

Turning next to the type of data that can be shared, central bank experience suggests that fintech statistics can be enhanced by using regulatory data (balance sheets directly reported by financial institutions).³⁰ Pooling regulatory data from various financial supervisors improves the accuracy of sectoral classifications, and expands the coverage to the non-bank sector. In this regard, the South African Reserve Bank (SARB) is finalising a multi-party information-sharing agreement between cryptoasset businesses and the following regulators: SARB, Financial Intelligence Centre, South African Financial Regulator (FSCA), National Treasury and South African Revenue Service (SARS). These authorities will share information via a Fintech Data Hub, which will facilitate the use of common fintech definitions across regulators.

As fintech innovations are borderless with no single authority or jurisdictional boundary, international cooperation is also needed. The case for data-sharing is particularly strong, as many fintech firms are based in one country but operate across borders. Data-sharing could encourage the development of a formal business classification of fintech firms, or the collection of harmonised, cross-country statistics

- ²⁸ D'Aguiar, in Annex 3 of this report.
- ²⁹ Martinez and Rodriguez, in Annex 3 of this report.
- ³⁰ Tunç, in Annex 3 of this report.

²⁷ This follows the outcome of the first thematic workshop on Recommendation II.20 of the DGI-2 on data-sharing, summarised in an Inter-Agency Group on Economic and Financial Statistics (IAG) report from March 2017 (IAG (2017)).

on fintech activities.³¹ Both are crucial in monitoring fintech globally. Since there is currently no internationally agreed statistical definition for fintech firms and services, cooperation efforts need to be intensified. For example, around 64% of Latin American and Caribbean (LAC) jurisdictions report that there is no regular cooperation or exchange between authorities on fintech with regard to data or analysis (eg on the development of market structures).³²

3.6 APIs and AI-assisted web search

Since the official data sources (eg administrative or regulatory registers) often lack information, publicly available internet data or data collected from APIs can be used to fill the gaps, as long as they meet the quality criteria for central bank statistics.³³ Automated data-gathering techniques may be cost-effective and relatively easy to undertake, provided that qualified staff are available to programme the necessary tools. How straightforward it is to assess the data quality depends heavily on the cooperation of the internet data providers, and how much effort is involved in assessing and managing data quality issues (Deutsche Bundesbank (2020)).

As a case in point, some central banks report using internet data APIs for collecting data on cryptocurrencies (ECB ICTF (2019)). The ECB has defined cryptocurrencies as "a new type of asset recorded in digital form and enabled by the use of cryptography that is not and does not represent a financial claim on, or a liability of, any identifiable entity". Cryptocurrencies and related activities need to be closely monitored to identify potential implications for monetary policy, and to monitor the smooth functioning of market infrastructures and payments, as well as the stability of the financial system.³⁴

Cryptocurrency indicators tailored to the ECB exercise have been grouped into four categories corresponding to the focal points of its monitoring framework: (i) markets; (ii) gatekeepers; (iii) linkages; and (iv) other (see Table 4). Cryptoasset indicators so far cover largely off-chain transactions and only selectively on-chain ones.

Due to data quality issues, the raw pricing and trading data collected were largely unfit for the purpose of preparing indicators. Typically, data quality problems experienced by data aggregators or platforms arise from technical issues (eg service outages, connectivity errors and unstable APIs), and also misleading names for identifying some market activities. To enhance data quality and identify anomalous or erroneous observations, there is a growing interest in using functional data analysis and machine learning, among other advanced analytical techniques.

- ³³ For example, derived from the public commitment on European Statistics by the ESCB: <u>www.ecb.europa.eu/stats/ecb_statistics/governance_and_quality_framework/html/escb_public_com</u> <u>mitment_on_european_statistics.en.html</u>.
- ³⁴ The analysis of long time series shows that each cryptocurrency appears to follow its own trend in global financial markets, indicating that cryptocurrencies, when included in a portfolio, could be used for hedging purposes. In particular, cryptocurrencies seem to move independently from exchange rates or global stock market indicators; see Kostica and Laopodis, in Annex 3 of this report.

³¹ For a discussion on how to construct statistics on new activities such as crowdfunding, see I Abarca: "Lessons from lending-based crowdfunding in Chile", in Annex 3 of this report.

³² Martinez and Rodriguez, in Annex 3 of this report.

Overview of indicators for cryptocurrencies

Table 4

	Category	Example of indicators	Data sources	
Off-chain	Markets	 Pricing and trading volumes, market capitalisation, trading vis-à-vis fiat currencies (based on granular end-of-day information for all trading pairs on each trading platform) Pricing and trading volumes of financial instruments traded on institutionalised exchanges (futures, exchange-traded products and others offering exposures to cryptocurrencies), exchange rates 	 Cryptocurrency trading platforms; data providers of aggregated information Commercial financial markets data provider 	
	Gatekeepers	 Breakdowns of trading and pricing information aggregated across various metadata items of trading platforms 	JI J JI J	
		 Arbitrage indicators Indicators based on metadata information regarding wallets 	Various online data providers	
		 Indicators based on metadata of the cards supporting cryptocurrencies Indicators based on metadata and some general information about the number of ATMs 		
	Linkages	• Holdings of financial instruments traded on institutionalised exchanges	• Securities Holding Statistics ³⁵	
	Others	 Indicators based on metadata of initial coin offerings (ICOs) and raised funds 	Online data providers	
On-chain		 Indicators based on the number and values of transactions, fees and difficulty Concentration 	Online data providers	
		• Social media, news on cryptocurrencies	Online data providers	
Source: Kocha	inska, in Annex 3 o	f this report.		

3.7 Surveys

Statistical data and publicly available data on the internet do not cover all the topics of interest for financial stability, payments, market infrastructure, analysts and policymakers. To fill these gaps, statisticians may need to use surveys. One additional advantage of surveys is when reporting obligations are difficult to implement, as voluntary surveys of financial intermediaries and financial service users can be used as a complement. Lastly, surveys can be geared flexibly to evolving needs and circumstances – a key issue when facing the rapid pace of innovation witnessed in the financial industry.

In general, surveys can serve to monitor two main areas:

• the financial service providers' side, ie to gather information on fintech companies; and

³⁵ See <u>Securities holdings statistics</u> on the ECB's website for more information.

 the demand side, to learn about the adoption of financial innovation. For fintech, the demand side may typically be other financial firms or non-financial companies or households.

Several central banks have already conducted such surveys. In Portugal, the central bank has "mapped" the fintech market in 2018 and plans to run new surveys. These will be targeted at payment and e-money institutions, as well as at fintech entities, focusing on information that is not available on public data sources such as websites.³⁶

As regards Italy, the Bank of Italy conducted two surveys in 2017 and 2019 on the adoption of technological innovations by banks, non-bank intermediaries active in the markets of payment services, asset management and credit, and by technology providers.³⁷ The questionnaire, which was sent to both Italian and foreign financial intermediaries operating in Italy, collected information on:

- current and planned fintech projects, related investment plans and partnerships (if any) with fintech firms;
- the presence of new professional figures, eg chief innovation officers, and dedicated organisational units focused on the integration of fintech projects into the intermediary's business model and core technology system; and
- perceived opportunities and constraints related to fintech initiatives.

The Swiss National Bank (SNB) also sampled 34 banks with the aim of finding out how digitalisation and fintech are currently influencing banks in the deposits and lending business (SNB (2019)). According to this SNB survey, banks expect a strong level of digitalisation in areas such as payments and mortgage lending as well as internal processes. They view this as a source of opportunities to cut costs and improve service quality. Banks consider that the main risks they face are the erosion of margins and the possible loss of direct customer contact. Generally, banks foresee increasingly fierce competition among the incumbents, which will be further intensified by emerging digital banks and big techs. Most banks are reinforcing the digitalisation of their existing business areas with products and services of the kind typically offered by new market participants including payment apps, the provision of crowdfunding/crowdlending platforms, and robo-advisory offerings.³⁸

Other surveys include the Alternative Finance Industry Benchmarking Survey run by the Cambridge Centre of Alternative Finance (CCAF (2020)), and the many country-level innovation surveys conducted by national statistical offices in the European Union and in Norway and Iceland under the umbrella of the community innovation surveys (CIS)³⁹ – although these are on firm-level innovation and do not focus specifically on fintech. Examples of demand-level surveys are the Bank of Canada's

- ³⁶ D'Aguiar et al, in Annex 3 of this report.
- ³⁷ Branzoli and Scognamiglio, in Annex 3 of this report.
- ³⁸ van Wersch, in Annex 3 of this report.
- ³⁹ See: <u>https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey.</u>

Bitcoin Omnibus Survey⁴⁰ and the Panel on Household Finances⁴¹ conducted by the Deutsche Bundesbank, which recently ran a module on awareness and usage of robo-finance and credit platforms.

3.8 Compulsory reporting requirements and statistics

Regulatory authorities establish compulsory reporting requirements, which are the key to developing statistics, as for instance has happened in Mexico.⁴² One example in this context is information about loans granted by fintechs, eg characteristics of these loans (among others, payments and related guarantees, identification of the lenders, contract date, maturity date, currency, interest rate and destination), as well as client characteristics. As with other financial intermediaries, information on the financial statements of fintech firms is required (cash flows, financial position and consolidated profit and losses). Information about claims is also called for, in particular, quarterly information on the claims of clients against fintech firms (either credit applicants or investors).

Information can also be requested on the characteristics of borrowers applying for loans granted by fintechs, such as geographical location, economic activity to which the resources will be allocated, and fees paid. This goes hand in hand in Mexico with the collection of information about investments made by fintech firms, such as fees paid by the investors, and expected return on investment. In the case of collective securities financing, information could be collected on the expected return on investment, guarantees given on collective financing and secondary market operations carried out by fintech firms. Moreover, information on related persons within fintech firms and information about the solvency of these firms could be required.

Some central banks are already producing statistics based on new reporting requirements. For example, the Bank of Finland has set up a new peer-to-peer and crowdfunding statistics (Kuussaari (2019)). To satisfy the demand from national users for stability analysis and after the Ministry of Finance collected data for 2014–16 to support legislation, the Bank of Finland launched an annual collection of crowdfunding and peer-to-peer lending statistics in 2018, and gained further experience over a period of two years. The lessons learned are: (i) there is keen demand for and interest in these new data, even though volumes are still low; (ii) the market is developing rapidly and new players are emerging, making it a challenge to keep up with the reporting population; (iii) there is a need to invest time in reporting agent cooperation; (iv) experimental statistics can be set up in a cost-effective manner; and (v) profiles of new funding channels are significantly different from traditional bank lending data.

⁴² Avila et al, in Annex 3 of this report.

⁴⁰ See Henry et al (2019).

⁴¹ See: <u>www.bundesbank.de/en/bundesbank/research/panel-on-household-finances</u>. The survey on fintech usage is a one-time module in summer 2019, see von Kalckreuth and Schmidt, in Annex 3 of this report.

3.9 Towards the monitoring of new developments

Identifying fintech developments is key, but challenging. Existing standards and concepts were developed in the past, so they are not entirely useful in identifying new trends. These need to be identified through a variety of tools, which include the monitoring of media and web portals, meeting with fintechs on industry events, and collecting data from alternative data sources.

Once new activities and firms are identified, statisticians can collect the existing information, eg in a database, and make it accessible to analysts in economics, financial stability, supervision and payments departments. This information will be scattered in different repositories, such as registers, financial statement collections, banking statistics, industrial statistics and – if accessible – tax data. Making use of this information will help existing information to be assessed, consolidated and turned into knowledge. Furthermore, it will allow the ongoing transformation process in the financial sector to be tracked. Finally, it can be the basis for gathering additional information via compulsory statistical or supervisory reports or voluntary surveys.

The central bank statistical units can help users to monitor the fintech market in two ways. First, by informing users on the emergence of new firms or new business models (eg as identified through AI-supported web searches); this would facilitate their early detection and analysis of financial innovations and their impact on the economy and society. Second, by providing reliable data for measuring the developments under way, which can be used with a degree of trust that is similar for "traditional" official statistics – considering in particular the Fundamental Principles that govern the production of appropriate and reliable official statistics and adhere to certain professional and scientific standards.⁴³ Good communication and cooperation between statisticians and users is obviously key to ensure these objectives.

4. Recommendations on the way forward

In order to address fintech-related statistical issues, the WG recommends that the central banking community focus on four main areas that relate to the classification of fintech activities; their methodological treatment; their monitoring through statistical frameworks; and the promotion of innovative technological solutions.

4.1 Classification of fintech activities

Central banks should promote the global adoption of a revised classification of economic activities that better takes into consideration fintech service providers, by:

• Supporting the IFC recommendation to revise the ISIC at UN level with regard to section K, as formally submitted to the UNSD in 2019. The ultimate goal is that this section should contain all activities with regard to the full value chain of financial intermediation, and provide all the relevant categories for integrating fintech segments.

⁴³ See <u>https://unstats.un.org/unsd/dnss/gp/FP-Rev2013-E.pdf</u>.

- Conveying this recommendation to the various international forums in charge of
 official statistical methodology, such as the Intersecretariat Working Group on
 National Accounts (ISWGNA), mandated by the United Nations Statistical
 Commission (UNSC) to provide strategic vision, direction and coordination for
 the methodological development and implementation of the SNA, and the IMF
 Committee on Balance of Payments Statistics (BOPCOM), tasked with making
 recommendations on methodological and compilation issues in the context of
 BoP/IIP statistics.
- Considering ways to implement this recommendation for the specific data collection exercises in which the central banking community is involved, including:
- (i) data on payment transactions, not least to better capture fintech entities' participation in payments and settlement services, especially as regards FX/cross-border transactions; and
- (ii) the international banking and financial statistics already compiled by the BIS on behalf of the relevant central bank committees – eg the BIS international banking statistics (IBS), the international debt securities (IDS), and the over-the-counter (OTC) derivatives statistics.

In particular, and given the increasing importance of the services provided by fintech firms on a cross-border basis, it may be useful to consider ways to specifically identify these entities when they are involved in global financial intermediation – including in the context of the FSB global monitoring exercises (FSB (2020)) – and/or among the non-bank financial counterparts of internationally active banks.

4.2 Methodological treatment of fintech activities

Central banks should ensure that the statistical methodologies followed to measure fintech activities adhere to sound professional and scientific standards, in line with the fundamental principles that govern the production of appropriate and reliable official statistics. This calls in particular for:

- Following high standards in terms of timeliness, periodicity, accuracy, quality assurance and transparency (on eg the availability of detailed information, coverage completeness, details of the methodologies used, sources and metadata) when compiling statistics on fintech activities and collecting granular data for this purpose, in line with the principles governing more conventional statistical domains.
- Recognising the importance of international coordination to define commonly accepted methodological guidelines when measuring fintech activities and compiling related statistics. A key objective is to prevent differences between countries' recording of certain activities that arise because of differences in statistical practices, processes or techniques.
- Ensuring that the above-mentioned principles are comprehensively and consistently considered in the context of the already launched international consultations for the preparation of the next versions of the SNA and BoP/IIP standards that form the cornerstone of the international official statistical system.

4.3 Monitoring of fintech through adequate statistical frameworks

Considering the rapid and accelerating pace of technology-driven innovation in financial services and its consequences for financial systems in multiple locations simultaneously, central banks should develop a comprehensive process to continuously monitor the situation and address fintech-related data issues that may arise. Based on the WG conclusions as outlined in Section 3, possible actions to construct fintech statistics may include:

- Setting up a national statistical strategy to develop fintech statistics, if possible in close coordination with all the components of the national statistical system as well as with international statistical standard setters.
- Implementing the various steps described in this report (eg definition, list of fintech firms, linking with existing data, cooperation with other data providing agencies, AI-supported web search, surveys), when seeking to compile fintech statistics in a specific jurisdiction.
- Promoting cooperation and knowledge-sharing to mitigate the "not invented here" syndrome. Such cooperation should involve the domestic counterparts of central banks, in particular financial supervisors and NSOs, as well as their peers in other countries and relevant international organisations. This cooperation could take place through regular meetings and the sharing of experience and data from pilot projects organised under the umbrella of the BIS and the Baselbased committees including the IFC.
- Setting up and sharing among statistical compilers of a globally consistent register/database on fintech activities, not least to facilitate the capturing of their cross-border dimensions. This calls in particular for an active support of those international initiatives to promote global identifiers, such as the Legal Entity Identifier (LEI) endorsed by the G20 (FSB (2012)).

4.4 Promotion of innovative technological solutions for fintech statistics at the global level

As underscored in the various case studies referred to in this report, IT innovation can be instrumental in addressing the statistical challenges raised by the development of fintech activities. To spur such innovation, central banks are invited to:

- Promote technological solutions that can facilitate the compilation of relevant statistics to capture the complex and rapidly evolving universe of fintech services, with a particular focus on payment innovations, the impact of big tech, progress in regtech and suptech, fast-paced electronic markets, trade finance digitalisation, and financial inclusion.
- Cooperate with other domestic and international stakeholders to develop and share/explore adequate IT tools and processes to compile and disseminate fintech statistics, with a view to achieving economies of scale by working together.
- Make available to the international community and possibly to the public the various solutions developed in this endeavour, for instance through the sharing

of IT tools, such as software codes through secure online software repositories,⁴⁴ and/or through active support for the related initiatives sponsored by the BIS Innovation Hub – which aims to identify and develop insights into critical trends in financial technology of relevance to central banks, explore the development of public goods to enhance the functioning of the global financial system, and serve as a focal point for a network of central bank experts on innovation – where it would be possible to share data among institutions.

⁴⁴ The international statistical community including central banks is already sharing such IT tools in the context of the SDMX (Statistical Data and Metadata eXchange) standard for structuring and exchanging statistics (IFC (2016a)).

References

Basel Committee on Banking Supervision (2018): Sound Practices. Implications of fintech developments for banks and bank supervisors, February.

Cambridge Centre for Alternative Finance (2018): 2018 Global Fintech hub report, alternative finance benchmarking reports.

——— (2020): The Global Alternative Finance Market Benchmarking Report.

Deutsche Bundesbank (2020): Monthly Report, March.

Dorfleitner, G, L Hornuf, M Schmitt and M Weber (2017): Fintech in Germany, Springer.

European Banking Authority (2017): *Discussion Paper on the EBA's approach to financial technology (Fintech).*

——— (2018): The EBA's Fintech Roadmap.

European Central Bank Internal Crypto-Assets Task Force (2019): "Crypto-Assets: Implications for financial stability, monetary policy, and payments and market infrastructures", *ECB Occasional Paper Series*, no 223, May.

Eurostat (2008): "Statistical classification of economic activities in the European Community", *Eurostat Methodologies and Working Papers*, NACE Rev. 2.

Financial Stability Board (2012): A Global Legal Entity Identifier for Financial Markets, June.

——— (2017): Financial Stability Implications from Fintech, June.

——— (2018): The use of Regtech and Suptech by firms and authorities: Market developments and financial stability implications.

——— (2020): Global Monitoring Report on Non-Bank Financial Intermediation, January.

Financial Stability Board and Committee on the Global Financial System (2017): *Report* on *FinTech credit,* May.

Henry, C, K Huynh, G Nicholls and M Nicholson (2019): "2018 Bitcoin Omnibus Survey: Awareness and Usage", *Bank of Canada Staff Discussion Paper*, no 2019-10, November.

Inter-Agency Group on Economic and Financial Statistics (2017): *Update on the Data Gaps Initiative and the Outcome of the Workshop on Data Sharing*, March.

Irving Fisher Committee (2015): "Data-sharing: issues and good practices", *IFC Report*, January.

——— (2016a): "Central banks' use of the SDMX standard", IFC Report, March.

——— (2016b): "The sharing of micro data – a central bank perspective", *IFC Report*, December.

(2020): "Central banks and fintech data issues", IFC Report, February.

International Monetary Fund (2018): The Bali Fintech Agenda, October.

Kochanska, U and V Papaefthymiou (2020): "Characterisation of the euro area fintech scene", box in ECB, *Financial Integration and Structure in the Euro Area*, March.

Kuussaari, H (2019): "Setting up new peer-to-peer and crowdfunding statistics – a case study by the Bank of Finland", presentation in the IFC-BNM Satellite on "Statistics on Fintech – bringing together demand and supply to measure its impact".

Swiss National Bank (2019: "Survey on Digitalisation and Fintech at Swiss Banks", August.

United Nations, Department of Economic and Social Affairs, Statistics Division (2008): "International Standard Industrial Classification of All Economic Activities, Revision 4", *Statistical Papers, Series M*, no 4, rev 4.

US Executive Office of the President Office of Management and Budget (2017): North American Industry Classification System.

Van Wersch, C (2019): "Statistical Coverage of Trade Finance – Fintechs and Supply Chain Financing", *IMF WP/19/165*, July.

World Bank (2013): "Crowdfunding's Potential for the Developing World. 2013", infoDev, Finance and Private Sector Development Department.

World Economic Forum (2015a): *The future of fintech: a paradigm shift in small business*, October.

——— (2015b): *The future of financial services*, June.

Annex 1: Mandate – IFC Working Group on Fintech Data Issues

Fintech has been defined by the FSB as technologically-enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services.⁴⁵ It is rapidly modifying the structure of financial markets, by eg fostering new forms of credit (peer-to-peer lending), leading to the emergence of cryptocurrencies, and prompting changes in payments systems. These aspects are impacting on the whole range of financial institutions, especially the banking sector.

Previous work by international financial institutions (eg the FSB, the BIS and its central banks' committees and the IMF) has examined several aspects of fintech, including the total size of global credit, its market structure and type of participants; interlinkages between new fintech firms such as credit platforms and traditional financial intermediaries; and its operational impact (eg cyber security, reputational risks). There are also ongoing initiatives to monitor the development of cryptocurrencies and the related challenges/opportunities.

Good quality data are needed to monitor these issues, especially to assess the impact of fintech growth on financial markets and the associated financial stability risks. But so far analyses have mainly relied on publicly-available sources, leveraging on data collected on an ad-hoc basic from industry associations. Certainly, some regulators (eg Australian Securities & Investments Commission) have started to conduct dedicated surveys among market participants. But there are currently no formal initiatives for compiling public statistics on fintech in a structured and comprehensive way and with a global perspective. Moreover, new and unexpected data needs may well arise as financial innovation evolves further.

Central banks have a key interest in addressing this information gap. Commercial banks' exposures to fintech credit or cryptocurrencies could result in financial stability risks; the rapid growth of fintech might erode the market share of "traditional" institutions and lead to the emergence of new market players outside regulatory perimeters; and innovations in payments systems can pose multiple operational risks for the functioning of the financial system; etc.

Against this backdrop, it is proposed to set up an IFC Working Group (WG) to analyse the data issues raised by the development of fintech and derive possible recommendations for central bank statistics. More specifically, the working group will:

- Take stock of existing data sources, their actual uses and existing fintech data initiatives;
- Assess central banks' additional needs for fintech data and potential use cases;
- Identify key data gaps, and assess the costs and benefits of initiatives to address them;

⁴⁵ Carney, M (2017): "The promise of Fintech – something new under the sun?", speech at the Deutsche Bundesbank G20 Conference on Digitising finance, financial inclusion and financial literacy, Wiesbaden, 25 January.

- Clarify the roles and responsibilities of the various parties that could be tasked to design, collect, collate and maintain statistics on fintech; and
- Provide guidance for developing adequate statistical definitions for collecting comprehensive information on fintech from a global perspective.

Annex 2: Members – IFC Working Group on Fintech Data Issues

Chair and Secretariat

Deutsche Bundesbank	Chair: Robert Kirchner Ulf von Kalckreuth Stephan Mueller Corinna Mueller Norman Wilson
BIS, IFC Secretariat	Jose Maria Serena
Representatives	
Central Bank of Angola	Joel Bumba Sambo Futi
Central Bank of Armenia	Gagik Aghajanyan Lusine Harutyunyan
Statistics Canada	Yves Gauthier
CEMLA (Center for Latin American Monetary Studies)	Anahí Rodríguez Serafin Martinez Jaramillo Raúl Morales Resendiz (up to December 2018)
Central Bank of Chile	Tamara Godoy
European Central Bank	Ioannis Ganoulis
Bank of France	Elisabeth Devys
Bank of Greece	Eleftheria Kostika
Bank Indonesia	Anggraini Widjanarti
Bank of Italy	Nicola Branzoli

Central Bank of Lebanon	Chucri Mouannes
Central Bank of Malaysia	Nur Fazila Mat Salleh
The Netherlands Bank	Raymond Chaudron
Bank of Portugal	Filipa Lima
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Central Bank of the Republic of Turkey	Burcu Tunç
Board of Governors of the Federal Reserve System	Susan McIntosh Hume Elisabeth Holmquist (up to August 2019)

Annex 3: Countries' or institutions' Case Studies on fintech

Contents

Fintech from a national accounts perspective: information from use tables

Raymond Chaudron, Netherlands Bank

Lessons from lending-based crowdfunding in Chile

Iván Abarca, Central Bank of Chile

Mexico's fintech law

Juan Fernando Avila Embriz, Rafael Morales Guzman, Manuel Sanchez Valadez and Mario Alberto Reyna Cerecero, Bank of Mexico

The fintech market in Turkey: statistical implications

Burcu Tunç, Central Bank of the Republic of Turkey

Obtaining fintech statistics: an experience with identifying fintech firms in Spain

Luis Angel Maza and Auxi Moreno, Bank of Spain

Dataset and indicators to monitor the crypto-assets phenomenon

Urszula Kochanska, European Central Bank

Identifying the adoption of technological innovations among financial intermediaries

Nicola Branzoli and Alessandro Scognamiglio, Bank of Italy

An overview of the Costa Rican case and its experience identifying fintech firms

Valerie Lankester and Andrea Oconitrillo, Central Bank of Costa Rica

Dynamic linkages among cryptos and global financial markets: data issues

Eleftheria Kostika, Bank of Greece, and Nikiforos Laopodis, American College of Greece

Fintech and financial inclusion in France: a mapping exercise

Elisabeth Devys, Bank of France

Fintech companies in Canada: opportunities for growth

Alexandre Fortier-Labonte and Yves Gauthier, Statistics Canada

Keeping up with fintech activities in Portugal: working together works

Luís D'Aguiar, Diogo Lencastre, Rita Prior Soares, Cláudia Florentim, Carla Marques, Inês Drumond, João Rodrigues and Nuno Pereira, Bank of Portugal

The South African Reserve Bank's experience with fintech

Anrich Daseman, Barend de Beer and Danie Meyer, Reserve Bank of South Africa

Fintech data cooperation in LAC countries: advances and challenges

Anahí Rodríguez and Serafin Martinez Jaramillo, CEMLA

Fintech at Swiss Banks

Cornelia van Wersch, Swiss National Bank

Digitalisation and adoption of Fintech in Germany: gathering survey evidence on households

Ulf von Kalckreuth and Tobias Schmidt, Deutsche Bundesbank

Fintech from a national accounts perspective: information from use tables

Raymond Chaudron,⁴⁶ Netherlands Bank

Introduction

Data on fintech is difficult to find, especially in macroeconomic statistics. Nevertheless, this case study explores the possibility to use supply and use tables from national accounts to compile information on the importance of fintech. The case study discusses how to identify fintech activities in national account statistics, what this information represents and what the drawbacks in using this data are. The approach is illustrated using the data from a small selection of countries.

Defining fintech from a statistical perspective

Fintech has been defined by the FSB as technologically-enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services. By concatenating financial with technical, the terms aims to signify technical innovations in the financial sector. In economic statistics, fintech is not easily identified. Fintech is not recognised as a sector or an activity (as identified by eg NACE or ISIC), nor are activities defined in combination with a certain user or buyer of the activity. Economic statistics do not measure how transactions are concluded, but only the economic relationship that is established through the transaction. An example is the introduction of online banking, which – in many countries – has replaced personal contacts with clients at brick-and-mortar branches almost completely. While the banks' products and services themselves have not changed, the channel through which they are provided has become 'digitised'.

It is questionable then whether general (macro) economic statistics in their current form will provide a perspective on fintech that is useful for the questions asked by policy makers. Statistical classifications have to be clear, unambiguous and stable through time. Because fintech is changing rapidly, very specialised and experimental in nature, fintech will be fundamentally difficult to capture in a statistical nomenclature. There are a number of initiatives to complement official statistics with details relating to the 'digital economy'. Until these kinds of initiatives are implemented, (macro) economic statistics seem to be of limited use. Nevertheless, some indirect information on fintech might be obtained by using existing statistical information by looking at use tables. These do not provide a direct view of fintech but focus on the inputs used, such as ICT, in the provision of financial services.

Information from use tables from national accounts

A use table provides information on the inputs used for production by industries in an economy. It provides information by industry crossed with products and services. Its major advantage is that it is based on a well-established methodology which has

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been part of the standard business of making economic statistics for many years. In fact, the compilation of a use table is one of the steps in deriving estimates of GDP. The data should therefore be of higher quality than ad-hoc surveys specifically targeted at fintech. Furthermore, because the methodology is harmonised internationally, the data should be comparable across countries and time. It also enables comparisons across industries. The approach could for instance enable a comparison of fintech with eg healthtech, edutech and tradetech.

The identification of financial industries as such is fairly straightforward. Using the ISIC Revision 4 standard, financial services are classified under section K. Section K is further subdivided into three divisions (64, 65 and 66), groups and classes. This detailed classification makes it possible to distinguish distinct activities such as banking, leasing, life and non-life insurance and pension funding. For products/services, it seems logical to start with Central Product Classification division 45 – Office, accounting and computing machinery. Information and communication services/products are classified under the Central Product Classification divisions 83 – Professional, technical and business services and 84 – Telecommunications, broadcasting and information supply services. Some countries publish data in even greater detail. For the sake of this case study, I define fintech in the context of use tables as the use of information and communication services/products in the production of financial activities. It represents the intermediary use of information and communication services.

Supply and use tables have a number of substantial drawbacks for the analysis of ICT intensity. The most important drawback is that the data is not quite as detailed and versatile as certain users might require for the study of fintech. The statistical classifications are fairly broad, even at the most detailed level. Another major drawback is the fact that use tables only identify products and services bought/sold between companies. ICT activities are not identified within financial industries if it takes place in-house. Industries are identified by their primary activity and, in some exceptional cases, a secondary activity. A final drawback is that the statistical community is still discussing how and where to record certain activities that are relevant to fintech. In fact, the latest version of the SNA already recognised explicitly that ICT activities are difficult to measure. Paragraph 5.45, SNA 2008: "This may be regarded as a serious disadvantage for certain purposes, such as analysing the impact of "information technology" on productivity when the processing and communication of information are typical ancillary activities". As the methodological rules on fintech and its influence have not yet been settled, differences between countries' recording of certain activities is likely and the level of detail will remain low. The information value of use tables therefore depends on the implementation of statistical guidelines. As a consequence, for the foreseeable future, differences in ICT-use, especially between countries, are likely to be influenced by differences in compilation methods although it is difficult to judge to what degree.

Data and analysis

Although this note does not aim at an exhaustive analysis of the data, I summarise some notable facts as an illustration of analyses across countries, industries and over time. Table 1 below presents information from use tables for a selection of countries. The percentages indicate the share of ICT products and services as identified in the countries' national accounts in total intermediate consumption for financial industries for 2012-2017. The data indicate that the level of ICT intensity varies considerably between countries.

ICT intensity of finance

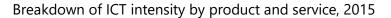
Share of intermediate consumption on ICT products and services (percent)					Table 1	
	2012	2013	2014	2015	2016	2017
Australia	20.9	22.4	22.3	22.6	22.9	23.2
France	9.6	9.6	9.5	9.3	-	-
Germany	6.1	7.7	8.0	7.8	-	-
The Netherlands	5.5	5.4	5.3	5.2	6.4	6.0
Singapore	11.1	12.5	11.9	10.1	-	-
United Kingdom	13.8	13.7	14.6	14.5	14.2	-
United States	4.6	4.8	4.8	4.6	4.7	4.8
Sources: national statistical institutes.						

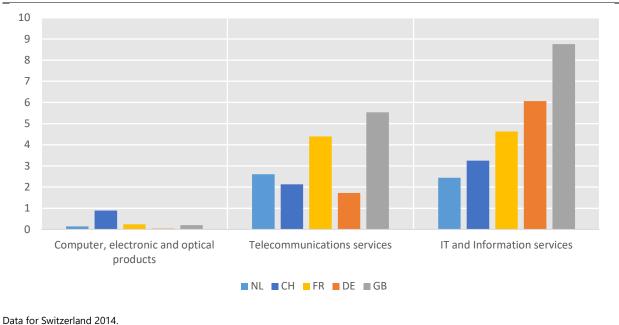
Table 2 for the United States suggests the banking and securities industries are the most ICT-intensive, spending around 10 per cent and 7 per cent of their intermediate consumption on these services. Insurance is the least ICT intensive sector, spending between 1 per cent 2 per cent on ICT. As insurance is an important customer of the other financial services industries, a lot of ICT for insurance companies might also take place there. The average ICT intensity for all financial industries lies just below 5 per cent. The series appear quite stable for all industries, although figures vary from year to year.

ICT intensity of financial sectors in the United States

Share of intermediate consumption on ICT products and services (percent)				Table 2	
2012	2013	2014	2015	2016	2017
9.4	9.9	10.1	10.1	10.2	10.2
6.7	6.9	6.9	7.0	6.7	6.7
1.2	1.4	1.2	1.0	1.4	1.6
2.2	2.6	2.5	2.7	2.8	3.7
4.6	4.8	4.8	4.6	4.7	4.8
	2012 9.4 6.7 1.2 2.2	2012 2013 9.4 9.9 6.7 6.9 1.2 1.4 2.2 2.6	2012 2013 2014 9.4 9.9 10.1 6.7 6.9 6.9 1.2 1.4 1.2 2.2 2.6 2.5	2012 2013 2014 2015 9.4 9.9 10.1 10.1 6.7 6.9 6.9 7.0 1.2 1.4 1.2 1.0 2.2 2.6 2.5 2.7	2012 2013 2014 2015 2016 9.4 9.9 10.1 10.1 10.2 6.7 6.9 6.9 7.0 6.7 1.2 1.4 1.2 1.0 1.4 2.2 2.6 2.5 2.7 2.8

Graph 1 shows the level of ICT use by product or service bought for 2015. Across countries, expenditure on computer equipment is small, amounting to less than one per cent of intermediate consumption. Consumption of telecommunications services in most countries comes second with around 3 per cent. Expenditure on telecommunications varies considerable between countries, though, from 1.7 per cent in Germany to 5.5 in the United Kingdom. Most of the expenditure goes towards IT and information services. Financial industries spend on average 5 per cent on IT services. Here too, the variation is considerable. Spending is lowest in the Netherlands with 2.4 per cent and highest in the United Kingdom with 8.8 per cent.





Share of intermediate consumption on ICT products and services (percent)



Sources: national statistical institutes.

It should be noted again that more analysis is necessary to determine to what extent data from different countries are comparable. The level of ICT intensity as calculated here depends on many country specific characteristics, such as the level of competition in the ICT-market (higher profit margins could conceal lower ICTintensity) and the level of vertical integration.

Reference

Ahmad, N and J Ribarsky (2018): "Towards a framework for measuring the digital economy", paper presented at the 16th conference of the IAOS.

Lessons from lending-based crowdfunding in Chile

Iván Abarca,47 Central Bank of Chile

Motivation

Crowdfunding is a framed fintech practice of raising funds from people. There are different ways to classify crowdfunding depending on both the retribution to the funder and the motivation to get funds from the fund recipient.⁴⁸ Financial authorities pay attention to lending- and equity-based crowdfunding since both have similarities with capital markets. Indeed, fintech credit can increase competition in lending as well as it could benefit market structure by complementing the role of traditional finance (FSB (2017)). Nevertheless, it has the potential to undermine financial stability through operational risks and authorities' ability to monitor this activity, which may be outside the regulatory perimeter, among other causes.

Lending- and equity-based crowdfunding promote financial inclusion since they are a new source or wave of financial assets. Moreover, access to invest in projects was commonly limited to a small number of users (Jenik et al (2017)).

Lending-based crowdfunding or Peer-to-Peer (P2P) lending is the most extensive in amounts and users. Its functioning is simple: a fund recipient is a creator of a project, which needs funds from people, then they become debt issuers; on the other hand, funders will receive interest for their inflow; consequently, they represent investors. The way to link those users is through platforms or funding portals: they publish the projects and provide a user-friendly interface to investors to lend under specific requirements. Those users benefit from each transaction, but there are both financial and operational risks to observe (Table 1). Likewise, Graph 1 depicts the relationship between them.

A diagnosis of this activity is needed to study any policy and regulation. In this regard, financial authorities would require some understanding of lending-based crowdfunding operations: users, statistics, interest rates, and other data of interest.

Chilean crowdfunding is quite intensive in lending. By 2017, almost 95% of the amounts, and 75% of projects belong to this category (Abarca (2020)). This case study comments on the statistics generated from P2P lending in Chile, compares them with relevant references and elaborates on the primary policy responses under development.

Statistical implications

Chilean crowdfunding has a sizeable relative volume, especially in terms of peer-topeer lending platforms (Herrera (2016)). Synthesised data from transactions, extracted by platforms' webpages, indicate the latter. However, only enterprises can access to P2P lending.

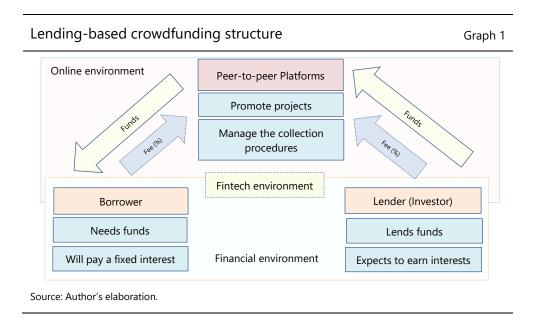
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⁴⁸ Crowdfunding can be classified according to the underlying transaction of the funder and fund recipient: donation, reward, lending-based or equity-based. World Bank (2013) proposes the first two as a donation and the other two as an investment.

Moreover, platforms define their credit risk policy, so they require issuers to guarantee their loans. For any loan, platforms explicitly indicate what guarantee is available for each loan request. There are three types of guarantees: (i) invoices, then platforms operate as a factoring enterprise in terms of the liquidity provider, and later the payment to investors comes from the sum of the mentioned invoice; (ii) services of a specific society that sells guarantees, called Mutual Guarantee Institutions (MGIs) or companies, so they backup loans in case of default; and, finally, (iii) other eligible guarantees as insurance or mortgages.

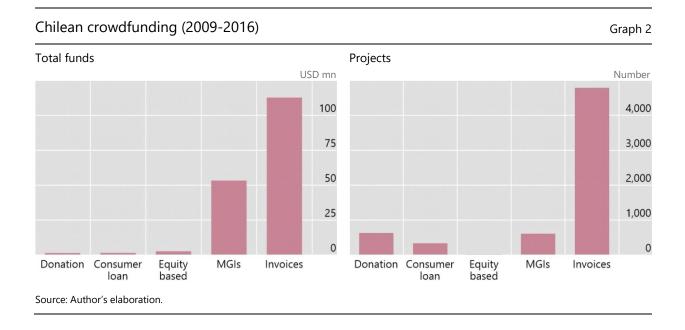
We can observe that 97.6% of the amounts refer to loans, of which 96.7% rely on Small and Medium Enterprises (SMEs) through invoices or MGIs. However, donations and capital contributions present a more significant weight in terms of transactions (projects), but lower in terms of amounts. The average financing of a project varies considerably according to its modality. Regarding projects, the average for loans from invoices is CLP 16 million (approximately USD 25,000), for loans backed by MGIs it is CLP 59.4 million (USD 91,000), for equity crowdfunding it is more than CLP 100 million (USD 160,000) and for donations it is closer to \$1.5 million CLP (USD 2,300). Graph 2 summarises a description of crowdfunding in Chile. Due to its size, from now on, we will focus on SMEs' loans.

	Benefits	Risks
Investors (Lenders)	Investment optionFinancial inclusionReturn on investment	 Credit risk Fraud risk Legal risk Cyber risk
Creators (Borrowers)	BenefitsLiquidity provisionOption to lower funding costsPublicity about brands/projects	Risks Misconduct risk Liquidity risk Cyber risk Legal risk
Platforms	BenefitsFees from creators and investorsAd hoc regulation	Risks Compliance risk Reputation risk Operational risk



A critical issue to take into account is the interest rate of the loans mentioned above. Weighting by the value of loans, we observe that P2P lending crowdfunding has had an interest rate for SMEs of 13.4%. From the latter, loans guaranteed by invoices show a rate of 13.9%, and those insured by MGIs a rate of 13.3%. Table 2 displays descriptive statistics of the interest rate of loans leveraged by crowdfunding. Now, users must consider that platforms charge a transaction fee to both investors and borrowers; that rate can be from 2.9% to 10.2% depending on the characteristics of the loan (Abarca (2020)).

As a reference to the Chilean banking system and the access to credit for SMEs, the Superintendence of Banks and Financial Institutions (2015) reported on the rates segmented by business size. The results show gaps between large firms and SMEs. An update was done in 2017 to see whether this gap prevailed, and the supervisor pointed out that this difference in rates is "significantly greater than applied in OECD countries". Overall, P2P lending could be an attractive alternative to finance projects – yet, the credit risk standards are distinct in comparison with the traditional lending.



P2P lending in Chile: statistics o	Table 2	
	MGIs	Invoices
No.	610	4,789
Min	8.0	6.7
Р5	11.0	11.0
Q1	12.0	13.0
Median	13.2	13.9
Q3	15.0	14.4
P95	17.0	16.8
Max	27.6	30.3
Average	13.5	13.7
Weighted average	13.3	13.9
Standard deviation	2.0	1.7

Response

The Financial Stability Report launched by the Central Bank of Chile (2018), in its special chapter dedicated to technological innovations and financial stability, indicated that crowdfunding platforms centralise the majority of the Fintech activity. Despite being a regulated activity in other jurisdictions, a regulatory gap prevails that is part of the agenda of the Chilean financial authorities.

Then, there is a general understanding that bringing some Fintech activities into the regulatory perimeter would be appropriate. In this regard, the Financial Market Commission (2019) recently published a "white paper", which outlines its vision on the importance of having a regulatory framework for crowdfunding and other services (eg, crypto-assets or robo-advisors). That document is shown as a relevant input to advance to a Fintech draft bill – although that project has been announced, it is not yet submitted.

The Chilean Fintech association has also expressed its willingness to have a regulation that contributes to greater competition and stability in the industry. In this sense, the proposal they have expressed is a flexible (that is, adaptable to technological changes that have not yet been seen) and technology-neutral regulation (that regulates the effects and not the technology itself).

Lessons

Any fintech activity is born under the preference of its users. This case study shows that crowdfunding in Chile has had considerable development even though it has been unregulated. For the time being, the lack of regulation has not caused significant issues for the activity, but it may raise operational and financial risks.

International experience is underlining the importance of regulating crowdfunding, and suggests that P2P lending can be a key source of both investments and loans. Observing the practices of other countries could be recommended to think about which practices and behaviours the policymaker desires to avoid and which ones to promote. Chile has made progress on this path, but there are still steps to be taken to achieve specific and agreed purposes.

From the data, we observe that crowdfunding is intensive in SMEs, possibly due to a low funding cost from P2P lending. Indeed, the interest rate can be attractive to all parties involved since each one makes a profit under normal conditions (Graph 1). Moreover, technology facilitates such a transaction, but it does not exempt the risks. Indeed, it can even increase them (eg, fraud risk). In this way, users must not ignore such characteristics in their lending operations.

For the same reason, financial stability issues may emerge due to loans that have different credit risk standards and are, at the same time, investments for one of the parties. A simple example would be the legal basis or eventual enforcement of swapping out an invoice provided by the borrower in its loan.

Still, statistics are needed. This study generated them by extracting directly from the platforms (each loan requirement), and although they may seem obsolete (as of 2016), it is the most up-to-date information available. If an authority requested details of transactions and users, we could characterize P2P lending better.

References

Abarca, I (2020): "Development of crowdfunding initiatives in Chile", in Annex 5 of this report.

Central Bank of Chile (2018): Financial Stability Report, First Half.

Financial Market Commission (2019): White Paper. Lineamientos Generales para la Regulación del Crowdfunding y Servicios Relacionados, February.

Financial Stability Board (FSB) (2017): *Financial Stability Implications from Fintech. Supervisory and Regulatory Issues that Merit Authorities' Attention*, June.

Herrera, D (2016): "Alternative Finance (Crowdfunding) Regulation in Latin America and the Caribbean. A Balancing Act", *Discussion Paper no 480*, Inter-American Development Bank.

Jenik, I, T Lyman and A Nava (2017): "Crowdfunding and financial inclusion", CGAP Working Paper, March.

Superintendence of Banks and Financial Institutions (2015): *Informe sobre condiciones de crédito a empresas por tamaño*, Santiago, Chile.

Mexico's fintech law

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Background

The development of new technologies and their application in providing financial services has accelerated significantly. These innovations can bring important benefits to final users by reducing costs in the provision of these services and fostering greater competition by lowering entry barriers, which, in turn, could result in a greater variety of services and in lower prices for end-users. As a result, new firms have entered into financial markets providing innovative services with high added value for consumers. However, without proper regulation, these innovations could also generate risks in the financial system.

In March 2018, the Mexican Congress issued the Financial Technology Law (Fintech Law). Mexico's approach is distinct from other jurisdictions regarding how the fintech sector is regulated. Instead of recognising fintech companies under some existing statute, regulators decided to create a unique tailored framework for those new companies.

Contents of the law

Considering the dynamic nature of the fintech industry, the Mexican Law is principlebased, leaving to financial authorities powers to draft secondary regulation with specific details.⁵⁰ Such principles are: i) financial inclusion and innovation; ii) consumer protection; iii) promotion of competition; iv) financial stability; v) the prevention of illicit activities (money laundering) and vi) technological neutrality. The main objective of the Fintech Law is to establish a level playing field for fintech companies to operate in conditions that benefit end-users of financial services, while mitigating potential risks that the operations of fintech firms could generate in the financial system.

In that sense, the Law shares common elements with the prudential regulation of traditional financial intermediaries, such as consumer protection clauses (disclosing the risks, as well as minimum standards of protection of personal data), information disclosure requirements, and provisions to prevent financial stability risks.

This framework gives certainty to industry participants, provides guarantees to the users, and allows fintech companies to compete within the financial sector formally. It also enables the sharing of data by financial institutions through public Application Programming Interfaces (APIs) and contemplates a trial space for pilot models similar to the Sandbox models set up around the world.

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⁵⁰ Banco de México and other financial authorities have issued between 2018 and 2019 other regulatory requirements, concerning issues such as minimum capital, limit of guarded resources by customers, financial statements and disclosure of financial information, accounting and business plan and hiring by third parties.

In particular, the Fintech Law in Mexico establishes the minimum requirements for the authorisation, organisation, and operation of these firms that offer financing, investment, payments, or transfer activities through alternative means of access, such as Internet, interfaces, or any other electronic or digital mean of communication. These institutions are categorised depending on their core business into Collective Financing Institutions⁵¹ and Electronic Payment Funds Institutions.⁵²

A relevant element of the Law is the creation of a regulatory framework similar to a Regulatory Sandbox, which is a trial space for innovative models in a controlled scenario. Under this "sandbox scheme", a temporary authorisation is granted for a maximum period of two years, to authorised fintech companies, financial institutions or companies allowed to test new products and services in a limited risk environment with lower regulatory costs. The concept of a regulatory sandbox has been successful in other jurisdictions.

The Fintech Law also includes the concept of Open Banking and requires all institutions within the financial system, including fintech companies, to establish APIs which are a set of computing protocols for building software applications. The purpose of requiring APIs is to allow access and connectivity within financial institutions to share users' open financial (aggregated) and transactional data (the latter with users' consent); and offer optimal services and products by improving their websites and mobile apps. APIs in the financial system allows for the facilitation of secure transactions between institutions, the analysis of market data and risks, and payment processing.

Information requirements

In order to properly assess the main financial risks that may occur within this new sector, it is important for financial authorities to get information on fintech firms and their operations. In this regard, Banco de México and the National Banking and Securities Commission (CNBV by its name in Spanish) are the main authorities responsible for collecting and analysing information on financial institutions.

Accordingly, CNBV and Banco de México are currently coordinating efforts in order to design the information requirements for fintech firms, which will be implemented once CNBV authorises fintech firms. In this regard, some information requirements about crowdfunding and electronic payment for institutions under the responsibility of the CNBV are ready to be implemented once these firms start receiving their corresponding authorisations to operate.⁵³

Some of these requirements are related to the value of the assets, liabilities and capital of fintech firms. CNBV is also planning to collect information about loans given by these institutions. In particular, fintech firms will report information related to the characteristics of these loans (among others, payments and related guarantees,

⁵¹ Collective Financing Institutions are institutions that bring together investors with debtors and entrepreneurs that offer in exchange equity, co-ownership or royalties, through electronic or digital means, typically via internet platforms.

⁵² Electronic Payment Funds Institutions are e-money companies that offer issuance, administration, accountability, redemption, and the transfer of electronic payment funds through electronic or digital means.

⁵³ The information requirements are available on the CNBV web page (available only in Spanish): https://www.cnbv.gob.mx/Anexos/Anexo%2018%20Fintech.pdf.

identification of the lenders, contract date, maturity date, currency, interest rate and destination), as well as the features of clients. As with other financial intermediaries, fintech firms will be required to report their financial statements (cash flows, financial position and consolidated profits and losses). Finally, information about claims will be required, in particular quarterly information regarding claims of clients of fintech firms (either credit applicants or investors).

Even though some information requirements are ready to be implemented, both CNBV and Banco de México are still designing future requirements. In particular, CNBV is considering whether it should require information on the identification of financing applicants, such as geographical location and economic activity to which the resources will be allocated, and fees paid, among other information.

CNBV is also planning to collect information about investments made through fintech firms, such as fees paid by investors or expected return on investment. In the case of crowdfunding,⁵⁴ CNBV is planning to collect information on the expected return on investment and guarantees given on collective financing and information about secondary market operations carried out by fintech firms. Finally, CNBV will require information on related persons within fintech firms and information about the solvency of these firms.

Banco de México will be responsible for collecting data with a high degree of granularity. In particular, Banco de México will require fintech firms to report information about transactions on the repo market, purchase and sale of securities. As part of its functions as a Trade Repository for Derivatives transactions, Banco de México will collect data on derivative operations (futures, forwards, swaps and options), including information about contracts, prices, payments, counterparties and guarantees.

Additionally, for Electronic Payment Funds Institutions, Banco de México will require information on the operations at a transactional level, electronic payments funds accounts, payment services provided by these institutions, as well as any identified fraud operations or management of funds involved in a claim by a customer.

To comply with the Law on Transparency and Management of Financial Services, Banco de México is planning to collect data on fees charged to their customers by fintech firms.

Finally, Banco de México is planning to collect detailed financial information by economic sector, which will be useful to construct monetary aggregates, as well as for the elaboration of statistics and financial indicators.

Final remarks

Fintech activities in Mexico are still under development and their importance within the financial sector is small. Nonetheless, the legal framework has been established to regulate these intermediaries and promoting the preservation of financial stability. Regarding information requirements, even though some of them are ready to be implemented, a large portion of these requirements are still in the planning stage but will be ready when CNBV grants authorisations.

⁵⁴ The practice of funding a project or venture by raising many small amounts of money from a large number of people, typically via the Internet.

The fintech market in Turkey: statistical implications

Burcu Tunç,⁵⁵ Central Bank of the Republic of Turkey⁵⁶

Fintech activities are growing in size and hence in importance. Their (possible) effects on financial intermediation and financial stability attract attention from authorities, creating a need for good quality data. Against this backdrop, this paper aims to summarise the developments of the fintech market in Turkey and illustrate its implications for central bank statistics with a focus on financial accounts and monetary statistics.

1. Fintech universe in Turkey

Having a young population with a well-developed securities market and experience in attracting foreign capital, Turkey is considered to be one of the emerging fintech hubs. As of May 2019, there are 428 fintech firms specialised in a broad range of activities including payments, corporate financing, insurance and crypto (Table 1).

Fintech universe in Turkey		
Number of firms ^{1,2}		Table 1
	2017	2019
Payment	138	159
Corporate Finance	55	69
Banking	40	62
Financing	26	30
Insurance	15	30
Investment	9	12
Crowdfunding	6	8
Personal Finance Management	5	6
Crypto (Fintech)	4	38
Big Data	3	4
Hubs & Others	2	5
Wealth Management	1	4
Asset Management	1	1

¹ Fintech companies operating in Turkey. ² Government and bank subsidiaries are not included. Source: startups.watch.

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⁵⁶ The views expressed are those of the author and not necessarily the views of the Central Bank of the Republic of Turkey (CBRT).

Comparing the number of fintech firms between 2017 and 2019 shows:

- number of firms are increasing in all business areas resulting in an increase in total number of firms from 305 to 428
- payments continued to be the leading business area followed by corporate finance and banking
- crypto market has the highest growth during that period and became the fourth largest business area in 2019 in terms of number of firms.

In addition to the increasing number of firms in fintech market, there is a digital transformation going on in commercial banks, too. To be able to keep their market share, commercial banks are adapting to changes in financial intermediation by (i) cooperating with or taking over fintech startups; (ii) producing technology; (iii) developing new business models (eg banks with no physical branches, mobile banking), and (iv) increasing cybersecurity.

2. Identifying data needs

The financial services provided by fintech firms either change the channel through which the service is given (eg replacing physical branches with digital banking) or create new instruments like electronic money and crypto assets. The importance of fintech activities for central bank statistics, on the other hand, depends on whether the services offered by these firms are included into financial statistics, whether they are classified correctly and whether these developments affect financial stability.

Thus, fintech developments are relevant for financial statistics if (i) the emergence of new business models results in new types of instruments and/or the (ii) changes in financial intermediation affect financial stability. This section is devoted to the identification of the data gaps resulting from fintech developments in Turkey based on the aforementioned criteria.

Turkish fintech ecosystem is largely dominated by electronic money and payment institutions followed by insurance and crypto-asset-related services while new types of instruments may be developing – eg electronic money and crypto assets. The treatment of fintech institutions in sectoral classification is another challenge to be considered. Digital financial services provided by commercial banks, on the other hand, are included in the financial statistics through banks' balance sheets and do not create new type of instruments.

Data needs arise from the effect of fintech activities on financial stability. But they also depend on the degree of market concentration, exposures of financial institutions to crypto assets and whether these institutions are in or outside of the regulatory area. In Turkey, despite the rapid increase in the number of fintech institutions, the financial system is still dominated by traditional banks and nonfintech non-bank financial intermediaries, suggesting no financial stability risk from fintech activities. Yet, electronic money and payment institutions are regulated, and hence obliged to report regularly to regulatory authorities.

3. Implications for central bank statistics

Money, credit and banking statistics

Electronic money – *there is no data gap but there is a room for enhancement through changing the presentation*

Electronic money is issued against central bank money, meaning that the total amount of money issued is stable. The mechanism is as follows: the amount that will be converted to electronic money is transferred from a bank account to an electronic money institution, causing a corresponding decrease in deposits. The volume of electronic money issued and used by the clients have the same effect as a withdrawal of deposits on monetary aggregates – neutral if that amount is deposited to another resident money holder sector's account and negative if the amount is taken outside of the banks. The volume of the electronic money issued but not used by the clients, on the other hand, is considered as excess funds and the legislation in Turkey requires electronic money institutions to hold such excess funds in a bank account. In that case, that amount is included into deposits and the effect on money supply will be neutralised.

Hence there is no data gap for the volume of monetary aggregates. Yet, the monetary statistics can be enhanced by representing the electronic money holdings of residents as a memo item to reflect the portion of the money supply issued by electronic money institutions.

Other digital financial services – there is no major data gap

Although financial intermediation is being more and more digitalised, traditional banks lead the process in Turkey and hence the related transactions are included into the financial statistics through the reporting of traditional intermediaries.

Financial accounts

Recording of electronic money institutions and electronic payment institutions – *enhancement is needed*

According to the European System of National Accounts (Eurostat (2013)), electronic money institutions principally engaged in financial intermediation should be included in sector S.122 (deposit-taking corporations except the central bank) while payment institutions (facilitating payments between buyer and seller) are classified in S.126 (financial auxiliaries). However, these institutions can hold both electronic and payment licences. In this case, the Manual on Monetary and Financial Statistics (IMF (2008)) suggests classifying these institutions in S.122 if they incur liabilities against the issuance of electronic money and in S.126 if they are primarily involved in the operation of electronic payment mechanisms.

Currently, positions of these institutions are included into the financial accounts through their transactions with the banking sector and classification is made by reporting institutions. The statistics can be enhanced by using regulatory data (balance sheets directly reported by these institutions) instead of counterparty information. The use of regulatory data will improve the quality by both increasing the accuracy of the sectoral classification and including all the positions held by these institutions (instead of the positions vis-à-vis the banking sector only).

Recording of crypto assets – further research is needed

The MFSM states that bitcoins are classified as non-financial assets and hence crypto assets are not included in financial accounts. Currently in Turkey, these assets are held for speculative purposes and they are not accepted as medium of exchange. However, with the increasing interest for these assets, further research is needed on their use as medium of exchange or store of value and the recording of these assets should be adapted to any changes in their uses.

Conclusions

Fintech is affecting financial intermediation by creating new businesses and business models, in turn leading potentially to data gaps and implications for monetary and financial statistics. These developments are more relevant for central bank statistics if they create new types of instruments and sectors and if they affect the financial stability.

This short analysis of fintech developments in Turkey reveals that there is a room for enhancement in both the presentation and coverage/data sources of monetary and financial statistics. Additionally, developments in the market and related research (especially on the use of crypto assets) deserve to be followed closely in order to make timely improvements to existing statistics.

References

Claessens, S, J Frost, G Turner and F Zhu (2018): "Fintech credit markets around the world: size, drivers and policy issues", *Quarterly Review*, September.

Cambridge Centre for Alternative Finance and Academy of Internet Finance (2018): "The future of finance is emerging: new hubs, new landscapes", *Global Fintech Hub Report*.

CESifo (2016): "The emergence of the global fintech market: economic and technological determinants", *Working Paper Series*, no 6131, August.

Committee on the Global Financial System and Financial Stability Board (2017): *FinTech credit: Market structure, business models and financial stability implications,* May.

Deloitte, Fintech İstanbul and BKM (2017): Fintech Ecosystem in Turkey, April.

Eurostat (2013): European System of Accounts ESA, 2010, Luxembourg.

International Monetary Fund (2008): "The monetary and financial statistics manual and compilation guide".

Lagarde, C (2019): "The next steps for international cooperation in fintech", June, Opening remarks at the IMF G20 High Level Seminar "Our future in the digital age" Fukuoka, Japan.

Obtaining fintech statistics: an experience with identifying fintech firms in Spain

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Against the backdrop of the digital revolution, the emergence of both new technologies in the provision of services in the financial markets and alternative operators poses a significant challenge to national and international statistical authorities in terms of characterising and quantifying the fintech phenomenon. In addition, the lack of a commonly accepted definition of the fintech industry and business in methodological manuals is one of the reasons why official statistics have so few data on fintech. Similarly to other countries, Spain has no official register of fintech firms, since some of their activities do not require registration with a supervisory authority. This, together with continuous fintech innovations, has hampered the construction of an exhaustive census of fintech firms.

The duties assigned to the Banco de España in the institutional organisation of the production of national statistics include the compilation of the contributions to the Financial and Non-Financial Accounts of the financial sector in the National Accounts and the dissemination of the database on the sectorisation of the Spanish economy⁵⁸ (data on the institutional sectors of the National Accounts). Within this remit, the Statistics Department of the Banco de España has considered it appropriate to launch a first initiative on the fintech industry in Spain, with a view to establishing the bases for production of regular statistics on this segment of the financial industry so as to measure and monitor its development.

The methodology used to identify fintech firms in Spain in this first analysis has been to build a database, drawing on information available from various public and private sources: the Spanish National Securities Market Commission (<u>CNMV</u>);⁵⁹ industry associations (such as the Spanish Fintech and Insurtech Association⁶⁰ and the Spanish Crowdlending Association);⁶¹ and private consultancy firms (Finnovating).⁶²

Although these results are only preliminary, since this fintech identification project is still under way, they may serve to obtain an initial characterisation of the demographics of fintech firms in Spain.

On the latest information available, as of October 2019, the sample of fintech firms operating on the Spanish market has a population of almost 400. Table 1 shows a breakdown of those firms grouped under four main business categories: (i) crowdfunding/crowdlending and loans; (ii) payment and currency exchange services; (iii) investment services; and (iv) other related financial activities.

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- ⁵⁸ <u>https://app.bde.es/sew_www</u>.
- ⁵⁹ List of crowdfunding platforms: <u>https://www.cnmv.es/Portal/Consultas/Plataforma/Financiacion-</u> <u>Participativa-Listado.aspx?lang=en.</u>
- ⁶⁰ <u>https://www.asociacionfintech.es/</u>.
- ⁶¹ <u>http://acle.es/.</u>
- ⁶² <u>https://www.finnovating.com/</u>.

The first category, the largest in the sample, comprises some 130 firms that are mainly engaged in lending to households and firms and obtaining funding through online platforms (crowdlending or crowdfunding). There are about 80 firms providing payment and currency exchange services, and approximately 70 fintech firms engaged in investment services (equity capital and financial advisory). The fourth category, which covers all other related activities (mainly including firms providing technology services and those engaged in insurance brokerage), comprises 120 firms.

Spanish fintech firms. Breakdown by business segments	Table 1
	Number of firms ¹
1. Crowdfunding/crowdlending and loans	131
2. Payment and currency exchange services	81
3. Investment services	67
4. Other related financial activities	120
TOTAL	399
¹ Figures at October 2019.	
Source: Authors' calculations.	

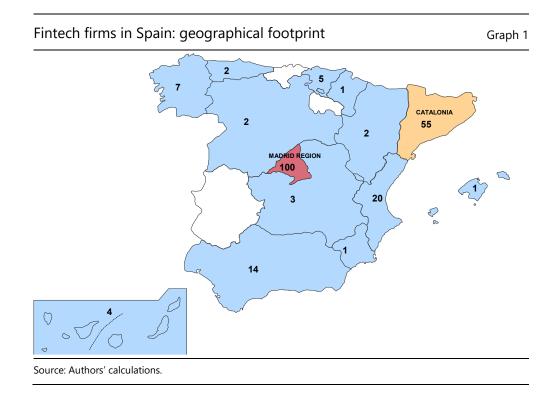
Although this compilation of data may provide important information for a first characterisation of the fintech phenomenon, it is important to note that this preliminary list is a simple aggregation of trade names and references to web pages. Accordingly, the primary sources used provide no data on firms' names, which hampers their identification. In addition, this preliminary database has no information that allows a distinction to be drawn between firms that are resident in Spain and firms that are resident abroad (ie firms that provide remote services in Spain through online portals or applications).

To remedy the data shortfall that these primary data sources entail for statistical purposes, the fintech identification exercise was organised in three stages. First, all the firms' web pages were individually searched for corporate references (company names), by browsing the commercial information available manually. As a result, the company names and tax identification numbers of approximately 250 firms resident in Spain were found, and some 30 foreign firms were identified. For the remaining 120 firms in the sample no minimum reference data were found to enable their identification, since in many cases the commercial web pages were no longer active. This is not unusual, given the low survival rate of businesses linked to small start-ups in their first years of operation.

In a second stage, for the subset of firms resident in Spain and for which a tax identification number had been found, the individual annual financial statements deposited in the Mercantile Registers were obtained. The aim was to extract information, eg qualitative and quantitative variables, permitting an initial assessment of the business demographics and of the significance of this new segment of the financial industry in the Spanish market.

Access to firms' annual accounts makes available identification data such as registered office, corporate purpose, Spanish National Classification of Economic Activities (CNAE) code or ownership structure. An initial exploitation of these data (see Graph 1) shows the geographical footprint of fintech firms, which extends across

almost the whole of Spain, albeit being highly concentrated in the Madrid region and in Catalonia (they host 100 and 55 fintech firms, respectively).



In turn, access to sample firms' balance sheet data, income statements and annual reports makes it possible to draw a more accurate picture. In terms of balance sheet volume, the total assets of the fintech sample aggregate amounted to almost €1,000 million at end-2018. Compared with the overall asset balance of the Spanish financial sector (over €4.7 trillion) this may be considered small in absolute terms. It should be noted, however, that in many cases the financial brokerage business carried out by fintech firms has no direct financial impact on their accounting statements, as they simply put lenders in direct contact with borrowers and receive income for the services provided. Accordingly, the significance of this business segment in terms of the financial flows channelled could be underestimated.

Regarding staff numbers, at end-2017 the fintech firms in the sample had around 2,500 employees. The breakdown by fintech segments shows that the other related financial activities category has the highest numbers in all three indicators assessed for the sample.

Our database also includes information on fintech firms' ownership structure, to allow characterising their form of ownership or shareholding. Most of the firms in the sample report no information on the existence of parent companies, and may therefore be considered to be unrelated to business groups. This could be due to business demographics, as small or medium-sized firms are set up as a result of entrepreneurial business initiatives. However, 15 firms were identified that belong to non-resident companies, and five that belong to large Spanish financial groups, which would suggest an interest on the part of traditional financial players in the development of this new market segment.

Access to firms' annual accounts also provides access to their CNAE code, as a result of the self-declaration made by firms when depositing their accounts, when

they indicate which has been their main activity in the course of the past financial year. Based on this information, the sample firms operate predominantly in information technology, computer services, consultancy and online portals.

However, from a statistical standpoint, the information obtained from the CNAE code is relevant but not determinant when it comes to assigning firms to statistical classifications of activities and products. This is because, in order to correctly assign an institutional unit, the specificities of what are, in some cases, multiple activities pursued by firms must be known. In the case of fintech firms, the usual challenge of determining a robust statistical classification for firms is exacerbated by the limitations and lack of definition of the statistics manuals themselves, in view of the difficulty to update their content to reflect the new reality stemming from the use of new technologies. One such example could be the lack of guidelines in the National Accounts or Balance of Payments manuals on the treatment to be given to cryptocurrencies (are they financial or non-financial assets?) and the firms that produce (are they mining companies?) or sell them.

The last stage of this ongoing project is to complete the institutional classification of these firms in the area of National Accounting, with a view to correctly assigning them to the financial/non-financial sectors of the economy. To that end, a protocol of action has been defined for an exhaustive, in-depth analysis of the characteristics of all the firms selected previously, focused on: the main activity included in their net turnover, their corporate purpose and the nature/composition of their balance sheet assets. In this way, they may be systematically and correctly assigned to the corresponding institutional sectors: (i) financial institutions (S.12) or (ii) non-financial corporations (S.11).

The first results obtained in this area have identified some 40 firms that have been classified in the financial sector (S.12), as financial auxiliaries (this category includes mainly crowdfunding and crowdlending platforms), electronic money institutions, payment institutions and securities brokers/dealers. Future classification efforts will concentrate on the remaining 210 firms, seeking to identify those that provide financial services so that they may be assigned to the financial sector. However, many of them will remain in the non-financial corporations sector, since they are engaged strictly in technology business.

To conclude, this note seeks to report on the recent experience of the Statistics Department of the Banco de España in its endeavour to address the problem of identifying fintech firms in Spain. The aim is to make it possible in the future for statistics to be compiled regularly for use by analysts, and to monitor the development of this growing market segment. For the time being, however, the size of the Spanish fintech industry may be considered not material, compared with the size of the financial sector overall.

Dataset and indicators to monitor the crypto-assets phenomenon⁶³

Urszula Kochanska,⁶⁴ European Central Bank

Measurement aim

With significant potential to have an impact on the global financial system, cryptoassets and related activities need to be closely monitored. Taking a central bank perspective, such monitoring is important to identify potential implications for monetary policy, the smooth functioning of market infrastructures and payments, and the stability of the financial system. The European Central Bank (ECB) has been analysing the crypto-assets phenomenon,⁶⁵ and in this context has adopted a stepwise approach toward the development of a monitoring framework, with a dedicated dataset and indicators as the focal point. Three aspects of the establishment of the crypto-assets dataset have been crucial:

- the definition of crypto-assets;
- the identification of a range of monitoring needs and the collection of available data following a review of various data sources;
- the preparation of the indicators on the basis of the cleaned and improved data following consistent methodologies.

To ensure the consistency of its analysis over time while remaining technologyneutral, the ECB has chosen to define crypto-assets as "a new type of asset recorded in digital form and enabled by the use of cryptography that is not and does not represent a financial claim on, or a liability of, any identifiable entity". ⁶⁶ This definition led to the clear identification of a range of monitoring needs which were juxtaposed with the review of available data.

Monitoring needs cover developments in the crypto-assets ecosystem and also, importantly, in the linkages between crypto-assets and the financial system and economy which may constitute risk propagation channels. Another important area of monitoring is the gateway function, which covers intermediaries which enable and facilitate the interconnections between crypto-assets and the economy and financial system (eg crypto-asset trading platforms or wallet providers).

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- ⁶⁵ In 2018 the ECB established the Internal Crypto-Assets Task Force (ICA-TF), with a mandate to deepen the analysis of crypto-assets. For a summary of the outcome of the ICA-TF's analysis, see: ECB Internal Crypto-Assets Task Force (2019) and ECB (2019).
- ⁶⁶ See ECB Internal Crypto-Assets Task Force (2019).

⁶³ Based on the paper "Dataset and indicators to monitor the crypto-assets phenomenon" in the annex of this report. The views expressed in the case study are those of the authors and do not necessarily reflect the views of the European Central Bank. Any errors and omissions are the sole responsibility of the authors.

Statistical process

Crypto-asset dataset

The crypto-asset dataset was created based on selected data using automated procedures and big data technology. A review of publicly available third-party aggregated yet granular data (provided by commercial and non-commercial data sources) was undertaken in the very first step of setting up the dataset. The data were screened for availability of granular information, completeness of coverage as well as for details of the methodologies used. Accordingly, from the wide variety of available sources, a few were selected for the provision of data with automated procedures using APIs and big data technologies. In-house statistics do not generally cover crypto-assets.

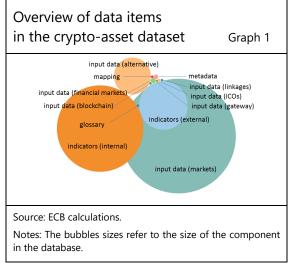
	Category	Example of indicators	Data sources
Off-chain	Markets	 Pricing and trading volumes, market capitalisation, trading vis-à-vis fiat currencies (based on granular end-of-day information for all trading pairs on each trading platform) Pricing and trading volumes of financial instruments traded on the institutionalised exchanges (futures, exchange traded products and others offering exposures to crypto-assets), exchange rates 	 Crypto-asset trading platforms; data providers of aggregated information Commercial financial markets data provider
	Gatekeepers	 Breakdowns of trading and pricing information aggregated across various metadata items of trading platforms 	 Crypto-asset trading platforms; data providers of aggregated information
		Arbitrage indicatorsIndicators based on metadata information regarding wallets	Various online data providers
		 Indicators based on metadata of the cards supporting crypto-assets 	
		 Indicators based on metadata and some general information about the number of ATMs 	
	Linkages	• Holdings of financial instruments traded at the institutionalised exchanges	• Securities Holding Statistics ⁶⁷
	Others	 Indicators based on metadata of Initial Coin Offerings (ICOs) and raised funds 	Online data providers
On-chain		 Indicators based on the number and values of transactions, fees and difficulty 	Online data providers
		Concentration	
		• Social media, news on crypto-assets	

⁶⁷ See <u>Securities holdings statistics</u> on the ECB's website for more information.

Crypto-asset indicators

Crypto-asset indicators tailored to the ECB monitoring exercise have been grouped into four categories corresponding to the focal points of the monitoring framework: i) markets, ii) gatekeepers, iii) linkages, and iv) other (see Table 1). Crypto-asset indicators so far cover largely off-chain transactions and only selectively on-chain ones.

While on-chain transactions are those recorded directly on a distributed ledger, off-chain transactions are recorded either on an institution's book (in the case of trading platforms) or in a private network of users that use the distributed ledger to record the net transactions. Indicators for off-chain transactions were largely based on granular end-of-day⁶⁸ trading and pricing information with a trading pair – trading



platform granularity collected from trading platforms and commercial data providers.

Commercial data providers and online data sources provided input for the indicators on gatekeepers and ICOs. Constructing indicators also required that other auxiliary data were collected, such as some financial markets data, exchange rates and "alternative" data.

Looking at the graphical representation of the content of the dataset (see Graph 1), input

data covering market category (excluding financial markets) constitute the biggest chunk of the database, followed by indicators calculated internally and indicators collected from external data sources. Within the market segment, input data refer to trading information obtained from more than 200 trading platforms and more than 11,000 trading pairs. A variety of indicators are calculated based on the input data and some indicators are also collected from external data sources and used for crosschecking purposes or as an input for calculating other indicators. Input data for other categories of indicators is comparatively small. Beyond the aforementioned data, the dataset also contains some metadata tables, mappings and a glossary.

Data quality issues of pricing and trading data

Due to the data quality issues the raw pricing and trading data collected were largely unfit for the purpose of preparing indicators. The partially unregulated crypto-asset market is susceptible to fraud and hacking, as well as related technical issues which may lead to some erroneous transactions affecting data quality of pricing and trading data. Typical data quality issues experienced by data aggregators or platforms are a

⁶⁸ As the crypto-asset market operates on a 24/7 basis, the end-of-day specification depends on the preferred settings and selected time zone of a data provider and may therefore vary across data providers.

result of service outages, connectivity errors and unstable APIs. Additionally, there are a number of studies that provide evidence of practices such as wash trading that distort published aggregate statistics on prices and trading volumes. Wash trading is trading conducted by market participants that sell to themselves in order to manipulate market developments by affecting expectations and market perceptions.⁶⁹ Wash trading might be conducted by some trading platforms creating transactions in order to inflate their trading volumes and gain market share. Also some individual (usually large) investors might conduct wash trading aiming to steer market developments in a specific direction.

Data quality enhancements with advanced analytical techniques

In the context of data quality enhancement the identification of anomalous or erroneous observations was needed. In particular, the collected raw data on pricing and trading needed to be cleaned of observations covering inactive trades as well as of anomalous data spikes reflecting idiosyncratic exchange-specific events eg technical failures. While dealing with the first issue is straightforward, handling the anomalous spikes requires more elaborate methods.

Two approaches were chosen to exclude outliers that may distort the aggregates. The approaches drew from the toolset of functional data analysis (FDA) and machine learning: i) the outliergram (Arribas-Gil and Romo (2014)) and the functional boxplot (Sun and Genton (2011) and ii) the isolation forest (IF, see Liu et al (2008)). The objective was to use data-driven and explainable machine learning methods which would not require intensive resources for daily application. In addition, to enhance the understanding of the relationships between crypto-trading platforms, the dependency network analysis based on XGBoost gradient boosting method using an interactive visualisation tool (Boumghar et al (2019)) was also employed (Chen et al (2016)).

Results and way forward

Overall, the first step in setting the dataset and constructing the indicators has been completed, paving the way for further work on developing new indicators, expanding data sources and thereby closing data gaps which are prominent with respect to the in-depth analysis of linkages and gatekeepers. The new indicators need to correspond to changing monitoring requirements and risks. The direction for this further work would involve going towards more granular off-chain and on-chain data and exploring various alternative data sources accompanied with further work on data quality.

With regard to the two techniques analysed⁷⁰ for outlier identification and filtering out, based on the FDA and IF, they have both made it possible to successfully unbundle observations on anomalous performance. Both techniques delivered stable results that were consistent with each other, as well as over time and with the monthly

⁶⁹ Hougan et al (2019) define wash trading as follows: "wash trading occurs when a single or affiliated trader executes trades with itself".

Overall for the analysis, daily data for the first six months of 2019 for the pair bitcoin/euro (BTC/EUR) traded in 58 trading platforms were considered. Pricing and trading data were enriched with several other indicators covering metadata features of trading platforms and some alternative data sources.

coverage of the CCCAGG index chosen as a reference.⁷¹ Filtering out identified outliers made it possible to enhance the robustness of pricing data with only non-invasive removal of underlying trading volumes. Being data-driven, agile and resource-efficient, both techniques analysed are suited to being part of the daily quality enhancement procedure while future work may focus on further extensions of both methods and also on engineering some new features. The dependency network analysis supported with the powerful 3D and 2D graphs proved valuable for gaining insight and understanding the relationships between the outlier and inlier trading platforms. The future work will gravitate towards exploring time dimension for the predictions, multi-target relations and the automation of the graph analysis for the anomalies detection and filtering out.

References

Arribas-Gil, A and J Romo (2014): "Shape outlier detection and visualization for functional data: the outliergram", *Biostatistics*, 15(4), pp 603-19.

Boumghar R, A Donati, R Madeira and I Angelis (2019): "Enhanced awareness in space operations using web-based interactive multipurpose dynamic network analysis", in H Pasquier et al (eds.), *Space Operations: Inspiring Humankind's Future*, Springer, pp 795-810.

Chen, T and C Guestrin (2016): "XGBoost: A scalable tree boosting system", in Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge, Discovery and Data Mining – KDD'16, ACM Press.

ECB Internal Crypto-Assets Task Force (2019): "Crypto-Assets: Implications for financial stability, monetary policy, payments and market infrastructures", *Occasional Paper Series*, no 223, May.

European Central Bank (2019): "Understanding the crypto-asset phenomenon, its risks and measurement issues", *Economic Bulletin*, issue no 5.

Hougan, M, H Kim and M Lerner (2019): "Economic and non-economic trading in bitcoin: exploring the real spot market for the world's first digital commodity", Bitwise Asset Management, May.

Liu, F T, K Ming Ting and Z-H Zhou (2008): "Isolation forest", in F Giannotti et al (eds.), Eighth: IEEE International Conference on Data Mining, IEEE, pp 403-12.

Sun, Y and M G Genton (2011): "Functional boxplots", *Journal of Computational and Graphical Statistics*, 20(2), pp 316-34.

⁷¹ See the <u>Crypto Coin Comparison Aggregated Index (CCCAGG)</u> developed by CryptoCompare.

Identifying the adoption of technological innovations among financial intermediaries

Nicola Branzoli and Alessandro Scognamiglio, Bank of Italy⁷²

The Bank of Italy Fintech Survey

Fintech – defined as technology-enabled innovation in financial services that result in new business models, applications, processes or products – promotes the adoption of new digital technologies and the reorganisation of productive process by financial institutions and fosters the entry of technology start-ups and bigtechs in the market for financial services.

In 2017 and 2019, the Bank of Italy conducted two surveys to collect information about current and perspective fintech projects in Italy. The questionnaire was sent to almost the whole banking system and to a representative sample of other financial intermediaries operating in the markets of payment services, asset management and credit provisioning and to technology service providers.

The surveys collected information on:

- current and planned fintech projects, associated budgets, involvement (if any) of fintech firms in the development, technologies used, risks and business areas involved;
- the presence of new professional figures, such as Chief Innovation Officers, and/or dedicated organisational units focused on the integration of fintech projects into the intermediaries' business model and core technology system;
- perceived opportunities and constraints related to fintech initiatives;

The response rate was near 100 per cent among banks and consistently above 80 per cent for the other categories of financial institutions, even though the participation to both surveys was on a best effort basis. Service and technology providers were less likely to provide answers, with a response rate that was below 50 per cent in both surveys.⁷³

The Bank of Italy has published two reports highlighting key messages emerging from each survey, which provided a wide range of information about roughly 280 projects.⁷⁴ For example, the results indicated that the majority of respondents was experimenting or planning to experiment with innovative technologies, although the majority of the overall investments was provided by a limited number of intermediaries. The projects involved a wide range of economic functions performed by banks, from payments and deposit taking to lending and asset management, as well as the efficiency of internal processes. Market operators seemed mostly interested in developing projects based on application programming interfaces, artificial intelligence, big data and robotics. The majority of initiatives were developed in-house, although around one third of the project was developed in partnership with

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⁷³ The response rate among service and technology providers was about 40 per cent and 30 per cent in 2017 and 2019 respectively.

⁷⁴ The report about the survey of 2019 is available <u>here</u>, the one about the survey of 2017 is available <u>here</u>.

fintech firms, suggesting the start-up can play an important role in the innovation of financial services.

Overall, the surveys have provided valuable insights about the development of fintech in Italy. However, data collected through *ad hoc* questionnaires are often not comparable with fintech statistics or surveys available about other countries. This limitation highlights the importance of coordinating authorities' initiatives in the area of fintech data collection.

An overview of the Costa Rican case and its experience identifying fintech firms

Valerie Lankester and Andrea Oconitrillo,⁷⁵ Central Bank of Costa Rica⁷⁶

The role of the Central Bank of Costa Rica towards the development of the payments system

In conformity to the Bali Fintech Agenda (IMF and WB (2018)), fintech is defined as the advances in technology that have the potential to transform the provision of financial services encouraging the development of new business models, applications, processes, and products. Therefore, fintech firms have the natural intention to solve market failures and provide a faster and better financial service by disrupting or modifying the traditional trading, banking, financial advice and products.

According to Berkmen et al (2019), in Latin-America and the Caribbean (LAC) fintech startups are growing, albeit from a low base. With information from an IADB and Finnovista survey (2018), there is a mapping of 1,166 startups operating in 18 countries in the region. Two thirds of them, approximately, have developed in three countries: 33% in Brazil, 23% in Mexico, and 13% in Colombia. Within them, payments and remittances, lending, and enterprise financial management are the three fintech segments with the highest number of start-ups.

When considering all the region, it is observed that the main business of fintech firms is on payments and alternative financing (lending and crowdfunding). Specifically, 24% are concentrated on digital payments and transfer services, 18% are alternative financing (lending) platforms, 16% give financial management to businesses and 8% give it to individuals.

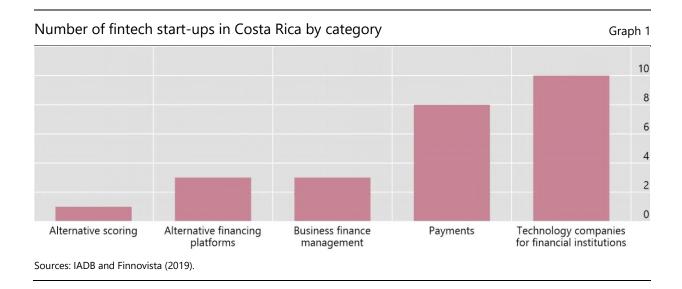
But when the focus is on Central America's fintech development, inclusivity is the main driver and in many cases the aim is to provide access to financial services for those who are excluded. Mostly, businesses with disruptive processes "compete" against non-consumption, in market segments with no supply from the *traditional* financial system.

Even when there are some similarities within Latin America and others within Central America, Costa Rica has some particularities that are relevant to mention and understand. For this country, the IADB and Finnovista report (2019) identified 25 startups related to fintech activities (Graph 1): ten are technological companies for financial institutions, eight are related to payments, three are classified as business finance management, other three are alternative financing platforms and one is involved in alternative scoring.

In general, and in accordance to the report, Costa Rica has good conditions and a positive outlook for the evolution of fintech companies, but the funding mechanisms are one of its weaknesses.

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⁷⁶ The views expressed here are those of the authors and do not necessarily reflect those of the Central Bank of Costa Rica.



One of the special features which have characterised the evolution of fintech startups in this country is the active role of the central bank in financial inclusion; specifically through its Payments System Division.

Two decades ago, the Banco Central de Costa Rica (BCCR) started to offer to the public the *National Payments System* (SINPE), which is an electronic platform that provides instant payments facilities 24/7. Also, since 2015, the Bank has provided agents with a digital payments platform called *Sinpe Móvil*, which allows people to make money transfers within the regulated financial institutions in real time at no cost, only with a text message.

These are only two of the services which the central bank provides, but with them, the bank has developed a strong and secure network, which has the trust of all participants, institutions and agents, who in response maintain a low cash level. As a percentage of GDP, Costa Ricans hold 3.6% in cash, which is lower than holdings in other Latin American economies such as Mexico (6.8%) and Brazil (3.8%), and even lower than developed countries such as Australia (4.6%).⁷⁷

Also, in Costa Rica, nearly 80% of adults have an account in a financial institution. This result is above the average for Latin America and the Caribbean, and signals strong financial accessibility, even for segments with low banking usage as young people, migrants, the elderly and low-income.

Therefore, fintech in Costa Rica has not developed in large proportions towards payments or financial inclusion but has targeted other inefficiencies from the financial system, such as the usage level of new technologies between financial intermediaries and sophistication and deepness of the financial markets. Also, these firms have promoted solutions to high intermediation and transaction costs resulting from an industrial organisation of few participants, were almost half is covered by public banking.

As of today, fintech firms do not have specific requirements or regulation in Costa Rica. What is expected is that, if they offer services which are regulated, they should

⁷⁷ This result is relatively high compared to Sweden (1.3%) where the electronic payments are at the top.

comply with the corresponding legal framework. However, the central bank updated its "Regulations for the Payments System" in September 2018, so that fintech companies can register to use the SINPE platform. This authorisation provides firms with the collection of payment services offered by the bank, which cover corporate and individual clients.

A first attempt to reduce fintech data gaps at the BCCR

Besides the fintech-mapping made by the above mentioned report, the BCCR has made some initial efforts to identify and characterise the fintech businesses in the country with a non-official survey.

The data were gathered from a questionnaire distributed among the self-named "fintech firms" that have requested access to the electronic platform of SINPE. This survey, therefore, had no formal method of identifying the firms; it was self-selection. Hence, the results do not consider the whole sample of fintech firms in Costa Rica.⁷⁸

From the survey the central bank has recorded the name, number of employees, date of foundation, if it is a project or if the firms have already established operations, description of their business model, capital origin (domestic or foreign) and if they have developed the technological infrastructure needed to connect with SINPE.

By June 2019, twenty five firms had responded the survey, from which eighteen (72%) had established operations and seven (28%) were in an early stage of their project. The majority (13) (52%) had begun their project within the last three years, and only 2 (8%) before the year 2000.

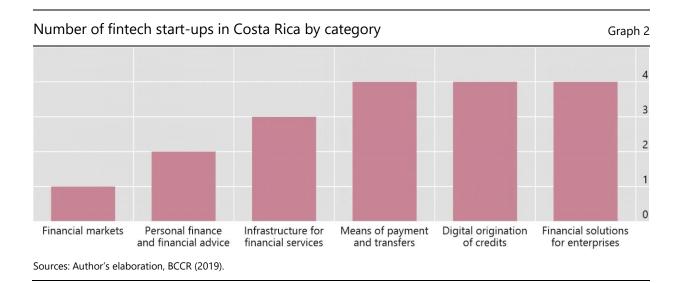
More than 80% of the companies are Costa Rican or have a percentage of national capital in their ownership structure, while four (16%) reported to be from foreign capital. Most of them (15) are considered small firms, as they have less than 10 employees and only 3 of them are considered large firms with more than 91 employees. Five firms stated they have between 11 and 35 employees and two have between 36 and 90 employees.

The majority of these firms (14) were not ready to be connected to the SINPE platform, as they needed further technological development in order to prove their systems are robust and do not represent a vulnerability to the technological platform and therefore, the financial system.

To determine the main activity of the eighteen fintech firms that had established operations, a working group of the central bank used the framework from the Mexican Fintech Law in a non-official exercise. The results (shown in Graph 2) reveal that, in equal proportion, the main services provided are a) digital origination of credits, b) financial solutions for enterprises and c) means of payments and transfers;⁷⁹ then comes d) infrastructure for financial services, e) personal finance and financial advice, and lastly, with just one firm, financial markets (currency market).

⁷⁸ As of today, the total number of fintech firms is unknown as long as there is not a formal inscription of these type of firms, and also because of the nature of these start-ups: they can arise and die quickly.

⁷⁹ These types of payments services are different from SINPE. They are, mainly, payment gateways, digital wallets and payments with fingerprint verification.



Future developments

Currently there are in Costa Rica two major studies analysing the fintech environment, which identify a similar number of companies, but differ in its exact composition. The study from the IADB and Finnovista only considers those which are 100% Costa Rican, and the BCCR's survey has only studied those interested in having a connection to SINPE. Also, both reports have different contexts, methodologies and classification categories. It is evident, then, that there is space for improvement in this matter.

It would be desirable to have a standardised process to obtain data and statistics in a regular manner about the Fintech companies and their activities, along with a uniformed classification system in which these firms can be categorised in accordance to their business model. The classification should be flexible and open for the inclusion of new categories on an ongoing basis.

In a general manner, the future development of this industry in the country will be determined by the balance between innovation and regulation. Defining the latter implies for the policy makers to decide their role in the industry: promoters or spectators.

From its actions, the BCCR seems to have a participative and enhancing approach, as two of its policy main drivers are market efficiency and financial inclusion. But for the government as a whole, the strategy has not been defined.

While the regulatory and supervisory framework has not changed, there are, nonetheless, internal efforts towards a productive discussion to define regulation by activity and in a proportional manner, and to enhance/help innovation by providing greater certainty to innovating firms while safeguarding consumers and financial stability. This line of action is similar to the one suggested by the OECD (2018), which states that opening entry to Fintech start-ups, with appropriate regulation would boost competition and reduce the high cost of financial intermediation in Costa Rica's financial market.

References

Berkmen, P, K Beaton, D Gershenson, J A del Granado, K Ishi, M Kim, E Kopp and M V Rousset (2019): "Fintech in Latin America and the Caribbean: Stocktaking", *IMF Working Paper*, no19/71.

Central Bank of Costa Rica (2019): Memoria Anual 2018, February.

Inter-American Development Bank and Finnovista (2019): *Fintech en Costa Rica: hacia una evolución de los servicios financieros*, June.

International Monetary Fund and World Bank (2018): *The Bali Fintech Agenda*, October.

Organisation for Economic Co-operation and Development (OECD) (2018): *Estudios Económicos de la OCDE: Costa Rica 2018*, March.

Dynamic linkages among cryptos and global financial markets: data issues⁸⁰

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Since 2008 cryptocurrencies have soared in popularity with more than 1,000 in existence today. Rising investor interest, significant global media coverage, increasing institutional involvement and increased digital token sales, amongst other things, highlighted the need to explore their properties and their interconnection with traditional financial assets. In the following sections, we investigate both the short-and long-run dynamic linkages between major crypto currencies and major world currencies and equity indices. Our estimates point that each crypto currency appears to follow its own trend in the global financial market, indicating that crypto assets, when included in a portfolio, form part of an internal hedge.

Since 2008, the volume and usage of cryptocurrency has exploded with the most prominent of them, Bitcoin (Maurer et al, (2013); Dwyer (2015); Katsiampa (2017)). During the last two years, digital currencies have experienced sharp price fluctuations, while since the start of 2018 they have been moving fairly closely in line with risky assets such as equities. Consequently, it might be tempting to conclude that this is because cryptocurrencies have become a sufficient part of the mainstream investment market.

Currently, there are more than 1,570 cryptocurrencies globally and the total market capitalisation, which scaled \$660 billion in 2017, stood at around \$430 billion at the end of August 2018 despite price fluctuations. The majority of them share the common element of the public ledger ('blockchain') including the introduction of new consensus mechanisms (eg, proof-of-stake) as well as decentralised computing platforms with 'smart contract' capabilities that provide substantially different functionality and enable non-monetary use cases. In addition, there are cryptocurrencies that show little to no innovation and simply attribute different parameter values (eg, different block time, currency supply, and issuance scheme), which are often referred to as 'altcoins'.

In this feature, we investigate both the short- and long-run dynamic linkages among major crypto currencies, major exchange rates and global equity indices. With the empirical evidence provided below, we show that despite common characteristics, cryptocurrencies do not reveal any short- and long-term stochastic trends with these exchange rates and equity returns.

The importance of our contribution is twofold. Firstly, each cryptocurrency appears to follow its own trend in the global financial market and is independent of any influences from the exchange rates or the global stock market. Secondly, the factors driving cryptocurrency prices are still rather different to those driving the prices of financial assets such as exchange rates and equities. As such, they could be

⁸⁰ This study is part of the paper "Dynamic linkages among cryptocurrencies, exchange rates and global equity markets" published in Studies in Economics and Finance (August 2019). The views expressed here are personal views and do not necessarily reflect those of the institutions the authors are affiliated with.

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considered for portfolios' diversification purposes and complementing prior research presented by Dyhrberg (2016), Bouri et al (2017), Corbet et al (2017) and Inci and Lagasse (2019).

The feature is organised as follows. The next section describes the data and the preliminary statistical investigation. The section after that presents the methodology employed in order to investigate both the short- and long-term linkages and the final section concludes the study.

Cryptoassets data and preliminary statistical investigation

Data on cryptocurrency assets (cryptos, henceforth) for those with a market value over \$1bn as of end August 2018 have been collected since the start of 2013. The cryptocurrencies under examination are Bitcoin, Dash, Etherum, Monero, Stellar and XRP. In addition, major exchange rates (EUR/USD, USD/GBP and USD/JPY) and major stock market index prices (SP500, Dow Jones Industrial Average, DAX, CAC, FTSE, NIKKEI, Hang Seng and Shanghai) have been collected in order to investigate the dynamic linkages among cryptos and all these series. Table 1 summarises some descriptive statistics for all series during the 2010s.

Descriptive statistics for all series' returns

7/22/201	0 to 31/8,	/2018										Table 1
	BITCOIN	DASH	ETHEREUM	XRP	EURUSD	USDGBP	USDJPY	CAC	DAX	FTSE100	NIKKEI	SP500
Mean	0.2813	0.2801	0.3936	0.1614	-0.0050	0.0050	0.0045	0.0066	0.0164	0.0069	0.0175	0.0217
St. Dev.	3.3686	4.4382	4.0214	4.535	0.2774	0.2713	0.2846	0.5905	0.5685	0.4421	0.6159	0.433
Skew	0.1907	1.4222	1.0479	2.664	0.3310	2.1194	0.3306	-0.2395	-0.3282	-0.1586	-0.5123	-0.4067
Kurtosis	15.528	25.488	8.5302	31.751	6.8675	28.766	11.298	7.3787	5.8912	6.0748	7.7425	8.1338
J-B	1143.1	2118.7	964.77	3910.1	1.197.6	5304.4	5391.3	1509.3	683.81	743.33	1834.2	2101.7
Probabilit	y 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observation	ns 1747	989	662	1097	1867	1867	1867	1867	1867	1867	1867	1867

¹ Bitcoin's sample starts from 7/21/2010; Dash's from 2/18/2014; Ethereum's from 8/11/2015 and XRP's from 8/6/2013; J-B is the Jarque-Bera statistic for non-normality; Probability is the probability for that test.

Sources: CryproCompare.com; Bloomberg; authors' calculations.

All cryptos have high and similar standard deviations with positive skewness, with some (Stellar, XRP and Dash) much more than others. This is an indication that they have experienced greater chances of extreme positive outcomes (or that bad scenarios are less likely). The fact that they have also exhibited extraordinary excess kurtosis implies that the likelihood of extreme outcomes is much higher than that predicted by the normal distribution.

Similar observations can be made on exchange rates and equity returns, in terms of normality departures. Some differences include the negative skewness in all equity indices and the EUR/USD exchange rate, which implies a higher likelihood of extreme negative outcomes (returns) and the much lower excess kurtosis values.

Table 2 shows the simple, unconditional correlations among all series. As far as the correlations among the cryptos are concerned, we see positive but weak correlations (especially between Bitcoin and Monero). However, their correlations

with the three exchange rates are much weaker, implying that each crypto has no relationship with each of the exchange rates. A similar pattern of weak and both positive and negative correlations among the cryptos and the equity indices has also been found (all correlations are not statistically significant). Finally, it is interesting to note that each crypto exhibited a negative correlation with a different equity index. For example, Bitcoin had a negative correlation with HangSeng, Dash with Dax, Etherum with CAC, and Stellar and XRP with Shanghai. However, these are simple, static correlations that do not reveal the dynamic linkages among the series. A more robust analysis is undertaken in the next section.

	BITCOIN	DASH	ETHEREUM	MONERO	STELLAR	XRP
DASH	0.339	DAGH	ETHEREOW	MONERO	STEED III	
ETHEREUM	0.336		0.411			
MONERO	0.188	0.180	0.237			
STELLAR	0.320	0.256	0.284	0.101		
XRP	0.302	0.176	0.242		0.034	0.670
EURUSD	0.005	0.036	0.007	0.027	-0.012	0.023
USDGBP	0.010	0.011	0.055	-0.017	0.034	-0.008
USDJPY	0.005	0.068	-0.009	-0.011	0.027	-0.002
USDCNY	-0.006	-0.021	-0.047	-0.028	-0.010	0.004
CAC	0.027	0.004	-0.067	0.007	0.045	0.008
DAX	0.037	-0.003	-0.045	0.019	0.034	0.024
DJIA	0.046	0.046	0.025	0.043	0.051	0.050
FTSE100	0.033	0.041	-0.053	0.009	0.035	0.028
HSENG	-0.027	0.008	-0.017	0.038	0.013	0.012
NIKKEI	0.029	0.046	-0.022	0.011	0.054	0.022
SHANGHAI	0.008	0.003	0.021	0.021	-0.008	-0.012
SP500	0.034	0.053	0.052	0.052	0.054	0.041

Simple Correlations among series

Sources: CryproCompare.com; Bloomberg; authors' calculations.

Short- and long-run dynamic linkages among cryptos, exchange rates and equity indices

Cointegration analysis among the cryptos themselves, between each crypto and the four exchange rates and between each crypto and the equity indices was implemented in order to examine the nature of the dynamics with each asset class and across asset classes. The finding of the absence of cointegration within the cryptos themselves suggested that there is no long-term association (stochastic trend) among these assets and thus, an investor could very well include them in a well-diversified portfolio. Second, absence of cointegration was also found between cryptos and the exchange rates and/or the major equity markets. Hence, it can be

stated that these cryptos do not share any long-term stochastic trends with these exchange rates or equity indices.

However, there may still be short-term, dynamic linkages among the series. To examine this possibility, a Vector Autoregressive (VAR) model was applied in order to trace the dynamic, short-run interactions among each cryptocurrency with the exchange rates and the equity markets, at the mean level.

The VAR impulse response functions of each crypto with the four exchange rates (EURUSD, USDGBP, USDJPY and USDCNY) showed a similar response of Bitcoin to shocks from the EURUSD and USDJPY exchange rates, in the sense that shocks initially positively affect Bitcoin's value but two days later they depress it, before fully absorbing it in the third or fourth day. The opposite occurs with the USDGBP, but the shock is still cushioned by the third day. Regarding the remaining cryptos, for most of them the degree of responses to exchange rate shocks is lower compared to Bitcoin (ie lower volatility shocks).

Regarding the generalised impulse responses of each cryptocurrency vis-a-vis the seven equity indices, Bitcoin seems to respond mostly positively to shocks from the equity markets, while almost all of the other cryptos react little or negatively to them. Thus, this may suggest a tendency to trade more in Bitcoin in the short run relative to the other cryptos. Second, in many cases some cryptos' reactions to shocks from Asian stock markets are negligible. Third, in all cases shocks seem to die out within five days (a week). Lastly, for some cryptos (such as Bitcoin and Etherum) the reactions to shocks from European and American equity markets are somewhat turbulent, in the sense that they alternate between positive and negative changes.

Overall, different reactions of each crypto to equity shocks during the period under investigation have been detected. Therefore, despite being similar instruments (alternative currencies), each crypto follows its own, distinct (independent) path in responding to global equity market shocks. In addition, such short-lived reactions to general shocks might suggest that global financial market conditions were not more important than the own structure and operation conditions of the cryptos over the period investigated. Hence, they appear to be isolated from market-driven shocks.

Conclusion

Impulse response analysis indicated different reactions of each crypto to equity shocks and that cryptos appear to be isolated from market-driven shocks. A notable exception is the turbulent, yet short-lived, dynamic responses of each crypto with the Chinese yuan. Given the differential relationships of each crypto with the equity markets, one could infer that they represent a decent short-run investment vehicle within a well-diversified, global asset portfolio (as they may increase the returns and reduce the overall risk of the portfolio).

References

Bouri, E, L A Gil-Alana, R Gupta and D Roubaud (2019): "Modelling long memory volatility in the Bitcoin market: Evidence of persistence and structural breaks", *International Journal of Finance & Economics*, vol 4, pp 412–426.

Corbet, S, A Meegan, C Larkin, B Lucey and L Yarovaya (2018): "Exploring the dynamic relationships between cryptocurrencies and other financial assets", *Economic Letters*, vol 165, pp 28–34.

Dwyer, G P (2015): "The economics of Bitcoin and similar private digital currencies", *Journal of Financial Stability*, vol 17, pp 81-91.

Dyhrberg, A H (2016): "Bitcoin, gold and the dollar - A GARCH volatility analysis", *Finance Research Letters*, vol 16, pp 85–92.

Inci, C A and R Lagasse (2019): "Cryptocurrencies: applications and investment opportunities", *Journal of Capital Market Studies*, <u>https://doi.org/10.1108/JCMS-05-2019-0032</u>.

Katsiampa, P (2017): "Volatility estimation for Bitcoin: A comparison of GARCH models", *Economic Letters*, vol 158, pp 3–6.

Kostika, E and N Laopodis (2019): "Dynamic Linkages among Cryptos, Exchange Rates and Global Equity Markets", *Studies in Economics and Finance*, August.

Maurer, B, T C Nelms and L Swartz (2013): "When perhaps the real problem is money itself!: the practical materiality of Bitcoin", *Social Semiotics*, vol 23, pp 261–277.

Fintech and financial inclusion in France: a mapping exercise

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Motivation: fintech for banking inclusion

Financial inclusion is of particular importance to the Banque de France, which has been entrusted by law with several tasks aimed at developing it: ensuring the right for every individual to have a deposit account, addressing household overindebtedness, supporting assisted microcredit activities and improving financial literacy.

In addition, the Banque de France chairs the Observatory for Banking Inclusion (OIB),⁸³ which brings together all the parties involved (public bodies, associations, banks) and aims to measure and promote banking inclusion. *The rapid expansion of fintech in France raises questions about its impact on this issue.*

Fintech is often associated with financial inclusion when referring to emerging and developing economies. In several countries, fintech has indeed enabled many unbanked people to access financial services, in particular thanks to mobile money.

In France, where 99.6% of households had a deposit account in 2014,⁸⁴ the problem lies more with the access of the underserved, who are often on low-incomes, to the full range of financial services. Indeed the definition of financial inclusion is broad. According to the World Bank, "financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit and insurance".

According to the Observatory for Banking Inclusion, 3.4 million people in France could be considered to be fragile customers at the end of 2018, mainly as a result of over-indebtedness, recurrence of payment incidents or the low level of their resources. Graph 1 shows that some French households are constrained in their capacity to save or get credit, in similar proportions to households in the euro area.

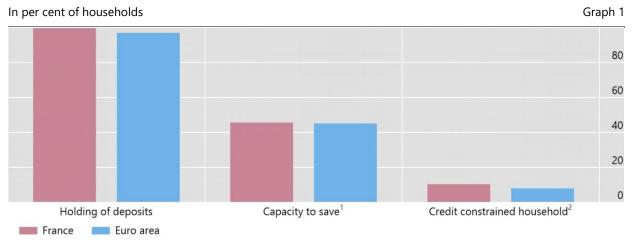
Although these constraints are mainly due to a low level of financial resources, fintech can play a role in offering these households new, cheaper, more tailored financial services. Through its goal of disrupting the banking and financial industry thanks to digital innovations and technology-enabled business model innovations, fintech is well-positioned to offer new services to those neglected by the traditional financial industry.

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⁸³ Observatoire de l'Inclusion Bancaire (OIB). OIB reports are available on this page.

⁸⁴ Household Finance and Consumption Survey, ECB, euro area central banks and statistical institutes.

Financial inclusion indicators



¹ Regular expenses are lower than income. ² Credit-constrained households are those whose credit application has been refused or reduced or who did not apply due to perceived credit constraints.

Sources: ECB; Euro area central banks; National statistical institute. Household Finance and Consumption Survey.

Statistical implications: matching demand-side and supply-side information

The demand-side: data on financial inclusion

A few databases on financial inclusion exist, the principal and most comprehensive one being the Global Financial Inclusion Database (Global Findex) which has been maintained by the World Bank since 2011. It contains some data on the use of fintech, including the use of mobile phones and the internet to conduct financial transactions.

For the euro area, another useful and comprehensive source is the Households' Finance and Consumption Survey (HFCS) conducted by the ECB, euro area central banks and some euro area statistical institutes. The survey collects data on households' finances and consumption. However, there are no specific data on the use of fintech.

On the supply side: data on fintech products and services

Information about the services proposed by the fintechs exist individually on the internet but, for the reasons highlighted in section 3.2 of the report, there is no taxonomy (such as ISIC – NACE...) codes and shared official list of fintechs, let alone data on business models or on the financial impact on customers.

This mapping exercise therefore appears to be a first and preliminary step towards filling this information gap.

A mapping exercise based on fintechs operating in France

In order to identify how fintechs can increase financial inclusion, an inventory exercise was carried out using a list of French fintech companies. This non-exhaustive list of 542 fintech companies or services was made based on the members of the "France

Fintech" association and of the Swave incubation platform, on the list of projects labelled by "Finance Innovation" and on the list of fintech companies that contacted the French prudential authority (ACPR).

The objective was to identify the business segments where fintech companies provide services that have a potential positive impact on financial inclusion. We split the concept of financial inclusion into four groups of financial services: (1) access to transaction and payment solutions, (2) access to credit, (3) access to saving and investment solutions, and (4) access to insurance. For the purposes of this case study, we chose to focus only on households and to exclude businesses.

To identify the fintech companies that have a positive impact on financial inclusion, we retained the three following criteria (which are not necessarily cumulative):

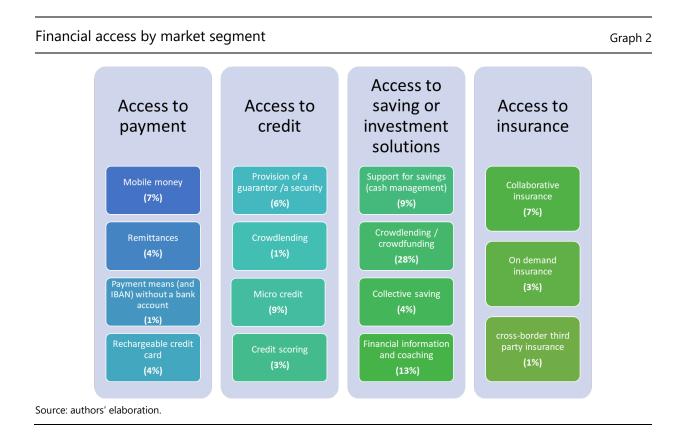
- Target: does the service target financially excluded or underserved populations?
- <u>Purpose</u>: does the company aim to make a service more accessible? Does it seek to make the customer less financially fragile?
- <u>Impact</u>: does the service provided by the company enable better access to financial services and products for underserved people?

Some methodological choices need to be specified. For the sake of clarity, we tried to identify common business models, even though each company has its own specificities. In addition, in numerous cases, for the identified companies, the positive impact on financial inclusion is only present incidentally or in a small part of their activities. However, those companies have to be considered as having a positive impact on financial inclusion. Furthermore, some entities may fall into more than one category. In this case, they have been assigned to the category that appeared to be their most prominent activity. Finally, by definition, Business to Business (B2B) services and entities have been excluded.

The result of this exercise is summarised in Graph 2. On 542 fintechs, 69 (ie 12.7%) were identified as having a positive impact on financial inclusion. The figure in brackets for each category is the percentage of companies that carry out the given activity, among those 69 companies.

Out of these 69 fintechs with a positive impact on financial inclusion, about half provide access to savings or investment solutions. For example, 28% of them provide crowdfunding or crowdlending solutions that open up new investment opportunities, particularly for small amounts of money. 13% of them provide financial information and coaching. 9% offer cash management solutions, ie services to better manage money thanks to rounding of payments allocated to savings, automatic transfers to an interest-bearing account or tracking of expenses. Finally, 4% of those fintechs offer collective savings solutions.

Fintech companies can also improve the access to credit, for instance by acting as a guarantor for real estate loans or providing participative guarantees (6% of the 69 fintech companies), by providing personal credit through crowdlending (1% of them), by granting micro-credits (9% of them) in the form of cash advances or split payments, or by improving the credit eligibility of certain people through credit scoring based on expenditure data (3% of them).



One area where fintechs have had a positive impact on financial inclusion is access to means of payment. Out of the 69 fintechs having a positive impact on financial inclusion, 7% provide mobile money, giving thus an access to payment means to potentially unbanked people, 4% enable people to send remittances quickly and cheaply, 1% provide payment means and IBAN identification without a bank account and 4% provide rechargeable credit cards for unbanked people.

Lastly, French fintechs with a positive impact on financial inclusion are also active in the insurance field, although to a lesser extent than in other areas. 7% of them offer collaborative insurance by group of friends or people who share the same needs, sometimes on a peer-to-peer basis. The goal is to make insurance more customised and more affordable. 3% of those fintechs offer on-demand insurance, where the customer can insure certain risks only when they feel the need, in an ad hoc and instantaneous way, therefore adjusting the cost to the needs. Lastly, 1% of the 69 fintechs offer health insurance for clients' relatives abroad, particularly in countries where health insurance is expensive and not widespread.

The way forward: the need for broader data

As stated before, this mapping exercise is only a preliminary step. It could lead to a more in-depth study thanks to data on fintech customers. A survey sent to identified fintech companies about their customers and their financial characteristics could help to fill the information gaps.

Furthermore, more precise data in the Global Findex and in the Household Finance and Consumption Survey (HFCS) about households' financial needs could also add valuable information. In particular, households' appreciation of fintech's impact on their financial situation would be very helpful. That kind of data could help to match the supply side and demand side. It would help to know what proportion of households' needs are covered by fintech.

Finally, this analysis focused on new business models. It did not take into account the cost decrease in financial services due to competition from fintech. An analysis taking this aspect into account would have a broader spectrum and would certainly be insightful.

Fintech companies in Canada: opportunities for growth

Alexandre Fortier-Labonte and Yves Gauthier,⁸⁵ Statistics Canada

The use of technology is rapidly increasing in the way business is conducted. All industries are being confronted by disruptive technologies, from the use of 3D printers in the manufacturing industry to autonomous vehicles in the transportation industry. The financial industry is no exception to these disruptive forces and sees a rise of financial technology (fintech) products, which are now putting pressure on traditional financial institutions to follow the trend. ⁸⁶

Canada may not be a leader in fintech, with an adoption rate of 18% in 2017, versus an adoption rate of 69% in China. However, the use of fintech products is expected to rise in the Canadian economy, from an adoption rate of 8% in 2015 to 34% in the near future (Ernst and Young (2017)).

The fintech industry in Canada is experiencing a boom in the supply of capital, mostly in the form of venture capital.⁸⁷ In 2015, venture capital investments in fintech companies totalled about 200 million dollars, and reached a bit more than 500 million in 2017, a growth rate of 150%.⁸⁸

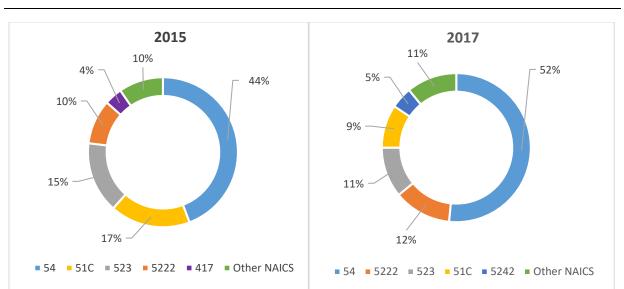
While there is information on the Canadian fintech ecosystem, there seems to be a data gap on the financial performance of these firms. This preliminary study tries to determine in which industry⁸⁹ are fintech companies operating within the Canadian economy, and what is their market share⁹⁰ in those industries. The study, which is far from being exhaustive, uses a sample of some of the largest fintech companies in Canada.⁹¹

The majority of fintech companies are classified in the professional, scientific and technical services

Even though fintech often refers to the financial industry, the majority of these companies are classified in the professional, scientific and technical services (NAICS 54), which is part of the non-financial industries. Their proportion in this industry went from 44% in 2015 to 52% in 2017 (Graph 1). In the financial sector, it was the non-

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- ⁸⁶ There is not a global consensus on how to define the fintech industry. There is not an industry classification specific to these companies.
- ⁸⁷ Venture capital is a form of private equity and a type of financing that investors provide to startup companies and small businesses that are believed to have long-term growth potential.
- ⁸⁸ Canadian Venture Capital Association (2018).
- ⁸⁹ The analysis was conducted using the NAICS grouping, according to Statistics Canada's Industrial Organization and Finance Division. See Annex A for a list of descriptions of the NAICS appearing in the study.
- ⁹⁰ Market share represents, for the purpose of this study, the percentage of an industry's total operating revenue that is earned by fintech companies over a specified time period.
- ⁹¹ Largest fintech companies as defined in LaPlante and Watson (2018).

depository credit intermediation industry (NAICS 5222) that had the highest share (12%) of fintech companies in 2017.



Proportion of fintech companies

by industry in 2015 and 2017

Source: Authors' elaboration.

Fintech companies in publishing, broadcasting, motion pictures, sound recording and information services industry have the highest market share

Across all industries where fintech companies operate, it is in the publishing, broadcasting, motion pictures, sound recording and information services industry (NAICS 51C) where they have the highest market share (1.13% in 2017, Graph 2). This was followed by fintech companies in the securities, commodity contracts, and other financial investment and related activities industry (NAICS 523), with a market share of 0.17% in 2017. Thereby, fintech companies account for only a small fraction of the overall revenues generated by Canadian companies.

Although fintech companies may have a small market share, it has been rapidly increasing. Fintech companies in the publishing, broadcasting, motion pictures, sound recording and information services industry have seen their market share reach 1.13% in 2017 from 0.44% in 2015, a growth of 156.8%. This trend is not exclusive to this particular industry, as fintech companies in most industries have seen an increase in their market share over the period of 2015 to 2017. In fact, fintech companies in the securities, commodity contracts, and other financial investment and related activities industry recorded a growth of 240%, while the growth in the professional, scientific and technical services reached 126.7%.

Graph 1

Market share of Canadian fintech companies

1.20% 1.00% 0.80% 0.60% 0.40% 0.20% ٠ 0.00% 51C 523 5222 54 44A

by industry for 2015 and 2017

References

Ernst and Young (2017): <u>The rapid emergence of FinTech</u>, EY FinTech Adoption Index 2017.

LaPlante, A and C Watson (2018): "An Overview of Fintech in Canada", Global Risk Institute.

Annex A: List of industries

417: Machinery, Equipment and Supplies Merchant Wholesalers

44A: Furniture, Home Furnishings, Electronics and Appliances Stores

51C: Publishing, Broadcasting, Motion pictures, Sound Recording and Information Services

5222: Non-Depository Credit Intermediation

523: Securities, Commodity Contracts, and Other Financial Investment and Related Activities

5242: Agencies, Brokerages and Other Insurance Related Activities

54: Professional, Scientific and Technical Services

Graph 2

Keeping up with fintech activities in Portugal: working together works

Luís D'Aguiar, Diogo Lencastre, Rita Prior Soares, Cláudia Florentim, Carla Marques, Inês Drumond, João Rodrigues and Nuno Pereira,⁹² Bank of Portugal

The experience of Banco de Portugal in coping with the fintech revolution

The new wave of technological innovation in financial services – or fintech – that has been observed in recent years, comprising new entities and players, activities and processes in this area, along with significant changes in the regulatory framework, has led to a greater diversity of financial service providers, differentiated products and services, and changes in the business models of those entities directly or indirectly active in this market. This technological innovation has the potential to generate significant gains, not only for the financial system itself, but also for the economy as a whole – eg by promoting an easier and widespread access to financial services. However, this process may also be a source of numerous risks, which might become systemic, and has the potential to amplify existing shocks to the financial system. Concurrently, fintech is a relevant topic for financial stability, besides consumer protection, and should be scrutinised by national and international supervisory authorities.

Banco de Portugal is the central bank of the Portuguese Republic and, as such, is an integral part of the European System of Central Banks. Being the national supervisory authority, macroprudential authority and payment systems overseer in Portugal, Banco de Portugal closely monitors the developments in financial innovation, in particular by focusing mainly on technical innovation and digitalisation:

- It partners with the relevant national and international entities, as the National Council of Financial Supervisors, the European Banking Authority, the European System of Central Banks, the Single Supervisory Mechanism and the European Systemic Risk Board, to develop and implement financial services' regulation and supervision.
- It encourages and takes part in the debate on the risks and opportunities that technological innovation – for example, open banking, artificial intelligence, central banks digital currency, the technologies behind the so-called "virtual currencies", Blockchain platforms and Distributed Ledger technologies/stable coins" and the use of Big Data – represents for financial services.
- It assesses the impact of digital transformation in terms of internal organisation and processes, tools and skills, with the goal of increasing effectiveness and efficiency in carrying out its mission to promote the smooth operation of payment systems and to safeguard financial and price stability and consumer protection, but always aligned with the vision on how those changes might be extended and further implemented within the current and future ecosystem.

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 It keeps track of the technological developments linked to financial compliance, commonly known as Regtech, including prevention of money laundering and terrorist financing.

To fulfil its mandate, Banco de Portugal also needs to deepen its understanding of how technological innovation is changing the supply of financial services and the underlying implications for the efficiency, stability and integrity of the financial system, for financial inclusion and for the economy as a whole.

In view of that, Banco de Portugal has been involved in numerous fintech-related initiatives, some of them in close cooperation with other national financial supervisory authorities, aimed at gathering more information about the new players in the financial sector – including fintechs – and taking this information into account in its different roles (eg prudential supervision, conduct supervision, payment systems oversight and financial stability).

Coordination across multiple regulatory authorities is, of course, of great importance, since fintech innovations are relevant not only for all financial regulators, but also for other authorities – eg, agencies in charge of consumer protection, cybersecurity, data protection. Indeed, such an approach is conducive to a higher level of transparency, by effectively clarifying the responsibilities of each of the agencies involved, promotes steady efficiency gains in dealing with fintech issues and, in general, allows for a more comprehensive approach to fintech and thus to achieve a more balanced and consistent regulatory outcome.

By working together with other national financial supervisory authorities, as well as with the fintech industry, Banco de Portugal has not only allowed to gather information on the innovation that these new players intend to bring to the market, but also to establish a fruitful dialogue through which Banco de Portugal provides useful information to fintechs as well.

Some examples of cooperation between *Banco de Portugal* and other entities in the field of fintech

To address internally the challenges underlying the technological innovation in financial services and to ensure a timely monitoring of technological developments in the financial sector, Banco de Portugal has created, in 2017, a permanent substructure of the Specialised Committee for Financial Supervision and Stability, chaired by a Board member, dedicated to digital innovation and fintech – the so-called **SCTECH**. This substructure is translated into a multidisciplinary group, involving several Departments of Banco de Portugal, which has been developing several initiatives, including those focused on promoting the dialogue and cooperation with market participants, to create conditions conducive to innovation in the Portuguese financial market, as well as to accumulate knowledge and technical experience.

The work of the SCTECH is being carried out along four principal topics:

- Communication (eg development of a contact channel dedicated to fintech, conferences and media communication actions);
- External relations (eg Portugal FinLab, fintech meetings and bilateral meetings with market players);
- Knowledge production (eg market characterisation study based on a fintech survey and fintech analysis from the perspective of financial stability);

• Innovation and regulation (eg blockchain proof of concept, internally and within the ESCB community).

These topics have been reflected in the following, non-exhaustive, list of initiatives:

- In May 2018, Banco de Portugal launched the **Fintech+** channel, available in its institutional website, through which it provides clarification on issues related to innovation in financial products and services, as well as relevant information about the initiatives in this field in which Banco de Portugal is involved.
- Another important initiative in this area is the **Portugal FinLab** platform, a
 partnership agreement protocol formally signed on 10 September 2018 between *Banco de Portugal*, the Insurance and Pension Funds Supervisory Authority (ASF),
 the Portuguese Securities Market Commission (CMVM) and Portugal Fintech.⁹³

Through Portugal FinLab, entrepreneurs – and also incumbent financial institutions – are able to receive guidance from the regulators on the regulatory issues that may arise from the implementation of their innovative projects. This guidance comes in various formats, starting with the application process and pitch interactions, and, in some cases, including the issuance of a single report where relevant regulatory bodies state their concerns and signal regulatory red flags to the entrepreneurs in order to enlighten them about the limits imposed by the Portuguese and European legislation.

Portugal FinLab was inspired by the best practices of innovation hubs around the world but has a distinguishing factor: it joins all the financial regulators in Portugal in a single innovation hub, something which was never done before. Innovative start-ups and incumbent institutions are directly led to the regulatory authority(ies) that may provide them with feedback – whether in setting operating limits or in clarifying the legal and regulatory framework – thus allowing for more flexibility and support. For instance, projects needing to be regulated by more than one regulatory authority have a central point of contact, but receive individual feedback from each one of the regulators. The existence of this innovation hub allows regulators to regularly and closely follow new projects and their promoters, thus fostering innovation-related knowledge. Furthermore, Portugal FinLab contributes to the decrease in regulatory uncertainty and associated barriers to the development of new projects.

Portugal FinLab is expected to benefit significantly the fintech ecosystem, including both Portuguese companies and non-resident companies that envisage to operate in Portugal.

- Another type of fintech-related initiatives that Banco de Portugal has been promoting – until now, mostly directed to the payment segment of the financial services – is the organisation of meetings with fintech operators – the so-called **fintech meetings**. These meetings have sparked debate on the challenges that
- ⁹³ See <u>https://www.portugalfinlab.org</u>. Portugal Fintech started in 2016 as the first non-profit fintech community in Portugal. Since then, it evolved into a network of individuals and companies, from start-ups to incumbents, dedicated to the fintech ecosystem. Its mission is to create an ecosystem where every fintech, regtech, insurtech and cybersecurity company in Portugal can easily interact with regulators, legislators, consultants, banks, investors and other relevant entities. The Association was a main propeller of the Portugal FinLab launch, though in the 2nd edition it was, by agreement of the parties, decided that it would assume more of a "Consultative" role and less that of the project's "Operational" responsible.

digital innovation poses to the financial system and regulators, focusing, until now, on the opportunities created by the Payment Services Directive (PSD 2), in particular the new payment initiation and account information services. ⁹⁴ These meetings also addressed the technical specifications of the access interfaces that the account servicing payment providers should offer for secure communication with the providers of (i) account information services, (ii) payment initiation services, and (iii) card-based payment instrument services. It should also be highlighted that these meetings involve not only Banco de Portugal and the fintech companies, but also other regulators, incumbent institutions, and further entities that take part in the discussions, bringing new insights and perspectives on the topic.

- Yet another relevant initiative developed in this area is the "mapping" of the fintech market. In July 2018, Banco de Portugal developed a survey targeting banks operating in Portugal (nearly 40 entities) and aimed at having a clear picture of fintech adoption and reaction by the incumbent credit institutions. The conclusions pointed not only to the strong adoption of certain technologies and services, but also to several challenges ahead. The outcome of the survey was shared with CMVM, which ran a similar exercise at the same time focused on investment services trends, so as to take into account the complementarities between the two studies. Banco de Portugal further developed follow-up activities in this area, through a deep dive of the previous conclusions for the banking sector, and by running new surveys targeted at payment and e-money institutions, as well as at fintech entities.
- Finally, Banco de Portugal has recently approved an "Innovation Operative Model" with a vision to promote an Innovation Culture which favours new ideas and the acquisition of new competencies. In line with the operative model, Innovation Lab was launched to address the challenges, risks and opportunities for changes enabled by technological innovation and has been experimenting challenging internal use cases supporting the central bank functions.

References

Banco de Portugal (2018a): Financial Stability Report, December.

——— (2018b): Payment Systems Report, April.

Financial Stability Board (2017): Financial Stability Implications from Fintech – Supervisory and Regulatory Issues that Merit Authorities' Attention, June.

Portugal FinLab (2019): Portugal FinLab Report.

⁹⁴ Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC and 2013/36/EU and Regulation (EU) No 1093/2010, and repealing Directive 2007/64/EC.

The South African Reserve Bank's experience with fintech

Anrich Daseman, Barend de Beer and Danie Meyer⁹⁵

In South Africa, financial technology (fintech) has attracted ever-increasing interest from innovators, regulators, policymakers and academics over the past decade. Two schools of thought have emerged. The one is evolutionary innovation, which integrates with existing business models along with symbiotic relationships between fintech firms and traditional financial intermediaries, and the other is revolutionary.

In South Africa, as in the rest of the world, fintech service providers tend to reconfigure financial services in a bespoke manner around consumers with innovations such as peer-to-peer lending, alternate mobile payments, crypto-assets (virtual currencies) and initial coin offerings, which disrupt the business models of existing financial products and services. This new breed of financial services is often offered by agile non-banks with small or even negligible capital and focused on consumer pain points.

The South African Reserve Bank (SARB) acknowledged fintech as far back as 2013 and assigned resources to investigate the topic to better understand the phenomenon's regulatory and policy implications for the financial sector and the economy as a whole, and to inform appropriate coordinated responses. South Africa is also committed to staying abreast of, and contributing to, global thought leadership on fintech.

Interventions

In 2013 the SARB joined an informal regulatory working group comprising the Financial Intelligence Centre, Financial Sector Conduct Authority (FSCA),⁹⁶ National Treasury and South African Revenue Service (SARS). In 2014 National Treasury issued a user alert and the SARB a position paper on virtual currencies.⁹⁷ The informal working group was formalised with the establishment of the Intergovernmental Fintech Working Group (IFWG).

In 2016 the SARB established an internal Virtual Currencies and Distributed Ledger Technology (DLT) Working Group. This cross-disciplinary working group, in the context of the growing prevalence of virtual currencies, was tasked with researching the use cases of emerging technologies, including block-chain and DLT.

In 2017 the SARB, in recognition of fintech's extension beyond virtual currencies and DLT, established a broader Fintech Programme with dedicated staff appointed to a newly established Fintech Unit to strategically review the emergence of fintech and to assess use cases in terms of both risks and benefits. The programme focuses on three primary areas: (i) fintech innovations with an impact on policy and regulatory issues; (ii) the collection and assessment of data on fintech; and (iii) the establishment of innovation facilitation structures.

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⁹⁶ The FSCA was formerly known as the Financial Services Board in South Africa.

⁹⁷ <u>https://www.resbank.co.za/RegulationAndSupervision/NationalPaymentSystem(NPS)/.</u>

The programme will review South Africa's position on virtual currencies to inform and develop an appropriate policy framework and regulatory regime. As a regulator, the SARB has a responsibility to promote a sound and effectively regulated financial system. This review will address regulatory issues such as clearing and settlement risks, exchange control impacts, monetary policy and financial stability, and other matters such as cybersecurity concerns. Through collaboration with the other regulatory bodies, matters such as tax implications, consumer and investor protection, and money laundering activities will also be addressed. The SARB is also investigating the possibility of issuing a rand-denominated central bank digital currency from a policy and practical perspective by exploring at least three different design and implementation models.

The programme also includes experimentation with exponential technologies, such as DLT. South Africa successfully completed Project Khokha in 2018.⁹⁸ This project developed a proof of concept (POC) in collaboration with the banking industry and contributed to global knowledge on the use of DLT. The POC replicated interbank clearing and settlement using DLT that allowed the SARB and the banking industry to jointly assess the potential benefits and risks of DLT. The POC processed wholesale payments using Quorum, an Ethereum enterprise DLT. The SARB's role as operator or provider of the national payment system, as well as its oversight and supervisory role, is affected by the advancement of these exponential technologies. Project Khokha assisted the understanding of the impact of such new technologies on the provision of such services. A second phase of this project is currently being considered.

The programme also intends to establish an innovation facilitator or hub, which is the collective term for regulatory guidance, regulatory sandboxes and innovation accelerators. The SARB decided to jointly set up an innovation hub with the FSCA by 2020. This structure will provide innovators with direct support and guidance to understand and navigate through regulatory frameworks. The success of the programme is dependent upon ongoing collaboration with fellow regulators in the IFWG.

The IFWG intends to develop and adopt a coordinated policy approach on financial services activities emanating from fintech. An enabling regulatory environment should nurture fintech innovation while ensuring the continued efficient functioning of financial markets, maintaining financial stability, and protecting the rights and interests of customers and investors. The forum will determine appropriate regulatory frameworks that ensure financial inclusion and the deepening of competition, as well as the implementation of effective anti-money laundering and anti-terrorist financing mechanisms.

The SARB, as a member of the IFWG, hosts annual market outreach events. The IFWG hosted its inaugural workshop on 19 and 20 April 2018, with the objective of providing a platform for regulators and policymakers to engage with industry and to jointly identify key considerations, including risks and benefits to develop a harmonised approach to fintech-driven innovations for the benefit of all South Africans. The conference was attended by fintech firms, incumbent financial institutions, academic institutions, regulators and policymakers, and other stakeholders with a vested interest in the financial services sector in South Africa. The

⁹⁸ https://www.resbank.co.za/Lists/News%20and%20Publications/Attachments/8491/SARB_ProjectKhokh a%2020180605.pdf.

2018 agenda focused on crypto-assets, financial inclusion and innovation facilitation.⁹⁹ The 2019 fintech conference took place on 3 and 4 September and focused on the following topical issues: open banking, digital identity, innovation, artificial intelligence, central bank digital currency and cybersecurity.

South Africa recognises the need for international collaboration, as fintech innovations are borderless with no single authority or jurisdictional boundary, and the need to actively participate in international regulatory and standard-setting bodies such as the various working groups at the Financial Stability Board (FSB) and the Bank for International Settlements (BIS). The SARB has contributed to papers published by these international bodies on topics such as assessing DLT and its impact on payments and securities markets, and the impact of fintech on financial stability. Other work continues on matters such as machine learning, artificial intelligence and digital currencies issued by central banks.

Landscape

Globally, fintech is transforming the financial services sector and could potentially improve efficiencies and reduce the costs of providers while also facilitating seamless real-time personalised customer transactions. In South Africa, this presents the possibility of significant benefits by not only improving the efficiency of the financial sector but also enhancing the financial health of citizens, including those in lower income brackets.

South Africa has an internationally recognised sophisticated financial system which, over the past decade, has been complemented by a small fast-growing fintech industry. In 2016 three South African fintech firms were acknowledged in the 'Fintech 100' list.¹⁰⁰ In 2019 the National Treasury, in collaboration with the World Bank, conducted a study on the fintech landscape in South Africa to support policymaking that does not stifle innovation. The study demarcated the fintech industry into eight market segments in terms of activities, as show in Table 1 (see also Graph 1).

⁹⁹ <u>http://www.treasury.gov.za/publications/other/IFWG%20Report%20April%202018.pdf.</u>

¹⁰⁰ https://assets.kpmg/content/dam/kpmg/xx/pdf/2016/10/fintech100-2016.pdf.

Fintech industry by market segment

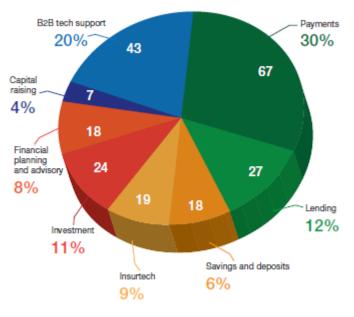
Description of business model	
Entities that perform part or all of the functions required to send and/or receive value from one party to another via any digital channel, including parties in the value chain that facilitate and perform settlement and clearing.	
Entities that facilitate the borrowing of money or finance the assets of individual consumers and/or small businesses with traditional and non-traditional financiers through internet, cloud or app-based platforms.	
Entities that are deposit-taking and provide digital banking services (including banking as a platform) as well as savings products using mobile technology.	
Entities that provide part or all of the insurance value chain functions (eg communication risk analysis, distribution) through the use of specific technologies (eg artificial intelligence, robotics) instead of traditional methods.	
Entities that provide digital platforms for investment and/or trading activity (including cryptocurrency) or enable individuals to trade on traditional exchanges/platforms from their own device(s).	
Entities that use artificial intelligence and/or robotics to provide financial advice to individuals or small businesses by recommending suitable savings, investment or credit products, and by managing financial wellness.	
Equity or debt-funding platforms that allow businesses or individuals to raise funds for investment purposes or charitable causes, including digital due diligence service providers.	
Entities that create or support platforms and/or products provided by other financial services providers for use by other fintechs but do not provide financial services to the general public through their own brand name.	

The market scanning exercise indicated a total of 222 active fintech companies in South Africa, with some operating across more than one market segment. Where this was the case, these companies were included under both segments. The fintech firms included in the diagnostic are those established in the past 11 years and which currently have a physical presence serving South African clientele.

Table 1

Number of South African fintech firms

by market segment



Source: National Treasury, Fintech Landscaping Study 2019

Source: South African Reserve Bank.

This initiative created the basis for a South African fintech registry. As it is a fastchanging industry, it is essential that regulators implement a sustainable and appropriate approach to monitor developments and engage with participants, and to establish the ability to collect both granular and aggregate data.

Currently, fintech firms are monitored through manual interventions and it is envisaged that in future a fintech data hub would provide a state-of-the-art capability that will enable fintech firms to register, update profiles, engage with multiple regulators through a single point of entry and provide data in multiple formats, as well as to provide regulators access to this data warehouse.

Approach

South Africa adopted the FSB's definition of fintech which is 'technologically enabled financial innovation that could result in new business models, applications, processes, products or services with an associated material effect on financial markets and institutions, and the provision of financial services' (FSB (2017)).

Fintech is therefore applicable to a wide range of activities, including electronic payments, automated advice, delivery channels, cybersecurity and peer-to-peer lending. In South Africa a variety of entities are involved in fintech. These do not only include start-ups or new entrants, but also scale-ups, mature companies and non-financial services companies such as telecommunication providers and e-retailers.

Fintech also does not only refer to technologies such as DLT or block-chain. South Africa intends to put in place a regulatory model that could respond to the dynamic nature of the financial sector. The regulatory model emphasises a consistent and harmonised approach to financial sector activities, irrespective of whether the entity performing the activity is a 'traditional' financial institution or a fintech firm. The focus would be on the financial service activity or function, neutral of the entity or technology.

Fintech Data Hub

The IFWG's fintech data initiative intends to move beyond the hype to understand the pace of change based on actual data. The fintech data initiative is focused on harmonising, collecting and analysing data on innovations such as initial coin offerings, virtual currencies, crowdfunding or emerging alternate payments platforms.

Currently, the SARB manually sources data from crypto exchanges on a voluntary basis. The data team is in the process of finalising a multi-party information-sharing non-disclosure agreement between the crypto-assets businesses and the following regulators: SARB, Financial Intelligence Centre, FSCA, National Treasury and SARS. Through this agreement, any institution may volunteer or agree to provide aggregate or granular fintech data to the IFWG members through an established Fintech Data Hub. It is envisioned that such a hub may be in place during the latter half of 2020.

The hub will also operationalise South Africa's fintech institutional registry. The registry will provide IFWG members with a dynamic view of active and emerging fintech firms in South Africa, including initial operational information for an assessment of the business model and risk. The hub's design has been carefully considered to ensure alignment with the Financial Action Task Force's recommendations for virtual asset service providers. Fintech firms may also be able to update their information, submit information to the IFWG and register themselves as they start operating via a governed self-service capability. The hub will be domestically based, will meet all required data protection and privacy regulations, and will facilitate common fintech definitions across regulators to enhance cooperation and collaboration efforts.

Macroeconomic statistics

The disruption brought about by fintech has impacted economic activity and affected the compilation of macroeconomic statistics. The question is how to methodologically treat the activities and classify the entities involved in technologyenabled financial innovation within the conventional macroeconomic statistical framework and related statistical domains.

The key challenge is to appropriately identify whether fintech firms operate within the 'traditional or known markets' while applying innovative technology to improve existing processes, or whether they are developing 'new markets' which may not be captured by conventional data sourcing methods.

The importance of fintech also varies globally across jurisdictions and is therefore not yet well recognised or appropriately measured in official statistics. However, the expanding nature of fintech activities compels international organisations and central banks to launch initiatives to close data gaps and to consider adapting methodological practices and macroeconomic frameworks. Fintech data to measure activities and compile statistics could be approached from either a supply-side or a demand-side (needs of data users) approach to identify and fill data gaps. The supply-side approach entails the sourcing of data from various identified market entities engaging in fintech activities – ranging from formalised exchanges for crypto-assets to selected private fintech entities with a significant economic impact and that participate in a wide range of fintech-related activities. However, this conventional approach to data sourcing is constrained by the lack of a globally harmonised and agreed-upon business and statistical classification of the fintech landscape related to entities, activities and financial instruments. It would also be beneficial to compile demand-side fintech statistics to measure the drivers of demand for fintech-enabled activities, as opposed to the more conventional channels.

It is important to reach an agreement on the conceptual treatment of fintech activities/entities within the macroeconomic statistical framework and to implement this agreed-upon principles uniformly at a national and international level – similar to the harmonisation drive that has been undertaken with respect to the more conventional statistical domains. Should this not be done, and statisticians continue only to rely on data from conventional mainstream financial entities, they run the risk of missing an important and evolving dynamic portion of the economy. However, the impact of this would be difficult to measure in the absence of formal statistical classifications and cooperation between national and international authorities (eg national statistical agencies). In this respect it is critical to: (i) agree on defining fintech activities; (ii) identify fintech firms; and (iii) maintain updated fintech entity lists. Furthermore, the concept of fintech should not necessarily be restricted to financial entities, as non-financial entities might also be operating business models that are intrinsically similar to fintech activities (which should also be captured in official statistics).

Various fintech activities already operate in the space of known macroeconomic statistical instruments, ranging from quasi deposits, to providing loans and raising capital (Table 2). Certain fintech activities and related business models can be linked to the conventional macroeconomic statistical framework.

Business models and the	Table	
Fintech activity	Business model	Conventional instrument
Savings and deposits	Ranges from digital banks to lay-buy and community-pooled savings such as stokvels	Deposits
Lending	Lending brokers (facilitator) and alternative lenders (own balance sheet)	Loans
Capital raising	Equity or debt funding platforms that allow businesses or individuals to raise funds for investment purposes	Debt securities/equity
Virtual currencies	Cryptographic assets are transferrable digital representations (assets), designed to prohibit their duplication	Non-financial assets

There are also alternative types of fintech activities and business models that do not necessarily fit into the conventional macroeconomic statistical framework, although these types are still relatively small in South Africa. However, the existence thereof and possible growth necessitate a comprehensive and inclusive macroeconomic statistical strategy. The Economic Statistics Department (ESD) of the SARB, in collaboration with the Fintech Unit, intends to embark on a process to develop a strategy to measure fintech in South Africa. The strategy will involve: (i) an understanding of the fintech landscape; (ii) the identification of fintech activities and business models; (iii) building a database of fintech entities; and (iv) sourcing data.

References

Financial Stability Board (2017): Financial stability implications from fintech, June

H2 Ventures and KPMG (2016): "FINTECH100 Leading Global Fintech Innovators". https://assets.kpmg/content/dam/kpmg/xx/pdf/2016/10/fintech100-2016.pdf

Fintech data cooperation in LAC countries: advances and challenges

Anahi Rodriguez and Serafin Martinez Jaramillo, CEMLA¹⁰¹

Motivation

In Latin America and the Caribbean (LAC) countries, the impact of the fintech industry varies on important dimensions such as the financial service provision, regulation, cooperation with other institutions, among others. In some jurisdictions, fintech firms are providing financial services, such as neobanks, fintech credit institutions, fintech insurance companies, and fintech providers of payments, clearing and settlement services. For instance, most of LAC countries identified that in the last years there has been a surge of fintech credit institutions and fintech providers of payments, clearing and settlement services as well. In contrast, fintech asset managers, fintech insurance companies and neobanks have developed more slowly.

Fintech firms have different development across countries. In Brazil, fintech credit institutions are allowed to provide other services, such as credit analysis, insurance distribution and issuance of electronic currency. In the case of Surinam, most of the fintech firms collaborate with an existing bank. In Uruguay, fintech firms are also providing services for check discounts and, in a relative low proportion, services as foreign currency exchange. In El Salvador, fintech firms provide services for alternative credit scoring. Costa Rica has not yet identified fintech firms with total clarity.

In most of the jurisdictions, traditional financial institutions are facing competition from fintech firms, especially for credit institutions and providers of payments, clearing and settlement services. In Peru, Argentina and Chile, insurance companies are also facing competition from fintech firms.

The impact of fintech on financial services provision is already being analysed by some LAC jurisdictions. In Brazil, it is observed that fintech credit institutions (eg credit platforms) are granting credit to new segments, such as neobanks. In the case of Ecuador, Uruguay, El Salvador, Argentina, Surinam and Mexico, fintech payment service providers are granting services to new segments. In most of LAC countries, traditional credit institutions are using fintech to extend credit.

Statistical implications

Brazil, Costa Rica, Ecuador, Mexico and Uruguay reported that their central bank is the authority that is regularly gathering information on fintech. In some other jurisdictions, another regulatory authority (other than the central bank) is collecting this type of data (Ecuador, Argentina and Mexico).

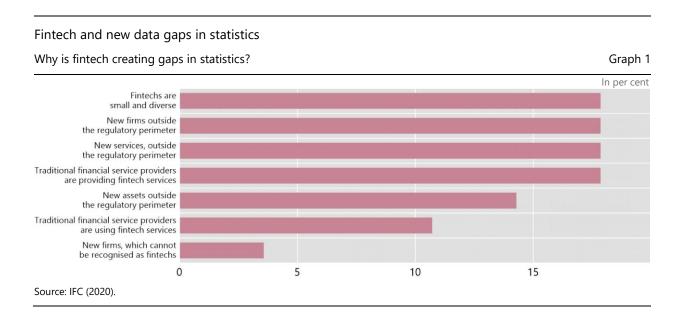
In many of the countries, there is not a (working) definition of fintech firms yet; indeed, only Brazil, Mexico, and Surinam have one. In the case of Mexico, this definition is available in the Mexican Fintech Law issued in 2018, where the legal figure of financial technology institutions (ITF) was created. In the case of Brazil, the Central

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Bank authorises in 2018 and regulates two types of fintech through resolutions 4,656 and 4,657. The first one refers to direct credit, such as credit operations through electronic platforms using own resources. The second one refers to peer-to-peer lending (performing a financial intermediary role). Besides their role in credit these types of fintech firms can provide other services to their clients. In the case of Surinam, the Central Bank defined fintech firms as a "technologically enabled financial innovation that could result in new business models, applications, processes, or products with an associated material effect on financial markets and institutions and the provision of financial services".

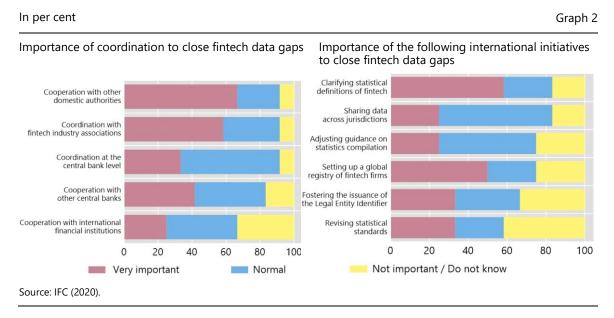
According to LAC jurisdictions, fintech is creating data gaps in statistics mainly because the firms are small, diverse and outside of the regulatory perimeter; furthermore, traditional financial services are offering fintech services. For instance, the Central Bank of Brazil highlighted the challenge of identifying the share of fintech services from traditional financial service providers using/providing fintech services (Graph 1).



Few countries agree that fintech data gaps are related to the lack of an internationally-agreed statistical definition of fintech firms and services.

In this regard, 64 percent of LAC jurisdictions identified that there is not a regular cooperation or exchange between authorities on fintech with regard to data or analysis (eg on the development of market structures) – see Graph 2. In the case of Mexico, Banco de Mexico has a regular cooperation with the National Banking and Securities Commission (CNBV) and the Ministry of Finance. In the case of Chile, the central bank has communication on fintech issues with the other national authorities, such as the Financial Market Commission (CMF), the Ministry of Finance and the Ministry of Economy, Development and Tourism, and the Financial Stability Council.

Cooperation and coordination



LAC countries pointed out that it is important to have coordination at the central bank level (eg fintech hub) as well as with the fintech industry associations. Mexico, Ecuador and Perú highlighted that it is also important to have cooperation with other domestic authorities (eg National Statistical Office (NSO)), and also with other central banks and international financial institutions.

Additionally, there are some international initiatives that are important to close fintech data gaps. According to LAC countries, the most important are: adjusting guidance on statistics compilation (eg national accounts, balance of payments), clarifying statistical definitions of fintech (firms and services), fostering the issuance of the Legal Entity Identifier and revising statistical standards. Additional initiatives include sharing data across jurisdictions and setting up a global registry of fintech firms.

Finally, LAC countries have not yet clarified in which areas of fintech measurement there is a need of more intensive cooperation with NSOs. Surinam highlighted that demand-side data collections (eg surveys on household use and financial inclusion) is the area that needs more intensive cooperation with the NSO.

Response

Some LAC jurisdictions are launching statistical initiatives to collect fintech data and cooperate with other data providers and authorities. Countries such as Brazil, Chile, Surinam, Argentina and Ecuador have already started with some of them.

For instance, Brazil is adjusting reporting requirements to cover fintech firms (eg neobanks), collecting financial statements from fintech firms, collecting loan-level data, and updating lists of fintech firms. Chile is developing internal cooperation through an internal fintech hub and also is updating a list of fintech firms. Additionally, Argentina is carrying out fintech credit simulations on websites to generate databases on financial costs of online credit.

Ecuador and Surinam are implementing quite a number of initiatives such as adjusting reporting requirements to cover fintech firms, amending financial access surveys, collecting financial statements from fintech firms, designing financial access surveys from households and non-financial corporations, updating lists of fintech firms. In particular, Ecuador is also using web-scraping techniques, data from commercial vendors and data compiled by other agencies through data sharing arrangement. Surinam is implementing internal cooperation through an internal fintech hub and collecting loan-level Statistics as well as data on government use of fintech services.

In this sense, Ecuador has already identified, in a special position, fintech firms in their current statistical classification system. More specifically, the Central Bank is working on a statistical auxiliary payment system which contains some of fintech firms.

As already mentioned above, Mexico and Chile have developed significant experience in terms of cooperation for collecting data on fintech services with other authorities. In the case of Mexico, Banco de Mexico has a regular cooperation with the National Banking and Securities Commission (CNBV) and the Ministry of Finance. In the case of Chile, the Central Bank communicates on fintech issues with other national authorities, such as the Financial Market Commission (CMF), the Ministry of Finance, the Ministry of Economy, Development and Tourism, and the Financial Stability Council.

Lessons

Fintech industry is developing at high speed, so it is necessary to advance with the same pace as regards regulation, data collections and even more so cooperation between different authorities and statistical offices to close data gaps.

It is important to highlight the need for a common ground about the definition of fintech firms and the identification of their activities which does not exist yet in LAC countries. The implementation of a Legal Entity Identifier (LEI) would be useful to collect data and identify the activities of this type of firms. The use of new technologies and methodologies, such as web scrapping, blockchain, text mining, could facilitate the building of fintech databases, enhance data quality and support information standardisation among statistical authorities.

Finally, for LAC countries it would be useful to implement a legal framework for fintech firms as Mexico and Brazil did in 2018. The creation of a Fintech Law could be a first useful step to start the regulation and monitoring of fintech firms and their activities, and would also provide the basis for establishing cooperation among authorities and statistical offices. International cooperation is also important to deal with money laundering activities and the financing of criminal activities, which could have significant effects on financial stability.

Reference

Irving Fisher Committee (2020): "Central banks and fintech data issues", *IFC Report*, February.

Fintech at Swiss Banks

Cornelia van Wersch, Swiss National Bank¹⁰²

In the fourth quarter of 2018, the SNB sampled 34 banks with the aim to gain a representative snapshot of how digitalisation and fintech are currently influencing banks predominantly operating in the deposit and lending business (SNB (2019)).¹⁰³ At the same time, the Institute of Financial Services Zug, IFZ, conducted its fourth review of the Swiss fintech market (IFZ (2019)).¹⁰⁴ Both studies sought to investigate how traditional banks are dealing with the digitalisation of the financial system and how they position themselves towards fintech.

In the meantime, Swiss data compilers are monitoring the changing landscape and have commenced to engage with their respondents to discuss, inter alia, the reporting of new instruments. Among the first economies, Switzerland's financial industry has started to build a bridge between traditional finance and the digital asset industry. While two crypto start-ups received a banking license in August 2019 and were added to the pool of reporters for the SNB banking statistics, traditional banks have also become active in blockchain and crypto finance.

Recent surveys on digitalisation and fintech in Switzerland

According to the SNB survey, banks expect a strong level of digitalisation in areas like payments, mortgage business as well as internal processes; they view this as a source of opportunities to cut costs and improve service quality, The key risks cited by the banks are the erosion of margins and the possible loss of direct customer interfacing. Believing that customers will increasingly turn to multiple banking and non-banking intermediaries – such as bigtechs and digital banks – for best service, banks are strategically seeking to bring their existing business models to a high level of digital maturity. ¹⁰⁵ Enhanced user-attractiveness will include efforts towards automation of account opening, the digitalisation of credit checks and ongoing borrower monitoring. Despite digitalisation, personal contact will continue to play an important role in the banks' view.

Generally, banks envisage increasingly fierce competition among incumbent market participants, intensified further by emerging digital banks and bigtechs (cf Graph 1). Bigtechs are becoming active primarily in the areas of payments and 'other lending' (ie lending other than mortgages, such as consumer loans or corporate lending). By contrast, banks view fintechs more as partners than as competitors.

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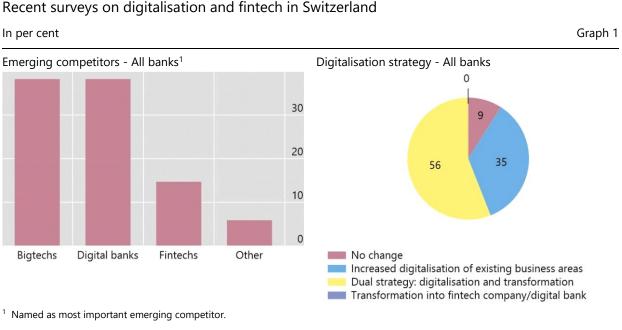
¹⁰³ https://www.snb.ch/en/mmr/reference/Fintech 20190827 umfrage/source/Fintech 20190827 umfrage.en.pdf.

¹⁰⁴ Cantonal banks, regional and savings banks, Raiffeisen, and private banks were among the participants in the survey. Though the IFZ survey cannot be considered representative for banks, it nevertheless provides indications on the tendencies of Swiss banks' IT strategies and challenges (see Chapter 7, IFZ (2019)).

¹⁰⁵ The *distributed bank* scenario is one of five possible scenarios based on the BIS document «Sound Practices – Implications of Fintech developments for banks and bank supervisors».

According to the 'IFZ Fintech Study 2020', the Swiss fintech sector has grown significantly with 382 active fintech companies by the end of 2019.¹⁰⁶

Thus, fintech companies are increasingly becoming an integral part of the financial industry by providing innovative solutions to support established financial institutions in their digital transformation. Both studies concluded that digitalisation and strong market penetration by new participants could contribute to consolidation in the industry.



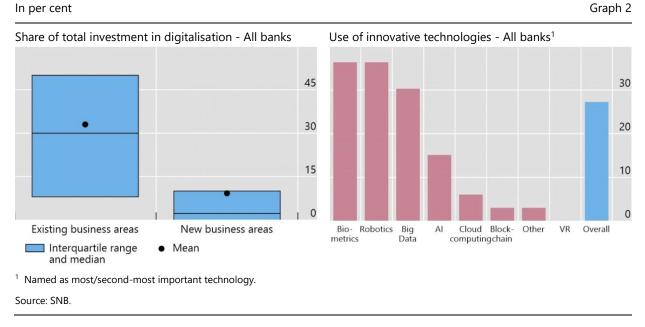
Source: SNB.

As the SNB-survey shows, the majority of banks are supplementing the digitalisation of their existing business areas with products and services typically offered by new market participants (cf Graph 1, right-hand panel). Examples include the payment app TWINT, the provision of crowdfunding/crowdlending platforms, and robo-advisory offerings. Especially in the payments area, banks consider necessary to enhance their existing solutions going forward, since new market participants are set to increase competition in terms of fees and user-friendliness, particularly for cross-

However, both surveys show that banks consider digitisation and optimisation of *existing* business areas as of a substantially higher priority compared to investing into new business areas, products and services (cf Graph 2, left-hand panel). Both studies also reveal that blockchain or Distributed Ledger Technology (DLT) are relevant for only a small number of banks currently and this expected to remain so in the very near future (cf Graph 2, right-hand panel).

border transactions or transactions in foreign currencies.

¹⁰⁶ IFZ (2020).

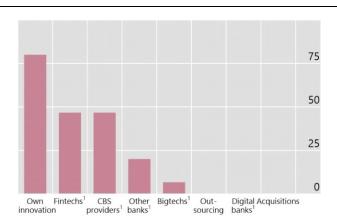


Digital innovation among Swiss banks

In their innovation strategies, larger banks predominantly focus on developing proprietary solutions or seek to cooperate with relevant market participants, above all with fintech firms and providers of core banking systems (cf Graph 3). Smaller banks less likely opt to develop their own innovative solutions and instead cooperate with a wide range of market participants, including fintechs, or acquire innovations from third-party providers.

Strategically important measures - Larger banks

In per cent



¹ Named as most/second-most important strategic measure. ² Cooperation/collaboration with relevant market participants

Source: SNB.

94

Graph 3

Fintech in Statistics

Fintechs and cryptoassets did not exist when the IMF and the UN last revised the main macroeconomic statistical manuals.¹⁰⁷ Since 2013, the Swiss regulator FINMA¹⁰⁸ has been paying close attention to the challenges arising from new technological developments in finance, and is responding to large numbers of queries related to regulatory or reporting matters.¹⁰⁹ FINMA communicates this information by publishing "Guidelines", such as one on the "Regulatory treatment of initial coin offerings: FINMA Guidance 04/2017", as well as through circulars and press releases. When approached by banks with queries on the correct reporting of crypto finance, the SNB Statistics Department works closely with FINMA to apply present Swiss accounting regulations coherently. The SNB also closely monitors new market entrants in the field of mobile payment statistics. In addition, national accountants and balance of payments compilers monitor fintech start-ups that have no banking license for their domestic and cross-border transactions, respectively.

References

IFZ (2019): "IFZ FinTech Study 2019. An overview of Swiss fintech".

International Monetary Fund (2018):"*Treatment of Crypto Assets in Macroeconomic Statistics*.

Swiss National Bank (2019): "Survey on Digitalisation and Fintech at Swiss Banks", August.

¹⁰⁷ Consequently, no international guidelines are available except a paper prepared by IMF staff in 2018 (IMF (2018)) and updated in 2019. This paper bases digital token classification on recommendations from the IFRS and the Swiss FINMA and Singapore MAS regulators, with the main conclusion that *Bitcoin-like crypto assets* (BLCAs) are to be treated as produced *non*-financial assets.

¹⁰⁸ See fintech dossier at <u>https://www.finma.ch/en/documentation/dossier/dossier-Fintech/</u>, where it is also stated that FINMA promotes Swiss fintech interests at a global level by actively engaging in a number of international bodies and bilateral Memoranda of Understanding.

¹⁰⁹ To boost innovation, the Swiss parliament has introduced a fintech licence, which FINMA is responsible for granting. The fintech licence allows institutions to accept public deposits of up to CHF 100 million, given that these are not invested and no interest is paid on them (cf https://www.finma.ch/en/authorisation/Fintech/Fintech-bewilligung/).

Digitalisation and adoption of fintech in Germany: gathering survey evidence on households

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Abstract

Research on fintech typically relates to the supply side; there is little evidence on the demand side, especially the household sector. We analyse the adoption of fintech solutions by households in Germany. Setting up a special module of the German wealth survey (PHF) with almost 4,200 active participants, we shed light on households' awareness and usage of two specific fintech services: robo-advisors and online credit platforms. We link it to the much more general concept of innovation (ie digitalisation) –, since, for households, digital competence determines much of the costs and benefits of fintech. We find that only a limited number of households are aware of robo-advisors and even fewer use this service. On the other hand, almost half of the individuals in Germany are aware of online credit platforms and about 12% of those use them. We suggest a three-stage model for adoption. Awareness of credit platforms is positively related to the level of digitalisation and negatively to age, and is less prevalent among women. Latent adoption (the willingness to consider using credit platforms when the need arises) is strongly related to digitalisation and, in addition, depends on age, income, gender and wealth, but also on social and financial networks. Among those who are ready to make an evaluation, concrete adopters (real users) are much more interested in speed and convenience, and worry less about data privacy and anonymity than those who have not yet adopted the service. As digitalisation will be increasingly universal in the years to come, also given the shifts induced by the ongoing pandemic, the spread of fintech usage can be expected to increase.

JEL-Code: C83, O33, M13, L 86

Keywords: Fintech, digitalisation, diffusion, innovation, household finance

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Introduction

Financial industries in Europe and the world are undergoing a transformation, fuelled by the successive steps of digitalisation. Fintech companies offer a range of new services at the household level, eg crypto-assets, robo-advisors and credit platforms, which have the potential to challenge the predominant role of banks in retail credit and financial investment. Just as with personal computers and mobile phones, fintech is changing the life of consumers directly. However, available information on fintech services typically relates to the supply side only. There is very little evidence on the demand side on the use of fintech. Who are the users? For what purposes is fintech used? What other, more traditional services may it replace?¹¹²

In an ongoing research project by the Deutsche Bundesbank, we analyse the adoption process of fintech services for households in Germany. Using survey data from a special module of the German wealth survey (PHF) on almost 4,200 participants, we shed light on households' awareness and usage of two specific fintech services: *robo-advisors* and *online credit platforms*. We link fintech adoption to *digitalisation*, a rather general and fundamental innovation. In our view, digital competences will determine much of the costs and benefits of fintech at the household level.

The results shown in this paper are all preliminary; the purpose is not so much to state new results but rather to gauge the potential of classical survey statistics in solving empirical issues on fintech use and adoption.

Analytical framework

We model the adoption of fintech solutions as a multi-stage process, adapting the mainstream theory of innovation diffusion to the issue of fintech use by households (Graph 1). As with other innovations, the first stage of the adoption process is awareness.¹¹³ Only households that are aware of a new product or service can consider it as part of their choice set when making a decision. In the second stage, they have enough knowledge about the new alternative to be able to make an abstract evaluation. If the evaluation outcome is positive, we label it a *latent adoption*: the household is ready to consider the innovation as a relevant (potential) solution when the need arises.¹¹⁴ Latent adoption is not the same as actual adoption – the third stage – because many financial services, such as financing purchases with credit, insurance or investment decisions, are actually made only intermittently, some only once in a lifetime. The decision on actual implementation is thus made with a view to the concrete circumstances of the financing decision at hand. In the second and third stage of adoption, classical cost-benefit analysis is expected to play an important role - more abstract in the second stage and very concrete in the third stage. A number of factors can influence this evaluation of costs and benefits, eq age, human capital levels, experience with related technologies, social network effects, etc.

¹¹² An exception is the study by Henry, Huynh, Nicholls and Nicholson (2019) on the use of bitcoin by households.

¹¹³ The standard reference is the pioneering work of Rogers (2003), now in its 5th edition. The first edition was published in 1962.

¹¹⁴ In the five stages of innovation diffusion described by Rogers (2003), this is the "persuasion phase".

1st stage: awareness

depending a.o. on preferences, benefits and costs of adoption

2nd stage: latent adoption - innovation considered a relevant alternative

as above, when triggered by concrete needs, eg credit demand

3rd stage: concrete adoption

Source: Authors' elaboration.

Among those determinants, we consider in particular the role of *digitalisation*. We argue that much of the cost side of fintech is captured by the personal level of digitalisation. If a person is highly digitalised, the remaining costs of using fintech services are rather specific to the financial situation of the consumer. On the other hand, if the household is not digitalised at all, eg has no internet access, the costs of adopting fintech services are prohibitively high. Digitalisation is thus an *enabler of fintech services* on the demand side. With our survey information, we are able to measure all three stages of the adoption process of online credit platforms and the level of digitalisation of households. This paper presents preliminary results; we will focus on descriptive evidence of awareness and on the two stages of adoption.

The database

In summer 2019, the survey team in the Bundesbank's Research Centre administered a survey on the use of fintech services as a module of an interim paper-and-pencil (PAPI) survey of the "Panel on household finances (PHF)".¹¹⁵ As the module is fully integrated into the household panel, it is possible to link the answers regarding the fintech questions to pre-existing panel information from the main face-to-face survey (CAPI). Among other things, this information includes an extended set of socio-demographic variables and details on households' asset holdings and liabilities. In total, we contacted 5,835 households and 10,397 people all over Germany. All the members aged 16 or older of the households participating in the main survey were contacted. The response rate was 40.6%, or 4,172 individuals. Not all respondents had

¹¹⁵ The PHF survey (Panel of Household Finance) is the German contribution to the Household Finance and Consumption Survey (HFCS), a set of harmonised surveys on households' assets and liabilities in the euro area. In terms of methodology and content, the PHF is comparable to the Survey of Consumer Finances (SCF) of the Federal Reserve Board but, unlike the SCF, it is conducted as a panel survey. The regular Computer-Assisted-Personal-Interview ("CAPI") surveys of the PHF collect detailed information on households' assets and liabilities every three years, and they are supplemented with interim Paper-and-Pencil ("PAPI") surveys in the year before the main CAPI surveys. Those interim surveys are administered to all panel members. For more details on the PHF, see von Kalckreuth et al (2012) and <u>www.bundesbank.de/phf-research</u>.

internet access though. Thus, for the major part of the analysis on fintech use and awareness, the sample consists of 3,712 observations.

Key empirical concepts

We focus on two services: online credit platforms and robo-advisors. To measure households' awareness, we use direct questions about whether respondents have heard of these fintech services. Similarly, for actual use/adoption, we ask about use of the service at present or at any time in the past.

To model the second stage of the adoption process of online credit platforms as described above, we need a measure of latent adoption. We extract it from a hypothetical question: respondents were first asked to state whether they would potentially be willing to take out a loan within the next five years for a number of stated purposes and then whether they would consider an online credit platform for taking out the loan. The latter are considered "latent adopters".

In order to measure digitalisation levels of households, we use three different digitalisation indicators (DIs). All of them are based on four survey questions: "How often have you used the internet in the last three months?", ¹¹⁶ "Do you use online banking for the account you use for the majority of your payments?", "Do you order securities online?" and "Generally speaking, do you like to settle transactions and other matters via the internet?". Although the measures are rather dissimilar in terms of construction, the DIs correspond very well with each other.

Preliminary results

a. Use and awareness of robo-advisors and online credit platforms

Using population weights on the data, we find that only a rather limited number of residents in Germany are aware of robo-advisors (< 8%) and even fewer use them: less than 10% of those who know about the service. On the other hand, almost half of the individuals are aware of online credit platforms and, of those, about 12% use them. Perceived advantages of online credit platforms are low fees, high speed and convenience. Perceived disadvantages include concerns about safety, data protection, but also issues of clarity and comprehensibility. Credit platforms seem to be especially relevant for people who are likely to borrow money for maintaining buildings, buying a car, and restructuring credits (40% to 50% of citations). To a lesser extent – less than a third – they are relevant for potential buyers of homes and other types of credit. Around 56% of those that had heard about credit platforms state that they might be willing to borrow in the future. Among those, about one third say that they would consider online platforms for at least one of a number of stated credit purposes.¹¹⁷

¹¹⁶ Households without internet access were not asked about their awareness and use of fintech services. However, they were asked about whether they would be willing to take out a loan (see below) and whether they consider online loans as an option.

¹¹⁷ This may not be considered as a potential market share since there are several purposes and the propensity to consider credit platforms is associated with smaller credit values.

Three household-level digitalisation indicators (DIs)

DI 1: Ad hoc grouping

- Level 2 internet several times a day, online banking as a rule, plus either the respondent states s/he is typically ordering securities online or likes very much doing business online.
- Level 1 Internet use at least several times a week and not level 2.
- Level 0 internet use once a week or less, or no internet access.

DI 2: Cluster analysis groupings

Respondents are grouped according to the similarity of their digitalisation data using cluster analysis. We choose a hierarchical clustering that results in 4 groups.

DI 3: Predicted fintech adoption probability

We regress actual fintech use on all of the four indicators described above (and nothing else) and compute predicted probabilities from that regression for each household. DI 3 implicitly weights the answers on the digitalisation questions by relevance for fintech use, which is very convenient. It has the added advantage that it is continuous and bounded between 0 and 1. Note that DI 3 is to be treated as a generated regressor in the context of regression analysis.

Source: Authors' elaboration.

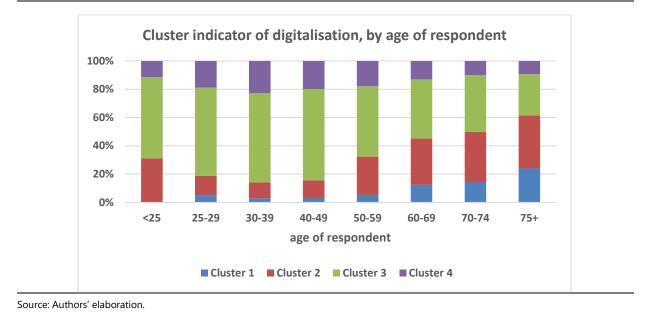
b. Digitalisation

In order to describe the adoption process, we need to look at digitalisation levels of the respondents, and we present some population-weighted figures first. More than 60% of German individuals with at least 16 years of age use the internet several times a day, around 13% do not use the internet at all or do not have access. Online banking is the main mode of operation for around 64% of adults, and around 31% of individuals use it rarely or (mostly) not at all. Only one third of users with internet access have a securities deposit. Among those, around one-third usually order online, and another 10% sometimes. Almost 20% like to settle transactions online very much, around 15% never do so. "Settling transactions" refers not only to finance, but quite generally also to purchases, applications, taxes and municipal matters.

Graph 2 shows the age profile of digitalisation according to DI 2, the clusterbased measure yielding a partitioning into four groups. Cluster 1, the lowest-ranking cluster, happens to be equivalent with level 0 of DI 1: it comprises people that have either no internet access at all or use it less than once per week. Cluster 4 is the highest level, with the unweighted frequency of 14.8% in the sample. The pattern of digitalisation according to age is U shaped in the unconditional tabulations. The initial increase is due to the fact that a number of the underlying digitalisation characteristics become relevant only at a higher age and income.

Ordered probit models regressing the cluster digitalisation indicator DI 2 on socio-demographic characteristics show that digitalisation varies strongly with major socio-demographic characteristics of households and individuals. Controlling for other characteristics, such as income, gender and education, the relationship of digitalisation to age is no longer inverted U shaped, but rather monotonously decreasing. Women are clearly less digitalised. The relationship with education, measured by ISCED attainment, and with household income is positive. The income of the reference group – "your acquaintances" – is very important; it is even more informative than the income of the respondent's own household.

Age profile of digitalisation



Unconditional tabulation

c. Awareness

Awareness of credit platforms covaries strongly with the level of digitalisation as measured by DI 2. Interestingly, and somewhat unexpectedly, with digitalisation and some other socio-demographic control variables given, no additional influence of education (ISCED) on awareness is detectable. On the other hand, we can see strong social network effects in various dimensions.

By means of a standard probit model not controlling for endogeneity, we learn that awareness regarding credit platforms varies strongly with digitalisation – the influence is exceedingly high. Women are generally less aware of credit platforms, even after controlling for age. The pattern of awareness according to age group shows an inverted U shape: an increase in the younger decades and a decrease in older age. Awareness increases with household income and – again – quite strongly in the income of the reference group. The covariation with household wealth is clearly negative. This may indicate that credit platforms are interesting for people who are not (yet) settled financially – consistent with this, the existence of a house bank relationship decreases awareness. The availability of credit from friends and relatives is positively related to awareness.

Social networks – friends and relatives on the one hand, and the reference group of personal acquaintances on the other – are important for both digitalisation and awareness of credit platforms.¹¹⁸ For awareness, financial networks (the house banking relationship) are also important.

Graph 2

¹¹⁸ We ask for the distribution of income among "personal acquaintances" and use the median to characterise the income of the reference group. Furthermore, as part of the ordinary panel survey, we have information on whether a household is able to borrow from friends and relatives.

d. Latent adoption and actual adoption

Regarding stages 2 and 3 of the adoption process sketched in Graph 1, it is necessary to keep the effects of conditioning in mind. Of the 4,172 respondents, 446 drop out, mainly because they lack internet access. For the remaining 3,712 respondents, awareness regarding online credit platforms can be measured. 2,108 respondents (56.8%) are aware of online credit platforms, the rest is not. Out of those, 1,162 respondents (72.5%) express willingness in principle to borrow. Of these, 518 consumers (44.6%) turn out to be potential adopters, 644 (55.2%) are not. The observational basis for analysing adoption conditional on awareness is thus much smaller than for awareness itself.

Our analysis of the factors influencing latent and actual adoption is yet inconclusive and preliminary. According to the theory of innovation diffusion, the adoption decision will result from the interplay of consumer preferences and the (perceived) characteristics of traditional loans versus loans from online credit platforms, as well as from the cost and benefit factors related to the sociodemographic situation of the individuals. Looking at later stages of adoption, we need to keep the earlier stages in mind. Individuals aware of the possibility to take out a loan from an online credit platform state that data protection and confidentiality, collateral requirements as well as convenience and speed are important factors they consider when making a decision between online credit platforms and other means of acquiring a loan. Actual users are much more interested in speed and convenience, and worry less about data privacy and anonymity than those who have not yet adopted, and they believe that online credit platforms are superior in terms of convenience and speed.

Interestingly, latent adopters exhibit digitalisation levels very similar to those of actual adopters, even in terms of distribution, see Graph 3. This confirms the value of the analytical concept of latent adoption, and we may infer that, *given latent adoption*, the decision to actually take out a loan via an online credit platform is driven by factors other than digitalisation.

In a regression with fintech adoption (either latent or actual) as a left-hand side variable, digitalisation clearly needs to be considered as endogenous: in parts at least, the two attributes are likely to be driven by the same unobserved characteristics. In our analytical work ahead, we will rely on multivariate probit and instrumental variable techniques to take account of this basic underlying simultaneity.¹¹⁹

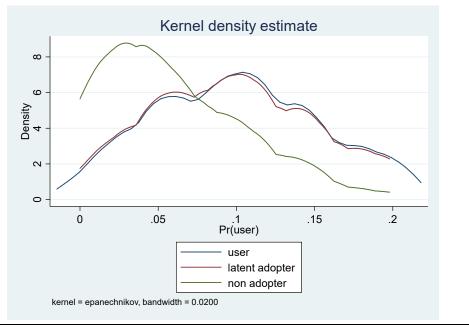
Projecting the future diffusion of fintech services

We have seen that key preconditions for the use of credit platforms are awareness and digitalisation. Further, propensity of usage is higher among younger people. Awareness is partly endogenous. Thus, if credit platforms continue to be a success, awareness will cease to be a limiting factor.

¹¹⁹ See von Kalckreuth, Stix and Schmidt (2014) for solutions in a similar analytical context: in a study on payment behaviour, the decision to adopt a credit card and its later use in payment are interdependent.

Kernel-Density Estimation of digitalisation levels for different types of households

Kernel density estimate



Source: Panel on Household Finances (PHF) - intermediate survey 2019 - unweighted, own calculations.

Second, digitalisation will be increasingly universal in the coming years and decades. Attitudes of younger people today will become typical also for the older digitalised. In spring 2020, as a result of measures taken by the German government in response to the Covid-19 pandemic, many people had to stay at home, for several weeks. Schools, shops, and banks were closed down. All of a sudden, traditional offline solutions were simply not available anymore or only to a limited degree. This may be expected to have a strong effect on digitalisation levels, both on the supply and on the demand side.

For these reasons, the prevalence of fintech services among German households is likely to increase. Fintech solutions are not necessarily associated with fintech companies. Commercial banks are likely to adopt the new modes of providing access to financial services, since they may otherwise risk losing market shares.

References

Henry C S, K P Huynh, G Nicholls and M W Nicholson (2019-10): "2018 Bitcoin Omnibus Survey: Awareness and Usage", *Bank of Canada Staff Discussion Paper*.

Rogers, E (2003): Diffusion of Innovations, 5th Edition, New York, Free Press.

von Kalckreuth, U, M Eisele, J Le Blanc, T Schmidt and J Zhu (2012): "The PHF: a comprehensive panel survey on household finances and wealth in Germany", *Deutsche Bundesbank Discussion Paper*, no 13.

von Kalckreuth, U, H Stix and T Schmidt (2014): "Using cash to monitor expenditures: implications for payments, currency demand and withdrawal behaviour", *Journal of Money, Credit, and Banking*, 46(8), 1753–86.

Annex 4: IFC letter to the UNSD regarding ISIC Rev 4 issues

By email

Mr Stefan Schweinfest Director Department of Economic and Social Affairs United Nations Statistics Division 2 UN Plaza, Office 1520 New York NY 10017 United States E-Mail: Business_Stat@un.org

27 September 2019

Global Consultation on issues with the International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 4

Dear Mr Schweinfest,

The Irving Fisher Committee on Central Bank Statistics (IFC) appreciates the invitation to take part in the *"Global Consultation on issues with the International Standard Classification of All Economic Activities (ISIC) Rev 4"* launched by the United Nations Statistical Division (UNSD). The IFC is a forum of central bank economists and statisticians, representing 91 central banking institutions, and operating under the auspices of the Bank for International Settlements (BIS).

In August 2018, the IFC launched a Working Group on Fintech data issues with the objective of assessing the information needs that digital innovation is creating, and identifying initiatives to address them. The results of the working group's own research and of the survey conducted among the IFC members reveal that fintech has created significant gaps in financial statistics. To an important extent this reflects the fact that fintech companies engaged in financial intermediation are not systematically classified in the financial sector. Against this backdrop, it may be useful to adapt the current classification of economic activities. For instance, new subcategories in group K ("Financial and insurance activities") may be needed to cover new types of financial service providers, such as those engaged in crowdfunding. For your kind consideration, we attach more detailed responses of some central banks on this issue.

The detailed Working Group recommendations will be disseminated in a dedicated report in the first half of 2020, and we will submit for your consideration those concerning the classification of economic activities.

Yours sincerely,

Mr Robert Kirchner Head of the IFC Working Group on Fintech data issues Mr Rashad Cassim IFC Chair

Annex 5: Statistics on fintech - bringing together demand and supply to measure its impact: selected central bank contributions

Contents

Development of crowdfunding initiatives in Chile

Iván Abarca, Financial Policy Division, Central Bank of Chile

Fintech and statistics – the challenge of classifying something that hasn't existed before

Ulf von Kalckreuth and Norman Wilson, Deutsche Bundesbank

Dataset and indicators to monitor the crypto-assets phenomenon

Redouane Boumghar, Urszula Kochanska, Aleksander Tracz, Angelos Vouldis, Alessandro Zito, European Central Bank

Development of crowdfunding initiatives in Chile

Iván Abarca, 120 Financial Policy Division, Central Bank of Chile

Abstract

In the context of disintermediation and fintech development, it may be appropriate to study crowdfunding. It has a direct relation with financial stability issues, main statistics, and any public action towards regulation, deterrence or promotion. Crowdfunding is a practice in which households and companies can, through digital platforms, finance existing projects and receive funds from people. With growing transactions, it is acquiring relevance internationally, as well as in Chile. In countries where this practice has presented greater depth, there are financial policy responses imposing limits and providing protections to its users. The paper presents the first diagnosis of this activity in Chile and compiles public statistics up to December 2016 - representing around US\$ 180 million traded, mainly focused on loans to companies (which represent 96% of the amount and 85% of the projects). Of these last transactions, we observe an average annual nominal interest rate of 13.4%, without adding fees. This activity provides some users with a more convenient financial alternative than the traditional one. In addition, evidence shows that large companies pay lower interest rates than small and medium-sized enterprises. However, it is not possible to compare these rates to those observed in capital markets, because these operations can be constrained for regulated institutions and also because the crowdfunding conditions are not necessarily subject to comparable credit risk standards.

Keywords: crowdfunding, disintermediation, SMEs funding, fintech regulation.

JEL classification: G23, G24, G28

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The views expressed are those of the author and do not necessarily reflect the views of the BIS, the IFC, or the Central Bank of Chile.

Introduction

Crowdfunding is the practice of raising funds and capital from large groups of people. Despite the fact that crowdfunding has different definitions and a long history, there are three typical components to take into account: small funds, diverse and non-traditional users such as households and small and medium enterprises (SMEs), and intensive usage of information technology (IT) for that purpose (Jenik et al (2017)).

Crowdfunding operations rely on platforms to reach out to funders. Platforms promote projects or initiatives to possible investors or financiers (Powers (2012), Herrera (2016)). Literature conceives crowdfunding as a practice that involves the fintech phenomenon (Shiller (2013), Son (2015)), a new wave of collaborative economy (European Commission, 2016; Hernando, 2016), and an alternative to encourage entrepreneurship and innovation (Schwienbacher and Hervé (2018)).

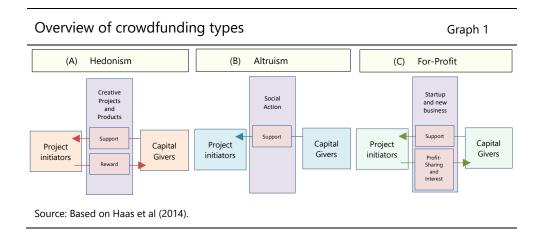
Authorities and researchers have classified crowdfunding according to the underlying transaction of the funder and fund recipient.¹²¹ In this regard, those can be:

- Donation: Philanthropy or any contribution without monetary compensation.
- Reward: funders receive a token, gift or pre-purchase service, product or experience.
- Lending-based or peer-to-peer lending (P2P): funders receive a debt instrument that relies on predetermined conditions. The instrument pays a fixed rate of interest and returns. Fund recipients are a kind of issuer and "its security" must provide investors a profit in the form of the fixed periodic payment.
- Equity-based: funders are investors and receive earnings in the function of the returns of the project. It can be a royalty, where a percentage of revenue is paid out over a period, or a stock, where the funder becomes a shareholder.

The World Bank, through its program *InfoDev* (2013), recognises the first two ways as "donation" and the other two as "investments", which act as financial instruments issued in a primary market. Similarly, each transaction in this market could complement or complete the financial market, and it consequently may lead to an issue of financial stability. Haas et al (2014) define an overview of distinctive characteristics from platforms, separating their key features and funders' motivations. They divide platforms into hedonism, altruism and utilitarian or for-profit. These three clusters are also suitable in specific projects; for instance, creative initiatives are closer to hedonism, sustainability and social action to altruism, and business and start-ups to for-profit (Graph 1).

Research has reported continuous growth of transactions and money collected through different platforms worldwide. The latter has generated public and private attraction. In terms of financial policy, some countries have regulated this activity to balance risks (eg operational risk or conflicts of interest) and benefits (eg financial inclusion or consumer protection). Notwithstanding, the current Chilean framework does not have regulation, and many users and platforms are mostly "self-regulated", sometimes sharing some explicit statements, and sometimes with asymmetric information.

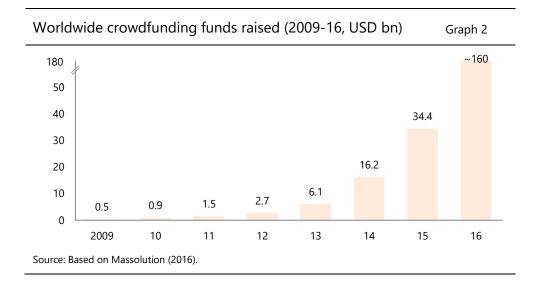
¹²¹ Giudici et al (2012), Levenson (2013), Belleflamme et al (2014) and Bouchen et al (2015) describe each crowdfunding type thoroughly.



The number of platforms in the world exceeds 1,400 (Ziegler et al (2017)). However, only a few of them stand out in the number of users or projects.¹²² Amounts traded in all forms of crowdfunding since statistics are available, have markedly grown (Graph 2). Now then, there is a problem that regulators and researchers maintain: to measure how big or small is crowdfunding, and how it is distributed among modalities, users and other characteristics.

This paper's exploration focuses on crowdfunding to fund investments (lending and equity-based) in Chile. Its importance underlies financial stability motivations regarding that practice (FSB (2017)) and the supplementary explanation of the Chilean fintech environment. The second part comments on its benefits and risks. The third describes a public discussion related to a crowdfunding regulation and presents some statistics about crowdfunding. The fourth part analyses, through crowdfunding platforms data, the state in Chile using transactions between 2012 and 2016. The fifth section exposes the leading statistics and approaches the lending-based mode, which is preeminent. The final section concludes and comments on the challenges to include crowdfunding into the regulatory perimeter. Thus, this study provides a quantification of the Number of fintech start-ups in Chile in attention to its incorporation to the regulatory perimeter.

Remarkable platforms (and their focus) are Lending Club (lending), Kickstarter (reward), Indiegogo (reward), Kiva (lending), AngelList (equity), DonorsChoice (donation). Levenson (2013) provides details on platforms.



Crowdfunding as an investment: benefits and risks

In both lending and equity-based crowdfunding, creators access to a new financial source (like standard "issuers" in capital markets) while funders reap the benefits from their monetary contribution (similar to "investors").¹²³ Common financial risks are keen to be experienced; however, crowdfunding adds operational risks due to its firm reliance on IT. Table 1 summarises benefits and risks to investors and issuers.

	Benefits	Risks	
Investors	 Access to invest through digital platforms Investment alternative and financial inclusion Return on investment 	 Credit risk Misconduct risk Fraud risk Legal risk Technological risk 	
Creators	 Benefits Liquidity Lower funding cost Promotion of projects or brands to the public 	Risks Misconduct risk Fraud risk Liquidity risk Technological risk Legal risk 	

Ziegler et al (2017) conclude that remarkable underlying risks in this industry are cyber-risk, misuse of personal data, platform misconduct, frauds and non-performing loans from issuers.

Overall, people who participate in crowdfunding campaigns seek their benefits. Issuers, principally unlisted companies, can get funds in a less costly way as well as

¹²³ Under some legal precepts, they (creators and funders) may not be called that way (issuers and investors), primarily since this operation can occur in a deregulated and unsupervised market.

generate a source of contacts and clients (Macht and Heatherson (2014)). Besides, collaboration may be feasible since people could provide feedback or promote projects through social media. On the other hand, investors profit as the model suggests; and, in terms of financial inclusion, crowdfunding leads a new source or wave of financial assets, that was commonly limited to a small magnitude of users (Jenik et al (2017)).

From a fintech perspective, crowdfunding relates to a hi-tech environment and its functioning is closer to financial intermediation. In this regard, there are foreseeable effects on financial stability that authorities should take into account. FSB (2017) remarks that the benefits and risks must be checked and balanced.

Microdata is such a limitation to analyse crowdfunding. Broadly, data are unofficial or unaudited, and their publication is subject to platforms and their will. In lending-based crowdfunding, more information could contribute to financial stability due to agents can evaluate and mitigate better the underlying credit risk (Marcel et al (2017)).

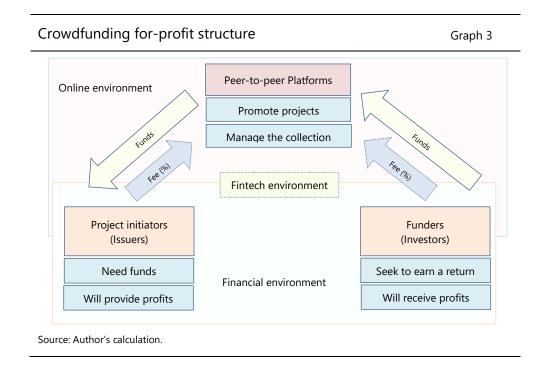
Crowdfunding regulation at a glance

So far and how the previous section exposed, investment crowdfunding moderately resembles financial assets in primary markets and their public offer. However, except for specific cases in which a regulation exists, users do not (need to) meet regulatory or supervisory requirements. Participants must follow guidelines of the local regulatory perimeter as long as jurisdictions design and enforce regulations, which is not necessarily identical for each country (Kirby and Worner (2014)). Thus, its integration of the regulation meets specifics objectives. For instance, some platforms are regulated as brokers and others as credit providers; or other cases have created specific laws to this activity (eg USA).

Issuers can prefer crowdfunding since the different options to get funds could be adverse, disadvantageous or simply non-existent (Kim and Hann (2014)). Meanwhile, investors could find out an attractive alternative to their investments or savings (Agrawal et al (2013)). In comparison with banks, crowdfunding may be competitive because of the access to different networks, those that were previously private (Rubinton (2011)).

Also, platforms may charge both parties commissions for the use of its services (use of the computer platform for trading), which usually depends on the amount traded and the investment term. Then, platforms publish different eligible projects considering both issuer and project characterization. Investors provide funds afterward, in spite of not having full information regarding the issuer and its project (adverse selection).

Then, the activity involves these three agents connected though online applications, however, the transactions they generate are purely financial. Moreover, each underlying payment relies on different accounts, usually checking accounts. Therefore, two environments are concurrent: online and financial, showing that a fintech environment is generated (Graph 3).



According to Kirby and Worner (2014), there are elements in lending-based crowdfunding that do not lead to systemic risk. Among them are its small size relative to total credit in the economy, less than 0.01% of the total (although it almost doubles annually), its low liquidity to generate secondary markets, and its low interconnection with other financial institutions. However, the vulnerability exists and may motivate the need to monitor the financial markets that participate in crowdfunding through portfolio investment.

Some jurisdictions regulate the activity through its involved agents (depicted in Graph 3). Financial regulation includes a legal basis, eligibility to take part in the transaction (platforms, investors and issuers), consumer rights, supervision, transparency/disclosure, and restraint of conflicts of interest. In general, countries that regulate crowdfunding posit it in the securities market.¹²⁴ The regulatory advances in platforms aim to resolve, additionally, the degree of supervision and standards of corporate governance, disclosure, and sanctioning regime. Note that all these latter definitions are explicit for entities belonging to the regulatory perimeter. For example, the Securities and Exchange Commission introduced a new category of a registered intermediary to ascribe platforms, called "funding portal", which may facilitate transactions subject to certain restrictions.

CGFS and FSB (2017) list changes in financial policy that jurisdictions have done regarding fintech credit (eg crowdfunding), including tax incentives, consumer protection and licensing (Table 2). European Commission (2018) states that there are initiatives to expand crowdfunding, such as avoid information asymmetries or fragmentation among jurisdictions.

Chile does not regulate crowdfunding, and this could generate uncertainty about the operations. Despite the Financial Market Commission (2019) published a "white

¹²⁴ For example, Italy, France, the United Kingdom, and the United States. See Gabison (2015) and Herrera (2016) for details on international frameworks.

paper" to discuss regulatory guidelines, challenges remain. That document provides general guidelines that should be taken into consideration for any regulatory design, to meet the problems and demands that may arise because of that new activity. Besides, last April the Ministry of Finance has announced a future legislative project to regulate alternative finance and other fintech services.

All the same, regulation is only one relevant aspect aiming at the proper functioning of this market. Thus, it is necessary to consider other factors such as availability of information, communication of risks related to investment, or implementation of performance indicators (Lehner (2013)). Similarly, there are adjacent elements that can facilitate or make crowdfunding more attractive such as technology and social media, culture to promote entrepreneurship, and to encourage the participation of financers and interested parties.

Crowdfunding in Chile

The Chilean case of crowdfunding and alternative financing is remarkable. Ziegler et al (2017) conclude that Chile is one of the leading countries in Latin America (Graph 4), driven mainly by lending models. Similar results document Herrera (2016), arguing that Chilean crowdfunding has a sizeable relative volume, especially in terms of peer-to-peer platforms, followed by Brazil and Mexico.

By 2017, 8 platforms are operating in Chile, most of them related to investments. This number is quite a small number in comparison with the total platforms worldwide. Each platform specialises in donations or investments.

Chilean platforms define the requirements to operate, ie accept users and projects. Funders have the option to be anonymous, but projects are always public to each funder. The latter adds more information about the issuer or creator as the amount for funding, the reason for requesting financing, its payment plan, details on guarantees (if there were) and other details such as enterprise characterization or abbreviated financial statements.

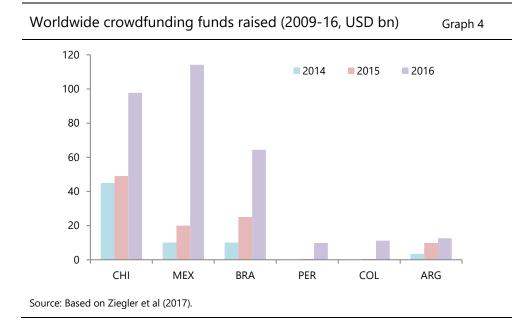
Selected features of fintech credit policy frameworks					
Jurisdiction ¹	Tax incentives	Regulations ²	Licensing / authorization	Investor protections ²	Risk managemen requirements 2
Argentina	-	-	-	-	-
Australia	-	-	-	-	-
Brazil	-	-	-	-	-
Canada	-	-	-	-	-
Chile	-	-	-	-	-
China	Yes	Yes	Yes	-	Yes
France	Yes	Yes	Yes	-	Yes
Germany	-	-	-	-	-
Hong Kong SAR	-	-	-	-	-
Indonesia		Yes	Yes	Yes	Yes
Italy	-	-	-	-	-
Japan	Yes	-	-	-	-
Korea	-	-	-	-	-
Mexico	-	-	-	-	-
Netherlands	-	-	-	Yes	-
Russia	-	-	-	-	-
Saudi Arabia	-	-	-	-	-
Singapore	-	-	-	-	-
South Africa	-	-	-	-	-
Sweden	-	-	-	-	-
Spain	-	Yes	Yes	-	Yes
Turkey	-	-	-	-	-
United Kingdom	Yes	Yes	Yes	Yes	Yes
United States	-	-	-	-	-

Selected features of fintech credit policy frameworks

¹ Dashes mean that there is no specific regulation.

 $^{\rm 2}$ Indicates that for lending activity the regulation is separated from the pre-existing rules of other financial intermediaries.

Source: Adapted from CGFS and FSB (2017).



Once platforms publish any project to raise funds, they promote it to potential funders (public and registered funders) mainly through social networks. The monetary transaction, which practically is "crowdfunding", occurs only if only the requirements defined by the platforms are met. For example, in investments, some platforms require some formalization through a legal document to reduce credit risk. Also, the platform tracks the subsequent payments related to the operation. However, platforms are never responsible for any eventual default.

In the Chilean case of peer-to-peer lending, only enterprises can access.¹²⁵ It might also be observed that platforms define credit risk policy, so they require issuers to guarantee their loans. Platforms explicitly indicate what guarantee is available for each loan request. There are three types of warranties:

- i. Invoices, then platforms operate as a factoring enterprise in terms of the liquidity provider, and later the payment to investors comes from the sum of the mentioned invoice.
- ii. Services of a specific society that sells guarantees, called Mutual Guarantee Institutions or companies (MGIs), so they backup loans in case of default.
- iii. Other eligible guarantees as insurance or mortgages.

Overall, parties structure a private contract (loan) and platforms only auspicious and support that relationship. Furthermore, platforms do not take credit risk.

Data as of December 2016, synthesised in public transactions and extracted by platform webpages, indicate that the predominant Chilean crowdfunding modality is peer-to-peer lending in both amounts traded and the number of projects as well. Donations and equity modality are minor. The values and transactions are substantially concentrated in Cumplo, which is the biggest platform in Chile to the date (Table 3).

¹²⁵ Currently, no platform promotes projects based on personal loans (as Lending Club or Credit Karma). Only one platform (Cumplo) take part in those loans until December 2014.

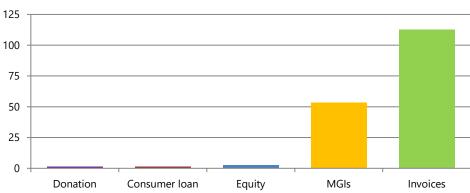
Distist	Classification	Projects		Funded Amount	
Platform	Classification	N°	%	USD mil.	%
Cumplo	P2P	5,207	81.6	159	88,6
Becual	P2P	180	2.8	8.4	4,6
RedCapital	P2P	135	2.1	5.6	3,1
Broota ¹	Equity-based	16	0.3	2.8	1,5
Facturedo	P2P	212	3.3	2.3	1,3
Fondeadora	Reward	321	5.0	0.7	0,4
IdeaMe	Reward	278	4.4	0.5	0,3
Catapúltame	Reward	5	0.1	0.3	0,2
DaleImpulso (currently inactive)	Donation	28	0.4	0.04	0,02
	Total	6,382		179.6	100

Chilean crowdfunding platforms and their transactions (2012-16) Table 3

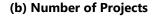
¹ Despite Broota has only provided funds to 16 public projects, there are private contracts that are not included in the statistics.

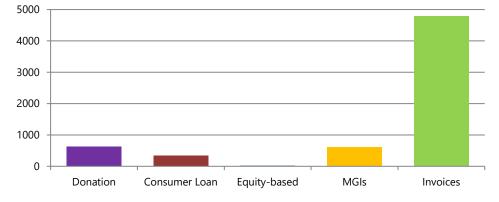
Source: Authors' calculation.

From the previous analysis, we can observe that 97.6% of the amounts refer to loans, and from them, almost a 96.7% relies on SMEs through invoices or MGIs. However, donations and capital contributions present a more significant relative amount of transactions (projects), but lower amounts. The average financing of a project varies considerably according to its modality. Regarding projects, the average for loans from invoices is CLP 16 million (approximately USD 25,000), for loans backed by MGIs is CLP 59.4 million (USD 91,000), for equity crowdfunding is more than CLP 100 million (USD 160,000) and for donations is closer to \$1.5 million CLP (USD 2,300). Graph 5 summarises a description of crowdfunding in Chile.

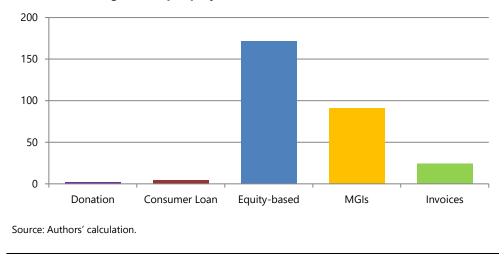


(a) Total funds (USD mil.)









At the public level, crowdfunding in Chile has been accepted based on the aforementioned benefits of financing and investing in SMEs. Local authorities have considered the practice in the following five instances:

- Execution of the "Plan C" program (of ProChile, of the Ministry of Foreign Affairs). Through this plan, local enterprises obtained funds through international platforms, and thus testes their global demand. By 2016, major foreign platforms such as Indiegogo or Kickstarter published ten Chilean projects. This program is no longer active.
- Allocation of public funds (through the Chilean economic development agency or CORFO, in Spanish) to local platforms. The objective of that decision was promoting crowdfunding at a Latin American level. At the same time, digital enterprises linked to these practices have the option to apply for grants. Indeed, this can be a grant for innovation.
- Inclusion of crowdfunding as a service to be considered in the Agenda for Productivity (2014 2018), including regulatory improvements.
- In 2015, the Chilean Ministry of Economy requested a consultancy from the Inter-American Development Bank (IDB) on the diagnosis of crowdfunding, its local platforms, and specific gaps to create an adequate crowdfunding ecosystem.
- Inclusion of crowdfunding in the agenda of the Chilean Financial Stability Board, especially to analyze its financial risks and explore a possible regulatory framework. This led to a request for assistance from the IDB and the creation of a Working Group to move towards a regulatory framework.

Chilean lending-based crowdfunding statistics

Lending-based crowdfunding is a variant of the investment modality. Issuers and funders interact similar to that indicated in Graph 3. Issuers or borrowers are willing to pay interests in to get funds, and funders receive those interests assuming traditional financial risks. Platforms obtain a fee for connecting these two agents and commit to supporting the transaction.

Then, users should consider fees when they participate. Issuers add them to the funding cost as well as funders must reduce their profits. Platforms design the fees according to the public loan characteristics. In most cases, users pay fees in advance.

From collected data, and taking into account the public information to 2016, we observe that the number of transactions and amounts has considerably grown. Almost 50% of crowdfunding was conducted in 2016. That evolution presented in Graph 6.

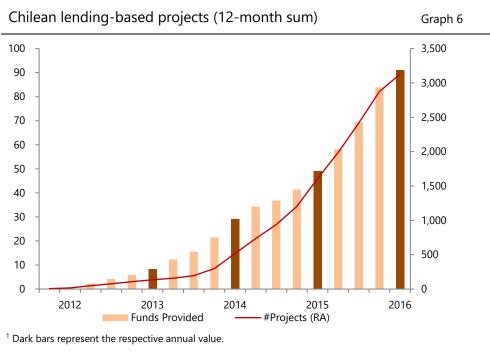
The interest rate for consumer loans was, on average, higher than the rate for enterprises. Weighting by the paid amount of loans, we observe that lending based crowdfunding has had a rate for consumer loans of 20.4% and enterprises 13.4%. From the SMEs, loans guaranteed by invoices show a rate of 13.9%, and those insured by MGIs estimate a rate of 13.3%. Table 4 shows descriptive statistics of the interest rate of loans leveraged by crowdfunding, and Graph 7 shows the relevant average and percentile relationship in the distribution of rates by type of loan.

Concerning the evolution of the annual rates for loans to SMEs, the average has been continuously higher than 12.5% and lower than 14.2%. Meanwhile, for the percentiles 10 and 90, the dispersion is limited, between 1% and 3% around the mean, while the interquartile range is in historical average a 1.75%, and in the last observation 2%. During the observation period, the highest rates are observed in 2016 (maximum observation of each quarter), notwithstanding the range formed between the 10th and 90th percentiles remains stable (Graph 8).

It should be noted that there is no more detail on the financial characteristics of the SMEs applying for these loans, so it is not possible to make a greater segmentation or analysis (for example, related to their size, risk profile or financial performance).

Although I explicit that any comparison should not be made directly, it is worth noting the difference in annual rates for commercial and retail loans. As a reference to the Chilean banking system, the Superintendence of Banks and Financial Institutions (2015) reported on the rates segmented by company size. The results show gaps between large and small firms. An update was carried out in 2017 when this gap prevailed (Graph 9), and the authority comments that this difference in rates is "significantly greater than applied in OECD countries".

OECD (2016) documented the interest rate spread between loans to SMEs and to large firms, where it stands out that in Chile this measure is considerably higher. Globally, in the post-financial crisis global trend, for the periods 2007–2014 the differences have increased (Graph 10). In this section, the report concludes that: "This suggests a worsening of the established practice of financial institutions lending to SMEs at less favourable conditions since the crisis, and that the risk perception of SME lending has increased over time".



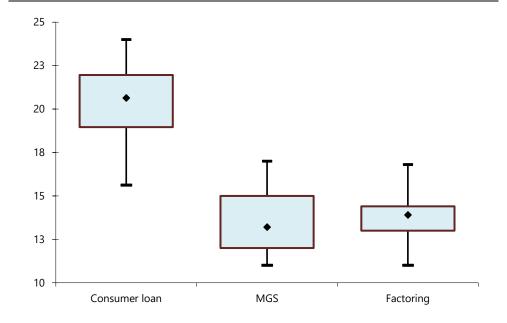
Source: Authors' calculations.

lending in Chile: statistics of annual rates			Table 4	
	Consumer loans	MGIs	Invoices	
No.	335	610	4,789	
Min	9.6	8.0	6.7	
P5	15.6	11.0	11.0	
Q1	19.0	12.0	13.0	
Median	20.6	13.2	13.9	
Q3	22.0	15.0	14.4	
P95	24.0	17.0	16.8	
Max	26.0	27.6	30.3	
Average	20.4	13.5	13.7	
Weighted average	20.4	13.3	13.9	
S.D.	2.5	2.0	1.7	

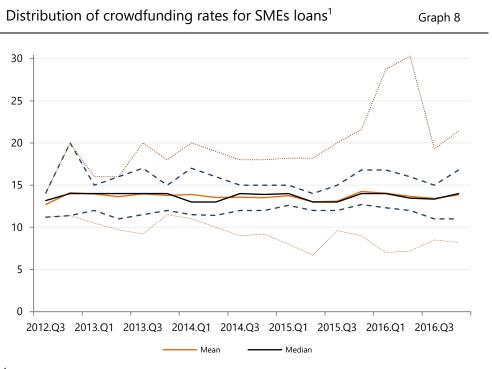
Source: Authors' calculations.

Crowdfunding rates¹

Graph 7

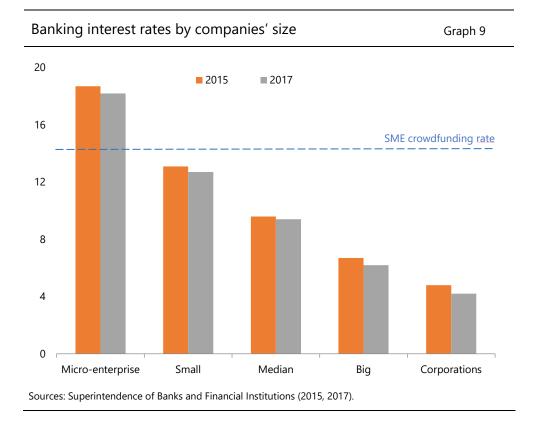


¹ Annual rates. Box represents Q1 and Q3, a dot is median, and the line represents the 5th and 95th percentile. Source: Authors' calculations.



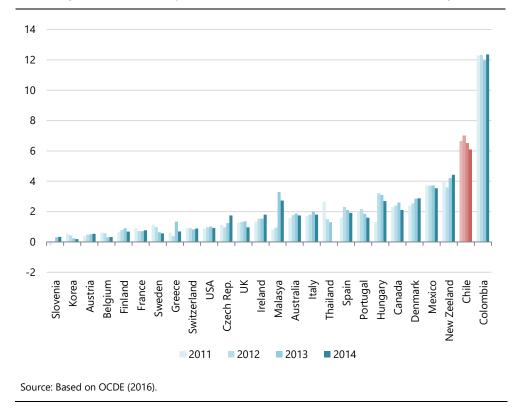
¹ Dashed lines represent the 10th and 90th percentiles, while the dotted lines represent the minimum and maximum interest rates agreed for the current quarter.

Source: Authors' calculations.





Graph 10



To participate in the transaction, funders and creators must pay a fee to the platform based on the characteristics of the loan. In this regard, as a service, platforms charge both to initiate and to manage the collection. Each platform defines their pricing; and, the longer the term, amount, or grace period, the higher the fee charged by the platform.

Additionally, borrowers must pay the procedure through required certificates (payment and sales history). There are other legal costs as well. On the side of the investors, they must pay the right to invest and then an amount of the outstanding balance. Furthermore, funders have to assess credit risk based on their risk aversion. However, there are not comparable public data on the platforms on non-performing or uncollectible loans. Only one Chilean platform publishes its default rate.

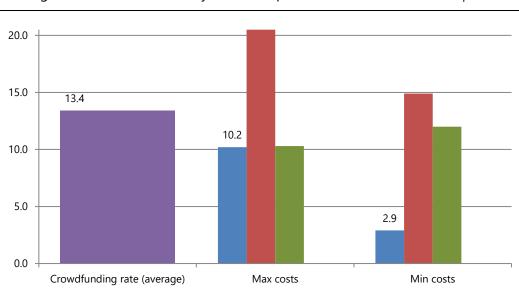
Therefore, crowdfunding rates do not correspond to the funder's earnings or the cost of funding to creators. In other words, platform fees must be included in the financial evaluation of each transaction. Fees are given in Table 5.

Next, a simple exercise is carried out to estimate the fees of platforms according to a one-year loan¹²⁶ and Table 5 as input. As a result, we observe that the cost for investors is between 1.4% and 3.1%, while for borrowers the rate is between 1.5% and 7.1%. Then, there are computable the maximum and minimum cases of operational costs for both parties. If we add the maximum fees in both parts, we obtain that the platforms profit 10.2% of the borrowed/invested amount, while for the minimum fees it would profit 2.9% (Graph 11).

¹²⁶ The exercise is referential according to the information published by the platforms.

Platform fees (perc	ent)		Table 5	
(A) Investment manag	ement fee	Platform A	Platform 0.7	
Investor service fee		0.7		
Type of loan	Invoices	1.2	1.4	
	French loan	0.7	1.3	
	Bullet loan	1.2	2.4	
	Zero-coupon loan	1.2	2.4	
Max		1.9	3.1	
Min		1.4	2.1	
(B) Borrowing manage	ement fees	Platform A	Platform E	
Guaranteed by Invoice	Invoice short term (<3 months)	7.1		
	Invoice long term (4 months)	5.4		
Other loans	Invoice short term (<3 months)		6	
	Invoice long term (4 months)		1.5	
Max		7.1	6	
Min		5.4	1.5	

Sources: Authors' calculations based on public information of Chilean platforms.



Average transaction costs and yields after platform fees Graph 11

■ Platform earnings ■ Creator/Borrower costs ■ Investor yield ■ Average crowdfunding interest rate

Source: Author's calculation.

Conclusions

Crowdfunding has had remarkable local and international growth in the last years. Studies link its development to new trends in fintech and the collaborative economy. Some jurisdictions have studied the scope of this activity, and others set policies to balance both their risks and benefits.

Investment crowdfunding is outstanding since the bulk of the operations and amounts is done in that way. In this framework, financial authorities pay attention to desirable financial features like stability, inclusion, or integrity.

There are incentives to crowdfunding as a source of funds in consideration of creators of projects can access to funds and funders observe projects that present an attractive risk and return relationship. In P2P lending, "borrowers" mean creators, and investors stand for funders. It is worth to mention that platforms are responsible for promoting and connecting these two users in an online environment (webpage).

Overall, crowdfunding could have many similarities with capital markets and financial intermediation. The latter does not imply that crowdfunding is comparable to formal sources of funds (eg, banks) considering that we can see many differences. These include operational and capital requirements supported by a regulator, standards of corporate governance, oversight by a supervisor, among others. While platforms have non-financial requirements and their self-regulation is discretionary, financial entities defined within the regulatory perimeter must operate under strict specifications. Therefore, in terms of the competitiveness of P2P lending with the formal sector, there is not enough information to conclude on the matter.

This study, collecting public information to 2015 of the crowdfunding platforms in Chile, shows that the crowdfunding has raised approximately US\$ 180 in 6,382 projects, mainly in loans to (small and medium) enterprises (96.7% of the amounts, 85% of the projects).

Specifically, in loans to SMEs, the weighted average crowdfunding rate is 13.4%, a rate slightly higher for backed by invoices. Now, to interpret any scope of benefit or cost over the rate to its users, we adjust on platform fees, which are estimated at between 2.9% and 10.2% of the amount.

Given the local growth in recent years and the interest shown by authorities in this activity, it is justified an evaluation to develop an ad-hoc regulatory framework in Chile. For instance, the Chilean Financial Market Commission (CMF, in Spanish) published a white paper to discuss regulatory guidelines on February 2019.

Finally, having more detail on transactions and platforms (such as characterization of loan applicants or payments history) would open up areas of research. Related topics can deepen on the competitiveness of the fintechinstruments, quantification of the risk of crowdfunding, persistence in the use as a source of new funds or investment, linkages with the entrepreneurial finance, and a more accurate assessment of the effects and risks of the local irruption of practices currently listed as fintech.

References

Abarca, I (2018): "Desarrollo del Crowdfunding en Chile", *Working Paper*, no 815, Central Bank of Chile.

Belleflamme, P, T Lambert and A Schwienbacher (2014): "Crowdfunding: tapping the right crowd", *Journal of Business Venturing*, vol 29, pp 585 – 609.

Bounchen, R, M Komorek and S Kraus (2015): "Crowdfunding: The current state of research", *International Business & Economics Research Journal*, vol 14, no 3.

Committee on the Global Financial System (CGFS) and Financial Stability Board (FSB) (2017): *FinTech credit: Market structure, business models and financial stability implications*, May.

European Commission (2016): *More than profit: a collaborative economy with a social purpose.*

Financial Market Commission (2019): *White Paper. Lineamientos Generales para la Regulación del Crowdfunding y Servicios Relacionados*, February.

Financial Stability Board (FSB) (2017): Financial Stability Implications from Fintech, Supervisory and Regulatory Issues that Merit Authorities' Attention.

Gabison, G (2015): "Understanding Crowdfunding and its Regulations", Joint Research Centre, Science and Policy Report, European Commission.

Haas, P, I Blohm and J Leimeister (2014): "An empirical taxonomy of crowdfunding intermediaries", Conference Paper.

Hernando, J (2016): "Crowdfunding: The collaborative economy for channeling institutional and household savings", *Research in International Business and Finance*, vol 38, pp 326 – 337.

Herrera, D (2016): "Alternative Finance (Crowdfunding) Regulation in Latin America and the Caribbean. A Balancing Act", *Discussion Paper*, no 480, Inter-American Development Bank.

Herve, P and A Schwienbacher (2018): "Crowdfunding and innovation", *Journal of Economic Surveys*, vol 32, no 5, pp 1514 – 1530.

InfoDev (2013): "Crowdfunding's potential for the developing world", Finance and Private Sector Development Department, Washington, DC. World Bank.

Jenik, I, T Lyman and A Nava (2017): "Crowdfunding and financial inclusion", CGAP Working Paper, March.

Kirby, E and S Worner (2014): "Crowdfunding: an infant industry growing fast", *Staff Working Paper*, IOSCO.

Lehner, O (2013): "Crowdfunding social ventures: a model and research agenda", *Venture Capital*, vol 15, no 4, pp 289 – 311.

Macht, S and J Weatherston (2014): "The benefits of online crowdfunding for fundseeking business ventures, *Strategic Change: Briefings in Entrepreneurial Finance*, vol 23, no 1, pp 1 – 14.

Marcel, M, C Madeira, P Furche and C Medel (2017): "Fintech y el futuro de la Banca Central", *Economic Policy Document*, no 63, Central Bank of Chile.

Massolution (2016): Crowdfunding industry report, Research Report.

OECD (2016): Financing SMEs and Entrepreneurs 2016: Highlights – An OECD Scoreboard.

Powers, T (2012): "SEC regulation of crowdfunding intermediaries under Title III of JOBS Act", *Banking & Financial Services Policy Report*, vol. 10, no 31, pp 1 – 7.

Shiller, R (2013): "Capitalism and Financial Innovation", *Financial Analyst Journal*, vol 69, no 1, pp 21 – 25.

Son, S (2015): "Financial Innovation – Crowdfunding: Friend or Foe?". *Procedia - Social and Behavioral Sciences*, vol 195, no 3, pp 353 – 362.

Superintendence of Banks and Financial Institutions (2015): *Informe sobre condiciones de crédito a empresas por tamaño*, Santiago, Chile.

(2017): *Financiamiento bancario de empresas de menor tamaño*, Santiago, Chile.

Ziegler, T, E Reedy, A Le, R Kroszner, B Zhang and K Garvey (2017): "Hitting Stride -The 2nd Americas Alternative Finance Industry Report", Cambridge Centre for Alternative Finance.

Fintech and statistics – the challenge of classifying something that hasn't existed before¹²⁷

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Abstract

This paper collects ideas on how to adapt classification systems for activities and products to the advent of "fintech" firms and their position in the financial system. Such a discussion is of concern for the upcoming revision of ISIC and NACE and is also highly relevant for the national accounts. A theoretical discourse on the classification of fintech activities is augmented by an empirical study on the official statistical sector classification of fintech firms in Germany according to the currently valid standards. There are three key findings. First, it will not be possible to base statistical classification on the definition of "fintech" currently used in the literature. The reason for this is that the two descriptors "innovative" and "technology" are absolutely essential for the common definitions of the term "fintech". These concepts are not time-invariant. Thus, a firm that is "fintech" now may not be "fintech" ten years from now if it continues to provide the same services. Second, using a sample of companies identified as "fintech" in a study for the German Ministry of Finance reveals that most of them are not classified as financial companies according to current standards. Third, in order to enable statistics to register and map financial activity in the economy, one useful way of doing this is to identify the key processes needed to produce financial services and to classify such activities and products as "financial", irrespective of whether they are provided within a traditional financial institution or for example, in an IT company specialised in one part of the financial value chain. This will render statistical measurement immune to outsourcing and specialisation within the financial industry and, at the same time, also make it open to rapid technological progress in the future. Ultimately, to cope with big tech firms, statistical reporting obligations on financial issues should not depend solely on a firm's industry classification.

JEL classification: C 81, C82, G20, D20

Keywords: fintech, bigtech, statistical classification, economic activities, product classification

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What is a fintech?

The financial industry in Europe and worldwide is undergoing rapid transformation, fuelled by digitalisation. Digital credit, payment and investment platforms offer a range of new services that have the potential to challenge the predominant role of banks in retail credit and financial services more generally. The process of granting and managing loans is being disaggregated into a sequence of steps that can be performed by multiple providers independently. A new class of digital assets, known as crypto-assets, has been created. In the future, some of those assets may become potential rivals of central banking money. But their principal technological basis, the distributed ledger technologies, also offer new ways of supporting payment infrastructures, especially on asset markets. These developments have the potential to affect monetary policy transmission, supervision and financial stability.

But "fintech" is not recognised in the official statistics, nor is there any unique characterisation of what "fintech" is outside the world of statistics. After a painstaking search through the entire body of available literature, Schueffel (2016) suggests on the basis of commonalities that "Fintech is a new financial industry that applies technology to improve financial activities". The definition by Mark Carney, the Financial Stability Board (FSB) and the Committee of the Global Financial System at the BIS is similar: fintech "can be broadly defined as technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets, financial institutions and the provision of financial services"¹³⁰ These and other definitions have three common features: ¹³¹

- financial services;
- technology;
- innovation.

Definitions along these lines are of limited assistance when it comes to revising classifications in order to help statistics give a better account of fintech activities. The first feature is straightforward. "Financial services" is clear cut and can be made even more operational by specifying "credit-related services", "payment-related services", "investment related services", etc.

The two other elements are difficult to deal with. What is at the *technological edge* today will be commonplace tomorrow – unlike 1970, for example, there is no bank today that does not make heavy use of information and communication technology (ICT). And, by definition, what is *innovative* today will either have disappeared tomorrow, because not all innovations are accepted, or it will be part of the mainstream menu of processes available to financial companies. A firm that is "fintech" now will not be "fintech" ten years from now if it continues to provide exactly the same services as today – or precisely because it does so. Thus, the features "technology" and "innovation" cannot be part of an operational classification system that is supposed to be stable over a significant period of time.

- ¹³⁰ See Carney (2017). The report refers to an earlier speech by Mark Carney, who was the FSB's chair at that time: "The promise of fintech something new under the sun?", speech at the Deutsche Bundesbank G20 Conference on digitising finance, financial inclusion and financial literacy, Wiesbaden, 25 January 2017. In that speech Carney himself, however, refers back to the FSB.
- ¹³¹ In addition to the two sources cited above, also see Wolf (2017).

What is really essential, though, is not a fintech sector as such, however it may be conceived. It is relevant to highlight the European Parliament's concern that there is a lack of important information on credit intermediation by non-banks.¹³² The major statistical challenge is the following: activities that have always taken place under the umbrella of traditional financial institutions (such as banks, payment providers, investment funds, insurers, etc.) are now migrating to new, sometimes small, companies that are not necessarily part of the existing reporting systems for financial activities. To the extent that this is the case, the time series collected by statisticians are losing their information value, and often there is no complementary information on such new activities.

A study by the European Banking Authority, EBA (2017), presents a sample of 285 European fintech firms in the EU. Competent authorities collected the sample on the basis of the FSB definition above. In the light of what has been said above, it is clear that this is a snapshot of today's firms producing financial services in an innovative way, based on new technological solutions. The sample is by no means random or representative, but it may still be seen as indicative of the total of around 1,500 fintech firms estimated to have existed in the EU by mid-2017. The study uses four broad clusters for fintech activities, which are subsequently defined by giving more detailed breakdowns (see Appendix A):

- (A) Credit, deposit, and capital raising services,
- (B) Payments, clearing and settlement services;
- (C) Investment services/investment management services;
- (D) Other financial-related activities.¹³³

In around 40% of cases, these firms were not subject to any regulation or registration regime, national or international, or it was not even possible to establish their regulatory status. Only 9% of firms are credit institutions under the Capital Requirements Directive.

It is hard for statisticians to come up with suggestions for what needs to be measured. Suggestions of this kind ultimately have to originate from statistical users engaged in economic, financial, political or supervisory activities. Fortunately, with regard to the question at hand, this may not be necessary in the first place. To a large extent, we already know what should be measured. In most cases, fintech firms are part of a value chain that leads to well-known final products or groups of products such as loans, insurance policies, payment services, etc. With the notable exception of crypto-assets, the essential contribution of fintech companies is their use of new technological approaches to gather, process, and disseminate information, and provide services -- either to other companies or to end-users -- on the market as links in the financial value chain. Many of these services used to be performed under the roof of a traditional financial institution. Often, standard banking services such as managing accounts, credit cards, consumer credit or business loans are offered, but using new delivery channels.¹³⁴ Fintech is indeed mostly about processes and the exchange of intermediate services, not about final products. The new technologies significantly roll back the frontier between what needs to be provided within a firm in

¹³² Within the IFC Working Group on Fintech Data, this concern is emphasised by the work stream on financial stability issues.

¹³³ Regtech, Insurtech and Proptech may be added as additional fields worthy of consideration.

¹³⁴ One prominent example is N 26, a German bank offering its services in 24 countries.

an organised division of labour and what can be traded over the market. If statisticians continue to rely on reports from traditional financial institutions, they run the risk of surveying half-empty shells and failing to identify the most important dynamics.

Fintech in current classification systems

There are two statistical classification systems which are relevant for guiding statistical activity concerning companies. One of these is the grouping of economic activities. The existing national and supra-national classification systems for economic activities derive from the International Standard Industrial Classification of All Economic Activities (ISIC), maintained by the United Nations (UN), currently in its fourth revision dating from 2008.¹³⁵ Routinely, the ISIC or some system consistent with the ISIC is used for *classifying entire firms*. For example, the German Classification of Economic Activities (Klassifikation der Wirtschaftszweige, WZ 2008) is based on the European NACE Rev. 2,¹³⁶ which, in turn, is derived from the ISIC. The process of revising NACE Rev. 2 was just started in 2019. But while WZ and NACE are mostly used as tools for classifying companies or other statistical units, the ISIC is essentially a classification of activities. When thinking about fintech, it is important to keep in mind that this is not really the same thing. Firms are classified by assigning them to a sector characterised by their most important activity. This is hard to measure in practice and will inevitably lack precision. Often, there will be more than one activity, and the relative weights of these activities may shift over time. This issue takes centre stage where "bigtech" firms are concerned, ie large conglomerates that are making inroads into the provision of financial services. How to deal, for example, with the present and future fintech activities of Google?

The other major classification system provides categories for the classification of *products* in an effort to induce structure to the world of output. Again, the blueprint for national and supranational systems is maintained by the UN, the Central Product Classification (CPC), currently in its version 2.1 of 2015.¹³⁷ Although it is generally not possible to establish a one-to-one correspondence between activities and products, there is a close relationship between the ISIC classification of activities and the CPC. A table outlining this relationship may be found in the Annex to the CPC.

To understand where the activities of fintech firms are allocated in the current classification systems, let us look at the classification decisions of the German Federal Statistical Office (Destatis) for 248 out of a group of 433 firms identified as fintech firms by Dorfleitner et al (2017), a major independent report commissioned by the

¹³⁵ United Nations (2008).

¹³⁶ NACE - Statistical Classification of Economic Activities in the European Community (Nomenclature Statistique des Activités Économiques dans la Communauté Européenne).

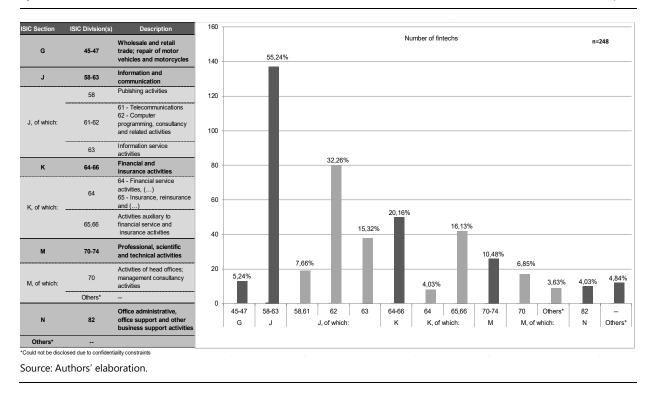
¹³⁷ United Nations (2015).

German Ministry of Finance.^{138, 139} Like the EBA sample mentioned above, this is a snapshot of "fintech" at a given point of time.

Number of firms in German fintech sample

by ISIC section or division

Graph 1

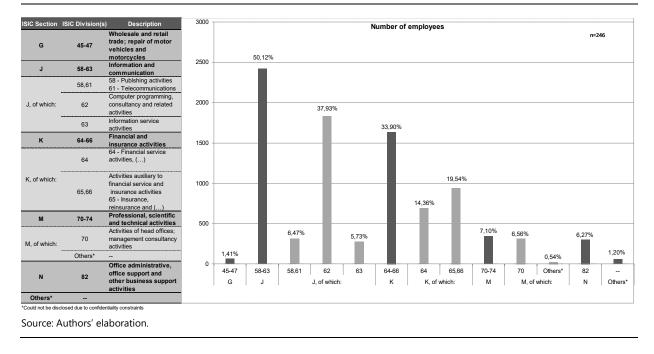


- ¹³⁸ The study of Dorfleitner et al looks at fintechs active in the years from 2007 to 2015. The mapping in this paper is based on a name search of the 2016 edition of the Statistical Business Register. Hence, there is a survivorship bias, because a number of fintech firms may have already been closed down or disappeared by merger and acquisition. Other firms may have changed their name or been added to the register only with some delay. In some cases, the same firm is represented with more than one activity in the database of Dorfleitner et al. A very recent study on the Austrian fintech industry may help also to throw some light on the structure of fintechs in Germany; see OeNB (2019).
- ¹³⁹ An update of this study is forthcoming in July 2020. It documents a strong increase of activity level of fintechs in Germany in recent years, see Dorfleitner et al (2020).

Number of employees in German fintech sample



Graph 2



In the business register of Destatis, Germany's national statistical institute, the firms identified as fintech firms are allocated to a wide range of economic activities. Graph 1 and Table 1 in Appendix B show the ISIC classification in the business register. On a two-digit level, the largest number of firms, 32.3%, are classified in ISIC division 62, Computer programming, consultancy and related activity. The second largest group (albeit only 16.1%!) are placed in division 66, Activities auxiliary to financial services and insurance activities, immediately followed by those in division 63 Information service activities. In total, only 20.2% of enterprises are placed in section K, Financial and insurance activities. As those companies are relatively large, the picture is somewhat more advantageous if one considers the distribution according to number of employees in Graph 2.140 One third, or rather 33.9% of the fintech employees in our sample work in an enterprise classified in section K. The tabulation and a graphical representation of the fintech activities of the enterprises that could be identified in the business register are available in Appendix B. Looking at this composition helps to understand the type of problems encountered with the current classification system. Gauthier (2020) obtains a comparable result for fintechs in Canada. He finds that more than half of Canada's fintechs are in NAICS 54C. This sector comprises NAICS 54151 "Computer systems design and related services".¹⁴¹

¹⁴⁰ In order to do so, it was necessary to make rough estimates of the fintech share in total activities for firms with more than one activity. The study in OeNB (2019) proceeds in the same way. For two firms there was no information on the number of employees in the register.

¹⁴¹ NAICS Canada 2017 Version 1.0 defines industry 54151 as follows: "This industry comprises establishments primarily engaged in providing expertise in the field of information technologies through one or more activities, such as writing, modifying, testing and supporting software to meet the needs of a particular customer, including custom video game design and development and

To round out this information, we sent a direct enquiry to Destatis regarding the current classification of two prototypical fintech activities: the trading of crypto-assets and credit platforms that serve as intermediaries between lenders and borrowers. In the EU, following the decision of a Eurostat committee on classification issues in 2012, the trading of crypto-assets such as Bitcoin is assigned to class 8299 *Other business support service activities n.e.c.* Credit platforms are grouped into class 6619, *Other activities auxiliary to financial service activities*, as the relevant corresponding product classification CPC 71599 explicitly covers the services of credit intermediaries.¹⁴²

National Accounts

The discussion on classification issues regarding fintech is also highly relevant also for national accounts There are two different aggregations of the economic activities of firms in national accounts: one according to industries (System of National Accounts (SNA) 2008¹⁴³ Section 5.E and European System of Accounts (ESA) 2010¹⁴⁴ 2.150), the other according to institutional sectors (SNA 2008 Ch. 4, ESA 2010 Ch. 2). Industries are defined directly on the basis of ISIC or NACE classification of establishments. Institutional sectors, for their part, are high-level aggregates of institutional units, and their definitions are abstract and do not refer explicitly to activity classifications. Hence, a fintech company corporation could, in principle, be part of the financial corporations sector, although – according to ISIC – it is classified in section J. SNA and ESA are silent on how the assignment to institutional sectors is to be performed. As a matter of fact (not of principle), the activity classification of firms is of crucial importance for the assignment of institutional sectors to corporations in the statistical business register. The algorithms used for the assignment of NA sectors in Germany, for example, will not assign firms in section J of ISIC to the ESA sector S.12 (financial corporations).¹⁴⁵ In our sample of German fintech firms, 20.6% are classified in Sector S.12 (financial corporations), the rest, 79.4%, are classified as non-financial corporations or general government entities.

Thus, the classification of fintech activities has direct consequences for national accounts. Hauf (2018) notes the marked decrease in the labour productivity of the German financial sector since the beginning of the century. It is well conceivable that this is because the innovative layers of the German financial industry are selectively missing out. Chaudron (2019) suggests inspecting supply and use table data to analyse the dynamics of the ITC content in the production of financial services.

Steps for revising the existing classification systems

Using the CPC as a starting point, one useful way of approaching a revision could be to proceed as follows:

 Circumscription of areas of interest: What are the broad fields in which the advent of fintech firms might compromise the information value of existing

- ¹⁴² Direct enquiry, communication dated 19.10.2018 by Hartmut Minkel, Destatis.
- ¹⁴³ Published as European Commission et al (2009).
- ¹⁴⁴ Published as Eurostat (2013).
- ¹⁴⁵ See Hauf (2018), p.12.

Internet webpage development; planning and designing computer systems that integrate hardware, software and communication technologies;...".

reporting structures for central banks and other agencies? This could result in a list of broader product classes, such as

- deposit services;
- credit-granting services;
- o corporate finance and venture capital services;
- o financial transactions services (payments);
- o brokerage and securities services;
- o portfolio management services;
- o pension funds services;
- o insurance services, etc.
- In each of these areas, with the help of specialists, the essential production processes are isolated. In the above-mentioned case of credit-granting services, these could resemble the following list:
 - o acquisition of clients;
 - handling credit application;
 - assessing credit risk;
 - o pricing new credit contracts;
 - o managing credit contracts,
 - o managing default, legal services,
 - o information management, internal and external accounting,
 - o risk management,
 - o funding (capital market, deposits, "crowdfunding"), etc.
- The CPC is designed to be complete and exhaustive: each and every product under the sun is supposed to fall into one and only one category. Thus, we can decide how a certain activity or process would be classified today, provided it is offered on the market. We can do this to all processes listed in step 2. This analysis should be augmented by an empirical study of where such activities are currently being grouped, using lists of fintech firms similar to those above.¹⁴⁶ The task is then to make sure that all activities that consist in carrying out the processes listed in step 2 in the context of producing credit granting services are recognised and registered as such. Typically (though probably not in each and every case), there will be a category for this kind of service, but not one that is specific to credit granting. In such cases, these services have to be separated from more general types of B2B (business-to-business) services of the same kind: managing a database of credit debtors has to be kept separate from managing other types of databases, say, on human resources. Handling credit applications is to be distinguished from other types of online sales platforms, like those for books. On this basis, new classes and subclasses can be formed, such as "data-base services auxiliary to credit granting".
- Once defined, the new categories can be relocated to Section 7.1. of the CPC, "Financial and related services". Another option would be to use "alternative aggregations" to define inclusive financial sectors and subsectors, such as "credit granting", by aggregating production from different sections, divisions

¹⁴⁶ Studying fintech firms will also help us specify the list of processes in step 2, ensuring that no important stages are overlooked.

and groups. See the Appendix of CPC Version 2.1 for three examples of alternative structures. Alternative aggregations are carried out along the same lines in the ISIC.

Starting from (idealised) stages of generating value added, rather than focusing on shifts in the supply of financial services that are observable today offers a major advantage in an environment characterised by innovation and "disruptive" new technologies: the revised classifications stand a fair chance of providing solutions for the longer run that will make the classification of financial products and activities robust in the course of further evolution.

The procedure proposed in step 3 for defining new subsectors may be called *minimally invasive* if it allows all existing aggregates and time series to be replicated. If the new fintech subsectors are kept separate from each other and not lumped together into one larger aggregate, then the "old" aggregates can be obtained by adding back the newly formed subsectors to their origin, for example to Information services.

Defining new subclasses for the production of financial services is meaningful only if such services are, in fact, financial in character. While maintaining a database on credit histories and evaluating credit risk will arguably be different from running a wedding website or a database of digitalised images, the same will not be true of more general horizontal functions such as the cloud services being used by a financial intermediary, its mobile phone equipment or its "know your customer" (KYC) routines. To put it somewhat drastically: it is not useful to define activities such as "Electric power generation auxiliary to financial services". It is input-output analysis and supply and use tables that deal with supply chains in general.

For the decision to be made in step 4, it is important to look at the consequences for *continuity over time* under both options. Looking at the sectoral classification, reallocating fintechs firms from information services to financial services, say, will create a one-off break in the time series on financial services if it is not possible to calculate appropriate back data according to the new definition. However, after such an adjustment has been made, those larger aggregates will be immune to changes in financial firms' business models, such as outsourcing, mergers and acquisitions, or close cooperation with other fintech firms. It will not be easy to maintain statistical reporting systems on a stable legal footing based on alternative aggregations. If the providers of major services in the financial value chain are not allocated to the same sector as financial firms, they will move in and out of data collection schemes depending on how their business models evolve.

It is vital to stress the fact that the suggested procedure does not need (and indeed will not yield) a definition of "fintech", either explicitly or implicitly, that goes beyond the general concept provided on page 2 above. Instead, this approach aims to ensure that the relevant financial activities and outputs of production processes are registered and monitored, no matter how far the production processes are split across a variety of firms working on the same product closely connected by ICT.

The procedure does not explicitly address the issue of "bigtech" firms (bigtechs) – large conglomerates that are making inroads into the provision for financial services. The issue with bigtechs is not so much the classification systems as such – rather, it is the way they are used when designing statistical processes. Very often, statistical reporting duties depend on the classification of the legal entity as a firm. The financial activities of Google or Amazon will hardly ever be large enough to justify reclassification of the entire group as a provider of financial services. Fintech activities

of bigtechs will then be recorded if and only if these conglomerates provide services through dedicated legal entities, as they will be classified and subjected to regulatory or statistical reporting requirements.¹⁴⁷ Therefore, it might be meaningful to make the creation of such dedicated entities compulsory.

Alternatively, we may ask why reporting obligations should not quite generally depend on the activities of a legal unit rather than on firm classification, ie on whether or not certain activities, such as the production of financial services, take place. This is currently the case for reporting duties in external statistics – provided certain thresholds are met, firms have to report on foreign trade or cross-country financing operations if they are involved in these activities, no matter what industry they are classified in.

¹⁴⁷ Interestingly, some conglomerates create subsidiaries to bundle their financial services activities (eg Google Payment Limited) while others leave them within the main company as a new service (eg Apple with Apple Pay). This may be related to supervisory aspects. It is easier to ring-fence additional reporting requirements by creating a legal entity for them.

References

Carney, M (2017): "Fintech credit, Market structure, business models and financial stability implications", report prepared by a working group established by the Committee on the Global Financial System (CGFS) and the Financial Stability Board (FSB), mimeo, May.

Chaudron, R (2020): "Fintech from a national accounts perspective: information from use tables". *IFC Working Group on Fintech Data Issues: Towards monitoring financial innovation in central bank statistics*, Annex 3: Fintech case studies.

Dorfleitner, G, L Hornuf, M Schmitt and M Weber (2017): Fintech in Germany, Springer.

Dorfleitner, G, L Hornuf and L Wannenmacher (2020): «Der deutsche Fintech-Markt im Jahr 2020», *ifo Schnelldienst* 7 / 2020, 73. Jahrgang (forthcoming).

EBA (2017): "Discussion paper on the EBA's approach to financial technology (Fintech)", EBA/DP/2017/02, August.

European Commission, Organisation for Economic Co-operation and Development, United Nations, World Bank (2009): *System of National Accounts 2008*, New York.

Eurostat (2013): European System of Accounts (ESA) 2010, Luxembourg.

Gauthier, Y (2020): "Fintech companies in Canada: opportunities for growth"; *IFC Working Group on Fintech Data Issues: Towards monitoring financial innovation in central bank statistics*, Annex 3: Fintech case studies.

Hauf, S (2018): "Produktivität: Staat und andere Sonderfälle", VGR-Kolloquium, Berlin, June.

National Bank of the Republic of Austria (OeNB) (2019): "Small but buzzing: the Austrian fintech ecosystem", in: *Financial Stability Report* 38, Dec, pp 46-55.

Schueffel, P (2016): "Taming the beast: a scientific definition of fintech, *Journal of Innovation Management*, vol 4 (4), pp 32-54.

United Nations (2015): "Central Product Classification (CPC)", version 2.1, *Statistical papers*, series M, no 77, version 2.1, New York.

(2008): "International Standard Industrial Classification of All Economic Activities (ISIC)", rev 4, *Statistical papers*, series M, no 4, rev 4, New York.

Wolf, S (2017): "Definitions: What is fintech", International Organisation for Standardisation, TC68 Fintech Tag, Memo, May.

Appendix A: Clusters of fintech activity according to EBA¹⁴⁸

Table 1

Credit, deposit, and capital raising services (Cluster A)	A1 Taking deposits; A2 Taking other repayable funds (ie funds other than deposits); A3 Lending, including, inter alia, consumer credit, credit agreements relating to immovable property, factoring, with or without recourse, financing of commercial transactions (including forfeiting); A4 Financial leasing; A5 Guarantees and commitments; A6 Credit intermediation under Article 4(5) of Directive 2014/17/EU (MCD); A7 Money broking; A8 Any other financial services of a kind within this cluster
Payments, clearing and settlement services (Cluster B)	B1 Provision of payment accounts; B2 Services enabling cash to be placed on a payment account as well as all the operations required for operating a payment account; B3 Services enabling cash withdrawals from a payment account as well as all the operations required for operating a payment account; B4 Execution of direct debits; including one-off direct debits; B5 Execution of payment transactions through a payment card or a similar device; B6 Execution of credit transfers; B7 Issuing of payment instruments; B8 Acquiring of payment transactions; B9 Money remittance; B10 Issuing and administering means of payment other than those referred to in Article 4(3) of Directive 2007/64/EU (eg travellers' cheques and bankers' drafts); B11 Services to initiate payment orders at the request of the payment service user with respect to a payment account held with another payment service provider; B12 Services to provide consolidated information on one or more payment accounts held by the payment service user with another payment and/or e-money services (Article 16(1)(a) of PSD); B15 Issuance of e-money; B16 Distribution of e-money; B17 Redemption of e-money; B18 Currency exchange; B19 Any other financial services of a kind within this cluster.
Investment services/Investment management services (Cluster C)	C1 Trading for own account or for account of customers in any of the items referred to in point 7 of Annex I to Directive 2013/36/EU; C2 Participation in securities issues and provision of services relating to such issues; C3 Advice to undertakings on capital structure, industrial strategy etc. (eg as referred to in point 9 of Annex I to Directive 2013/36/EU); C4 Portfolio management and advice; C5 Safekeeping and administration of securities; C6 Safe custody services; C7 Advisory services (eg under Article 7 of Directive 2014/17/EU); C8 Any other financial services of a kind within this cluster.
Other financial-related activities (Cluster D)	D1 Credit reference services (eg as referred to in point 13 of Annex I to Directive 2013/36/EU); D2 Comparison services; D3 Compliance services related to know your customer/AML; D4 Compliance services – other; D5 Any other services of a kind within this cluster.

¹⁴⁸ Taken from EBA (2017).

Appendix B: Sectoral classification of fintech firms according to statistical classifications in the business register of the Federal Statistical Office of Germany

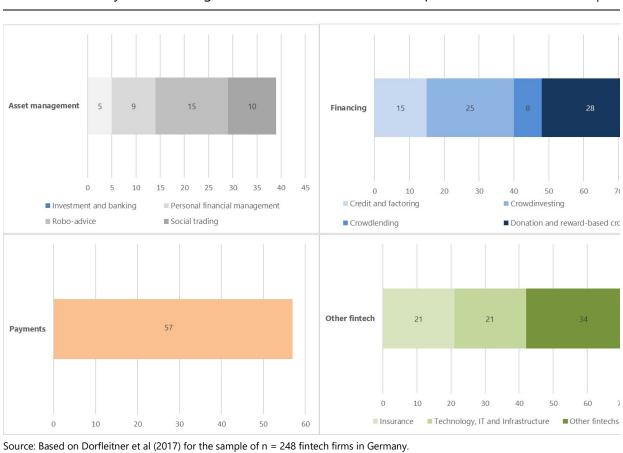
ISIC section and division of identified fintech firms

Table 1

SIC Section	ISIC Division(s)	Description	Number of Fintechs**	As percentage of all found Fintechs	No. of Employees***	As percentage o all employees
G	45-47	Wholesale and retail trade; repair of motor vehicles and motorcycles	13	5,24%	68	1,41%
J	58-63	Information and communication	137	55,24%	2.416	50,12%
	58,61	58 - Publshing activities 61 - Telecommunications	19	7,66%	312	6,47%
J, of which:	62	Computer programming, consultancy and related activities	80	32,26%	1.828	37,93%
	63	Information service activities	38	15,32%	276	5,73%
к	64-66	Financial and insurance activities	50	20,16%	1.634	33,90%
K, of which:	64	64 - Financial service activities, ()	8	3,23%	692	14,36%
	65,66	Activities auxiliary to financial service and insurance activities 65 - Insurance, reinsurance and ()	42	16,94%	942	19,54%
М	70-74	Professional, scientific and technical activities	26	10,48%	342	7,10%
M, of which:	70	Activities of head offices; management consultancy activities	17	6,85%	316	6,56%
	Others*		9	3,63%	26	0,54%
N	82	Office administrative, office support and other business support activities	10	4,03%	302	6,27%
Others*			12	4,84%	58	1,20%

** n=248

***n=246



Clusters of activity and subcategories for the German fintech sample

Graph 1

Dataset and indicators to monitor the crypto-assets phenomenon¹⁴⁹

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Abstract

Crypto-assets and related activities need to be monitored to measure their impact on the global financial system over time. The monitoring of the crypto-asset market is important to identify and examine potential risks in the financial system or market infrastructures, as it represents a major financial innovation with potentially farreaching implications for financial players.

Taking a stepwise approach to building the dataset and indicators needed to monitor the aspects of the crypto-assets phenomenon relevant to the financial system in Europe, the European Central Bank (ECB) adopted innovative approaches to collect data available from public and commercial sources and enrich them by calculating customised indicators as well as utilising advanced data quality monitoring and enhancement tools.

The article starts by describing, in section 1, the key elements involved in setting up the crypto-assets dataset, focusing on the monitoring needs juxtaposed with available data, making it possible to establish the first set of indicators covering issues such as markets, gatekeepers and linkages. Section 2 elaborates on data quality issues related for instance to "wash trading". Section 3 covers issues relating to the harmonisation of units, which is crucial for building aggregations and indicators. The final two sections provide insight into data quality enhancement techniques, which use some methods drawn from functional data analysis as well as machine learning. The analysis is enriched by dependency network analysis and sophisticated visualisation tools.

Keywords: fintech, distributed ledger technology, blockchain, crypto-assets, virtual currency, data quality, European Central Bank, machine learning, functional data analysis, isolation forest, dependency network analysis, gradient boosting

JEL classification: E42; G21; G23; O33; C18

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¹⁴⁹ The views expressed in this presentation and in the related paper are those of the authors and do not necessarily reflect the views of the European Central Bank. Any errors and omissions are the sole responsibility of the authors.

1. Key elements in establishing the crypto-assets dataset

With significant potential to have an impact on the global financial system, cryptoassets and related activities need to be closely monitored. Taking a central bank perspective, such monitoring is important to identify potential implications for monetary policy, the smooth functioning of market infrastructures and payments, and the stability of the financial system. The European Central Bank (ECB) has been analysing the crypto-assets phenomenon¹⁵¹ and in this context has adopted a stepwise approach toward the development of a monitoring framework, with a dedicated dataset and indicators as the focal point. Three aspects of the establishment of the crypto-assets dataset have been crucial:

- the definition of crypto-assets;
- the identification of a range of monitoring needs and the collection of available data following a review of various data sources;
- the preparation of the indicators on the basis of the cleaned and improved data following consistent methodologies.

Definition of crypto-assets

To ensure the consistency of its analysis over time while remaining technologyneutral, the ECB has chosen to define crypto-assets¹⁵² as "a new type of asset recorded in digital form and enabled by the use of cryptography that is not and does not represent a financial claim on, or a liability of, any identifiable entity". This clear definition led to the clear identification of a range of monitoring needs which were juxtaposed with the review of available data.

Monitoring needs against available data

Monitoring needs cover developments in the crypto-assets ecosystem and also, importantly, in **the linkages** between crypto-assets and the financial system and economy. Such linkages may constitute risk propagation channels. The risks stemming from crypto-assets include for example unhedged volatility risk and credit risks for direct and indirect holders. Holders of crypto-assets operate largely in an environment with limited regulatory protection. This environment is further complicated by the absence of an accountable party that would be responsible for managing risks and legality. The distributed architecture of crypto-assets as well as their cross-border nature constitute further dimensions potentially exacerbating the risks.

Another important area of monitoring is the **gateway function**, which covers intermediaries which enable and facilitate the interconnections between crypto-assets and the economy and financial system. Gatekeepers such as trading platforms offer on-off ramps for users to buy and sell crypto-assets in exchange for fiat

¹⁵¹ In 2018 the ECB established the Internal Crypto-Assets Task Force (ICA-TF), with a mandate to deepen the analysis of crypto-assets. For a summary of the outcome of the ICA-TF's analysis, see ECB Crypto-Assets Task Force (2019), "Crypto-Assets: Implications for financial stability, monetary policy, and payments and market infrastructures", Occasional Paper Series, No 223, ECB, Frankfurt am Main, May. See also: European Central Bank (2019), "Understanding the crypto-asset phenomenon, its risks and measurement issues", Economic Bulletin, Issue 5.

¹⁵² See ECB Crypto-Assets Task Force (2019), "Crypto-assets: Implications for financial stability, monetary policy, and payments and market infrastructures". Occasional Paper Series, No 223, ECB, Frankfurt am Main, May.

currencies or other crypto-assets. Crypto-asset wallet providers, which are another example of gatekeepers, provide the storage of cryptographic keys that are used to sign crypto-asset transactions. While developments related to the linkages and to the gateway function are at the core of the monitoring framework, some developments within the crypto-asset ecosystem (eg mining) feature less prominently on the monitoring need list at the moment; nevertheless, the list is constantly evolving to keep up with developments.

Crypto-asset dataset

The Crypto-asset dataset was created based on selected data using automated procedures and big data technology. A review of publicly available third-party aggregated yet aggregated data (provided by commercial and non-commercial data sources) was undertaken in the very first step of setting up the dataset. The data were screened for availability of granular information, completeness of the coverage as well as details of the methodologies used. Accordingly, from the wide variety of available sources, a few were selected for the provision of data with automated procedures using APIs¹⁵³ and big data technologies. In-house statistics do not generally cover crypto-assets.

Preparation of the indicators

Crypto-asset indicators tailored to the ECB monitoring exercise have been grouped into four categories corresponding to the focal points of the monitoring framework: i) markets, ii) gatekeepers, iii) linkages, and iv) other (see Table 1). Crypto-asset indicators so far cover largely off-chain transactions and only selectively on-chain ones.

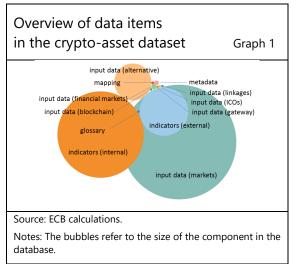
¹⁵³ An application programming interface (API) enables users to send queries to the data provider's database via http protocol (hypertext transfer protocol, the protocol underlying internet websites) and return data.

Overview of indicators

	Category	Example of indicators	Data sources
Off-chain	Markets	 Pricing and trading volumes, market capitalisation, trading vis-à-vis fiat currencies (based on granular end-of-day information for all trading pairs on each trading platform) Pricing and trading volumes of financial instruments traded on the institutionalised exchanges (futures, exchange traded products and others offering exposures to crypto-assets), exchange rates 	 Crypto-asset trading platforms; data providers of aggregated information Commercial financial markets data provider
	Gatekeepers	 Breakdowns of trading and pricing information aggregated across various metadata items of trading platforms 	Crypto-asset trading platforms; data providers of aggregated information
		 Arbitrage indicators Indicators based on metadata information regarding wallets Indicators based on metadata of the cards supporting crypto-assets Indicators based on metadata and some general information about the number of ATMs 	• Various online data providers
	Linkages	• Holdings of financial instruments traded at the institutionalised exchanges	• Securities Holding Statistics ¹⁵⁴
	Others	 Indicators based on metadata of Initial Coin Offerings (ICOs) and raised funds 	Online data providers
Dn-chain		 Indicators based on the number and values of transactions, fees and difficulty Concentration 	Online data providers
"Alternative data"		Social media, news on crypto-assets	Online data providers

¹⁵⁴ See <u>Securities holdings statistics</u> on the ECB's website for more information.

While on-chain transactions are those recorded directly on a distributed ledger, off-chain transactions are recorded either on an institution's book (in the case of trading platforms) or in a private network of users that use the distributed ledger to record the net transactions. Indicators for off-chain transactions were largely based on granular end-of-day¹⁵⁵ trading and pricing information with a trading pair –



trading platform granularity collected from trading platforms and commercial data providers.

Commercial data providers and online data sources provided input for the indicators on gatekeepers and ICOs. Constructing indicators also required that other auxiliary data were collected, such as some financial markets data, exchange rates and "alternative" data.

Looking at the graphical representation of the content of the dataset, input data covering

market category (excluding financial markets) constitute the biggest chunk of the database, followed by indicators calculated internally and indicators collected from external data sources (see Graph 1). Within the market segment, input data refer to trading information obtained from more than 200 trading platforms and more than 11 000 trading pairs. A variety of indicators are calculated based on the input data and some indicators are also collected from external data sources and used for cross-checking purposes or as an input for calculating other indicators.

Input data for other categories of indicators is comparatively small. Beyond the aforementioned data, the dataset also contains some metadata tables, mappings and a glossary.

Data quality and data gaps

Due to the data quality issues (see section 2) the collected raw pricing and trading data were largely unfit for the purpose of preparing indicators. They needed to be subject to quality enhancements which covered outlier identification and filtering out using selected tools from functional analysis and machine learning, empowered with the advanced visualisation machinery to gain insight into the data (see sections 4 and 5).

It is important to emphasise that prominent data gaps remain with respect to the gateway function and linkages between categories of indicators. Currently collected data from online sources do not allow for in-depth analysis neither of granular exposures to crypto-assets nor of gatekeepers. Closing data gaps and developing indicators which could shed more light on the risks will stay high on the priorities agenda.

¹⁵⁵ As the crypto-asset market operates on a 24/7 basis, the end-of-day specification depends on the preferred settings and selected time zone of a data provider and may therefore vary across data providers.

Overall, the first step in setting the dataset and constructing the indicators is completed, paving the way for further work on development of new indicators, expanding data sources and thereby closing data gaps. The new indicators need to correspond to changing monitoring requirements and risks. The direction for this further work would involve going towards more granular off-chain and on-chain data and exploring various alternative data sources accompanied with further work on data quality.

2. Overview of data quality issues related to pricing and trading information

As already mentioned, the collected raw pricing and trading data cannot be readily used to analyse the crypto-assets market. A number of values referring either to prices or trading data seem to stand out, representing anomalous behaviour, while there is an expanding literature that elaborates on the reasons why such anomalies ("outliers") occur in this market.

Specifically, the monitoring of data quality is fraught with significant challenges due to the specificities of the crypto-asset market which is partially unregulated. The market is susceptible to fraud and hacking, as well as related technical issues which may lead to some erroneous transactions affecting data quality of pricing and trading data. There are a number of studies that provide evidence of practices that distort published aggregate statistics on prices and trading volumes.

According to the findings of the Blockchain Transparency Institute (2019), a project aiming to investigate the quality of statistics for the crypto-asset market, a significant percentage of crypto-asset transactions is not underpinned by economic motivation although it is recorded in publicly available statistics. More specifically, the report argues that a large number of transactions can be characterised as "wash trading", which is trading conducted by market participants that sell to themselves in order to manipulate market developments by affecting expectations and market perceptions.¹⁵⁶ Specifically in the crypto-asset market, wash trading is conducted by exchanges creating transactions in order to inflate their trading volumes and gain market share. Furthermore, wash trading is conducted by individual (usually large) investors that conduct transactions in which they own both the buying and selling accounts, aiming to steer market developments in a specific direction. CER (2019) describe two ways in which exchanges can inflate their trading volumes, called "trading inside the spread" and "immediately filled orders" which represent algorithmic ways of mimicking actual trading. Although it is difficult to identify wash trading precisely, a number of studies also find evidence of the existence of wash trading and have reached the conclusions that the majority of recorded trades in the crypto-asset market can be attributed to wash trading. For example, the TheTIE, a data provider, identifies wash trading based on comparative analysis of web viewership metrics across exchanges for a sample of 100 exchanges for 30 days during the first guarter of 2018 and finds that 75% of the exchanges reported trading volumes that were more than double what would have been expected based on this comparative analysis.¹⁵⁷

¹⁵⁶ Hougan et al (2019) define wash trading as follows: "wash trading occurs when a single or affiliated trader executes trades with itself".

¹⁵⁷ See <u>https://twitter.com/TheTIEIO/status/1107671193417588738</u>, for a summary of the findings.

Regarding the bitcoin market, Hougan et al (2019) argue that the spot market for bitcoin trading is efficient, contrary to the public perception of an inefficient market, if one excludes the large share of wash trading. They argue that public perceptions are anchored in analyses based on publicly available data that also record the wash trading component. This gives rise, for example, to the perception that significant arbitrage opportunities are present in the bitcoin market. Specifically, their analysis is motivated by the tenfold velocity of bitcoin compared with that of gold, with velocity measured by the ratio of trading volume to market capitalisation, which is a symptom of the wash trading phenomenon. They collected order book entries and ongoing trades for 83 bitcoin exchanges for the week from 28 April until 5 May 2019 and found evidence of the existence of both wash trading and fraudulent prints in the date reported by exchanges.¹⁵⁸

Fraudulent transactions, cyberattacks and technical issues may result in erroneous transactions affecting data quality. Moore et al (2013) have found that transaction volume is positively correlated with a breach. Typical issues experienced by data aggregators or platforms are a result of service outages, connectivity errors and unstable APIs.

Overall, the issue of data quality is important when analysing developments in the crypto-asset market, especially with respect to the need for identification of abnormal market behaviour that may affect the conclusions reached as regards the efficiency of the market. Sections 4 and 5 that follow elaborate on quantitative approaches to identify the type of behaviour that was described in this section and to exclude from the aggregations the transactions with a non-economic motivation.

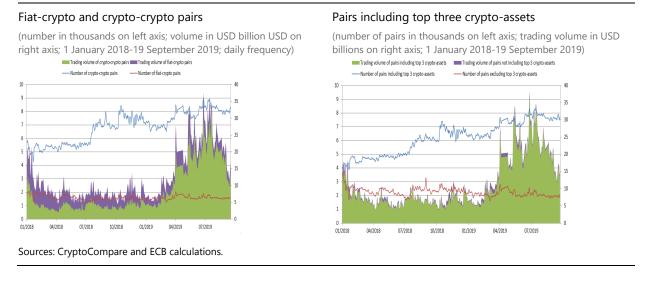
3. Harmonising units with synthetic exchange rate

In order to compare various crypto-assets, a harmonised measure of exchange rates of crypto-assets in a selected unit of fiat currency (eg in euro (EUR) or US dollars (USD)) is crucial. This is particularly relevant for those crypto-assets which are not traded against the target unit of fiat currency. Notably, the vast majority of trade pairs recorded in the database refer to crypto-assets versus other crypto-assets (see Graph 2). From the trade pairs covering fiat currencies, the highest share of 39.5% refers to USD. To express crypto-assets against a common fiat currency, synthetic exchange rates are considered, with three approaches to their calculation.

¹⁵⁸ Fraudulent prints are defined by Hougan et al (2019) as "volume that is simply printed on the tape by an exchange, with no corresponding trading taking place".

Number and trading volume

Graphs 2 and 3



The currently used approach involves **using one intermediary crypto-asset from a static bucket of three following a predefined hierarchy.** The three intermediary assets are the top three most widely traded crypto-assets in terms of number of trading pairs as well as in terms of trading volume aggregated over platforms. The choice of three as a number of intermediary crypto-assets is dictated by the trade-off between minimisation of the number of intermediary crypto-assets and maximisation of the coverage of trades between crypto-assets, for which crossexchange rates can be computed. The current selection is fixed over time and covers bitcoin, ethereum and tether. The above approach follows Makarov et al (2019). A price of a crypto-asset not traded against a target currency is converted to the target currency using the exchange rate of the crypto-asset to one of the intermediary crypto-assets according to the predefined sequence. This selection of intermediary crypto-assets makes it possible to cover a large share of the trading pairs as well as the vast majority of trading volumes (see Graph 3). Additionally, it is computationally inexpensive.

Number and trading volume

Pairs including top three crypto-assets

in terms of number of pairs

(number of pairs in thousands on left-hand axis; trading volume in USD billions on right-hand axis; 1 January 2018-19 September 2019)



Sources: CryptoCompare and ECB calculations.

in terms of trading volume

(number of pairs in thousands on left-hand axis; trading volume in USD billions on right-hand axis; 1 January 2018-19 September 2019)

Graphs 4 and 5

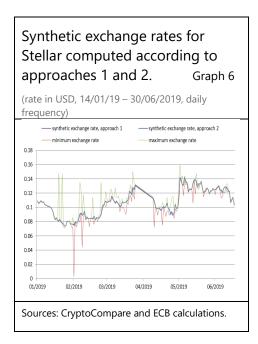


Sources: CryptoCompare and ECB calculations.

Notes: Bitcoin and ethereum are always included in the top three crypto-assets. Tether is included on 424 out of 600 days, dogecoin is included on 176 days.

Notes: Bitcoin is always included in the top three crypto-assets. Tether is included on 579 out of 600 days. Ethereum is included on 547 days.

In order to move away from the static predefined set of intermediary cryptoassets, two options have been investigated. The first approach of **applying the dynamic scheme for the daily selection of three intermediary crypto-assets** would not substantially change the picture (see Graphs 4 and 5). The synthetic exchange rate within this method is calculated using one available intermediary crypto-asset according to the sequence of their ranking within the set of top three.



The investigated option second synthetic involves calculating the exchange rate using on a daily basis all the available intermediary crypto-assets which are traded against the target unit of fiat currency. In this case, the synthetic exchange rate constitutes the average of the underlying intermediary exchange rates weighted by respective trading volumes. This option is independent of the selection of one intermediate crypto-asset and takes into account a bigger spectrum of intermediate crypto-assets and works well to capture variability across exchange rates in the market. The results obtained from options 2 and 3 are largely consistent (see Graph 6 for Stellar as example).

Both investigated methods provide

similar values of synthetic exchange rates across time. The average value of absolute differences between the values of exchange rates calculated applying both methods across time is equal to 0.09% for stellar, 0.10% for litecoin, and 0.07% for eos. One possible explanation of the similarity of values of synthetic exchange rates is the

leading role of bitcoin as an intermediate crypto-asset due to its high prevalence among trading pairs in the market.

Taking into account the above results and considerations, future work will focus on further investigation and application of the dynamic synthetic exchange rate with an expanded and flexible number of intermediary crypto-assets, especially as this method is also computationally straightforward and economic. Although it performs equally to the approach with the dynamic selection of one intermediary crypto-asset based on trading volume in an analysed time period, it may be expected to provide more accurate results should the market become more fragmented and the relative share of trades versus bitcoin diminish.

Overall, for the comparison between crypto-assets and building aggregated indicators, the currently applied way of harmonising units performs well. As the current method is static, in future work will focus on further investigation and prospective application of the dynamic synthetic exchange rate with an expanded and flexible number of intermediary crypto-assets.

Enhancing the quality of pricing and trading information by applying machine learning techniques and using alternative data sources

Importance of data preparation

Data preparation for developing robust indicators and aggregations to monitor the crypto-assets phenomenon (eg the aggregate price of a crypto-asset across all trading platforms) involves tackling issues related to the quality of underlying data (see Section 2). In particular, the collected raw data on pricing and trading needed to be cleaned of observations covering inactive trades as well as of anomalous data spikes reflecting idiosyncratic exchange-specific events eg technical failures. While dealing with the first issue is straightforward, handling the anomalous spikes requires more elaborate methods.

Two approaches were chosen for the data preparation, specifically to exclude outliers that may distort the aggregates, from the toolset of functional data analysis and machine learning: i) the outliergram and the functional boxplot, and ii) the isolation forest (IF). The objective was to use data-driven and explainable machine learning methods which and would not require intensive resources for daily application. In addition, to enhance the understanding of the relationships between crypto-trading platforms, the dependency network analysis based on XGBoost using an interactive visualisation tool was also employed (see Section 5).

Functional data analysis tools

The outliergram (Arribas-Gil and Romo (2014)) and functional boxplot (Sun and Genton (2011)) are functional data analysis (FDA)¹⁵⁹ methods employed to analyse the dispersion or outlyingness in samples of curves, the curves in this case being the time series of crypto-asset prices and trading volumes on specific trading platforms. These methods can be used to detect and visualise magnitude and shape outliers. Magnitude outliers are those curves that lie outside the range of the majority of the

¹⁵⁹ Functional data analysis is a branch of statistics that analyses data providing information about curves, surfaces or anything else varying over a continuum. See Ramsay, J O (2004).

data. Shape outliers may be defined as those curves that exhibit a different shape from the rest of the sample. Disregarding the differences in pricing and trading attributed to the fees charged by trading platforms, transaction processing times and other sources of friction, crypto-asset markets can be characterised as having low entry barriers owing to the digital nature of the market, and the trajectories of pricing curves across exchanges and for each crypto-asset pair are likely to follow a broadly similar pattern. The trajectories would be expected to be broadly the same for the trading volumes curves as well (Makarov and Schoar (2019)). While pricing curves can be used raw, trading volume curves need to be normalised, as high dispersion across the trading platforms is justified by the differences in the level of development and size, resulting in part from trading platform specialisations, locations and other features.

The functional boxplot extends classic ideas from descriptive statistics to a FDA framework. It is based on a notion of band depth (Sun et al (2012)) that allows curves to be ordered from the centre outwards and thus introduces a measure to define functional quantiles and the centrality or outlyingness of a curve. In particular, the magnitude outliers can be flagged as the curves which are outside the central region including 50% of all curves.

While magnitude outliers can be easily detected with the functional boxplot technique, shape outliers require a dedicated technique. The outliergram exploits the parabolic relationship between two measures of depth for functional data, the modified band depth (MBD) and the modified epigraph index (MEI – see Arribas-Gil and Romo (2014)) to detect shape outliers. While the MBD accounts for the proportions of bands in which a curve is entirely contained, the MEI accounts for the proportion of curves that lie entirely above a selected curve. The underlying idea is that if a curve with a different shape is introduced within a sample of otherwise perfectly aligned curves with common shape, then the pair (MEI, MBD) will lie far away from the parabola defined by the points corresponding to MEI and MBD for the rest of the curves.

The isolation forest technique

While selected FDA techniques were applied to pricing and trading data, in order to also exploit other data collected and to ensure the robustness of both methods, an isolation forest (IF – see Liu et al (2008)) technique was applied with a view to using various numerical and categorical variables. The technique is based on the assumption that anomalies are data points that are few and different. As a result of these properties, anomalies are susceptible to a mechanism called isolation. The algorithm isolates observations by randomly selecting a feature and then randomly selecting a split value between the maximum and minimum values of the selected feature. Since recursive partitioning can be represented by a tree structure, the number of splits required to isolate a data point is equivalent to the path length from the root node to the terminating node. This shorter path length, averaged over a forest of such random trees, may indicate anomalies.

An additional consideration while choosing the IF technique concerned the relative simplicity of the technique and its implementation, coupled with the limited computational resources needed. Moreover, the technique fit well considering the size and requirement stemming from the size of our dataset.

5. Overview of implementation steps

FDA tools

The functional boxplot and outliergram methods are applied, as implemented in an R package roahd (Tarabelloni et al (2017)) (**RO**bust **A**nalysis of **H**igh dimensional **D**ata). The package focuses on computational efficiency and supports both univariate and multivariate functional data. Importantly, for outlier identification the iterative steps (see the pseudo-code in the Annex) covering switching between functional boxplot and the outliergram are followed in order to address parameters tuning for our algorithm. We start the iteration with lax parameters and make the parameters stricter until the stopping condition is verified. The stopping is set to 10% of observations based on the assumption of a largely frictionless market where differences in prices are driven by different pricing schemes of trading platforms and some other factors (see Section 3).

The IF algorithm

The IF method is applied using the implementation in the Python project **Scikit-learn** (Pedregosa et al (2011)). The parameter contamination, ie the portion of expected outliers, was dynamically tuned using a function inversely proportional to the volatility of the market but constrained between 10% and 30%. This dynamic adjustment is necessary to make the algorithm robust in the event of sudden and big variations in prices, typical of the crypto-asset market.

Timeframes used for the training dataset (IF) and rolling window (FDA)

Both approaches are used in a dynamic framework created to emulate the daily production of indicators and aggregations. When using historical data to detect anomalous or artificial patterns, we must consider what time period should be used for the application of the FDA tools and also for the training dataset for the IF. Two-week data windows were applied in these cases and performed well. The FDA and the IF methods utilise the two-week rolling window to detect anomalies for the following day. A two-week training dataset for the IF was chosen so as to cover the relevant change in the market.

6. Dataset

While in the case of the FDA approach we consider time series of closing prices and normalised volumes as curves, for the IF, other variables, derived from daily open, high, low, close and trading volume information (or OHLCV), as well as alternative data, are also used. The transformations of the variables used in the IF technique are necessary in order to describe the relative performance of a trading platform with respect to others and exploit the isolation phenomenon. The features used in the IF method are listed and described in Table 2.

Features used	in	tha	IE	tochniquo
reatures used	III	the	ΙГ	lechnique

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Features	Description
	Price
close_md	Daily spread between the closing price on a trading platform and the median price across all trading platforms
d_hl_md	Difference between the high-low price spread on a trading platform and the median high-low price spread across all trading platforms; calculated daily
d_oc_md	Difference between the open-close price interval on a trading platform and the median open-close price spread across all trading platforms; calculated daily
	Trading volume
vol_norm	Ratio of trading volume on a given day to the maximum trading volume on a particular trading platform in the period analysed (six months)
	Trading platforms metadata
Centralised	Boolean variable indicating the centralised/decentralised ¹⁶⁰ feature of the platform (1 for centralised and 0 for decentralised)
Trades	Boolean variable indicating whether a trading platform publishes information on pricing and trading volumes
Order book	Boolean variable indicating whether a trading platform releases the order book to the public (1 for yes, 0 for no)
Incorporation	Score derived from country of incorporation and the World Bank's Governance Indicators (Kaufmann et al (2011)) that assess quality of governance in over 200 countries
	Alternative: News
Footprint score	Score computed by counting the occurrences of the name of a trading platform in a set of collected news. English language news only is covered

The features can be grouped into four categories concerning prices, trading volumes, metadata information of the trading platforms and indicators based on the alternative data. In the price related features, the denominator refers to the median price change across platforms, in order to capture the abnormal idiosyncratic price changes that pertain to specific platforms and are not due to synchronised movements that happen across all platforms. Likewise, an indicator of trading volume normalised by the maximum volume recorded on this platform in the analysed period is designed to identify some unusual trading volume patterns across time. Trading platforms may differ in their business models and the service they provide and the features related to the selected metadata characteristics aim to reflect this. By publishing pricing and trading information, as well as releasing their order books, some platforms may facilitate price formation. Trading platforms can be distinguished based on whether or not they hold crypto-assets on behalf of their clients and execute trades on their books (centralised) as opposed to the decentralised ones which rely on validation by distributed ledger technology network users to execute a trade. Furthermore, trading platform vary with respect to the country of incorporation or

¹⁶⁰ A platform is decentralised when it relies on validation by distributed ledger technology network users to execute a trade.

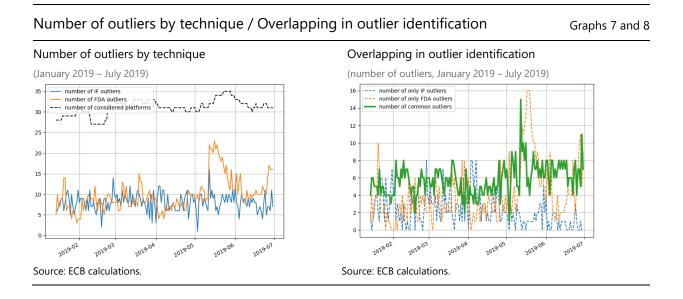
lack of thereof. The last feature based on alternative news data captures the presence of references to a trading platform in the English language news.

Overall for the analysis, daily data for the first six months of 2019 for the pair bitcoin/euro (BTC/EUR) traded in 58 trading platforms were considered. Pricing and trading data were enriched with several other indicators covering metadata features of trading platforms and some alternative data sources.

7. Results

Stability of the identified outliers over time

In the analysed period, the FDA tools and the IF method identified broadly the same number of outliers every day. The number of identified outliers was stable over time (between five and ten out of around 30 analysed trading platforms) with few exceptions notable for the FDA approach in May 2019, when the bitcoin saw a sharp increase in prices after staying flat since the beginning of 2019. The spike in May 2019 kicked off the proceeding price rally which was caused by positive market sentiment including on account of the first announcements¹⁶¹ of Facebook Libra. There is a significant overlap in the set of identified outliers with the two methods (see Graph 7 and 8); however, some outliers were identified only by one method. In general, the FDA tools identify more outliers and the vast majority of outliers from the FDA method were of magnitude.



¹⁶¹ Eg a tweet from a technology reporter at The New York Times on 8 April to the effect that Facebook was looking for <u>"big sums – as much as \$1b"</u> of venture capitalist funding for its crypto-asset project and would possibly use the <u>funds as collateral</u> for its stable coin.

Evaluation

For the evaluation, the results from the aforementioned methods are compared with the list of trading platforms included in the CCCAGG index¹⁶² as a reference, bearing in mind that they are not strictly comparable. Selection of trading platforms for the CCCAGG index aims to include as many of them as possible which have successfully completed the requirements in the testing period. Platforms are excluded if prices are considered too volatile compared with the market average, trading platforms suspend trading activity or have malfunctioning API and also when a verified user or social media report fake data reporting. Every case is discussed by the CryptoCompare Review Committee and the outcome of the discussions is published in a newsletter.¹⁶³ While the newsletter is available on a monthly basis and contains the expert judgement on the process, the objective for the FDA tools and for the IF was **to be able to assess the quality data of a specific traded pair with a data-driven technique that could be run on a daily basis or higher frequency basis.**

The precision and recall measures are used for the purpose of evaluation. The precision measure, also called the positive predictive value, is the share of trading platforms identified as inliers that are at the same time included in the CCCAGG index (true positives), to the number of identified inliers. The recall measure, which is also labelled sensitivity, takes the same numerator as in the case of precision measure (true positives), and juxtaposes it against the total number of trading platforms included in the CCCAGG index.

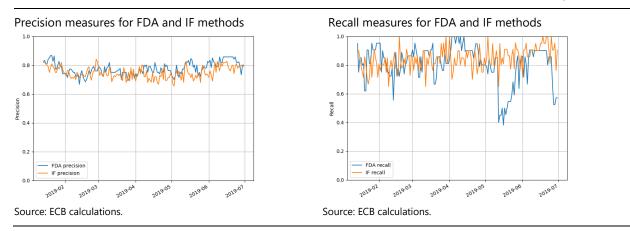
Outlier detection based on the FDA tools and the IF techniques returned satisfactory measures for both precision and recall measures (see Graphs 9 and 10), with both methods delivering very high overlap of identified inliers compared with the CCCAGG index and consistent across time.

¹⁶² See Crypto Coin Comparison Aggregated Index

¹⁶³ See the <u>CryptoCompare blog</u> where the newsletters are published.

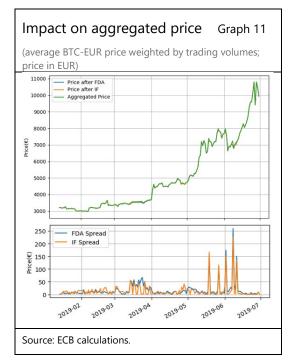
Precision measures for FDA and IF methods / Recall measures for FDA and IF methods

Graphs 9 and 10



Impact of the outlier removal on the aggregated price and trading volumes

Looking at the average price of BTC in EUR weighted by underlying trading volumes calculated based on information from all trading platforms and compared to the

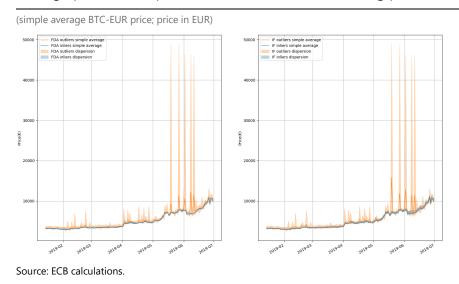


analogical indicators calculated for inlier trading platforms, the difference is not very significant and reaches 3.58% of BTC price (see Graph 11). Such non-invasive exclusion of outliers is due to the relatively low underlying trading volumes. Nevertheless, without a weighting mechanism the impact would be more pronounced and to the disadvantage of the quality of price information (see Graph 12). The simple average price of BTC/EUR pairs on the outlier platforms is up to 120% higher than the analogous price achieved on the inlier trading platforms. Likewise, the dispersion is several times higher within outlier subset than within inliers.

Turning to the impact on trading

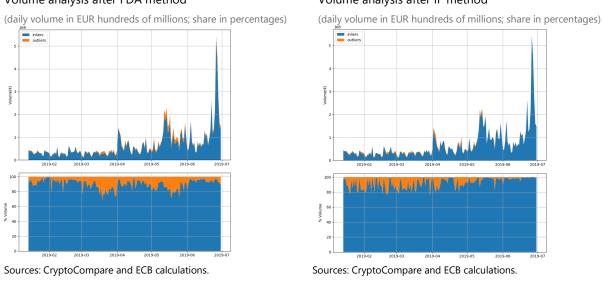
volumes, with the IF retaining more trading volumes, the excluded trading volume only occasionally exceeds 20% of the total. The FDA excludes slightly more trading volumes on aggregate (see Graphs 13 and 14).

Average price and dispersion on inlier and outlier trading platforms



 Volume analysis after FDA method / Volume analysis after IF method
 Graphs 13 and 14

 Volume analysis after FDA method
 Volume analysis after IF method



Assessment

The two techniques analysed, based on the FDA and the IF, made it possible to successfully unbundle anomalous performance of trading platforms and contributed to the robustness of indicators. Both techniques delivered stable results that were consistent both with each other and over time. The comparison of these data-driven, simple and timely methods with the coverage of trading platforms in the monthly CCCAGG index proves to be very positive, with the chosen cross-evaluation indicators of precision and recall pointing to very satisfactory results of broadly 80% in both cases. Additionally, filtering out of the anomalous price observations coupled with

relatively non-invasive exclusion of underlying trading volumes is assessed positively in the context of the application of the analysed techniques in the daily production processes. The important step of data quality enhancements has been completed, paving the way for the next steps of further improvements in the chosen techniques eg by investigating the optimised split points and optimised selection of the parameters for the IF.

8. Dependency network analysis

Rationale

The analysis of crypto-asset trading platforms involves the use of coupled pieces of intrinsic (attributes such as the platform's prices and volumes) and extrinsic (from social media, all other information not issued by the trading platform) information. The complexity of the analysis is due to the number of variables and their states, and in the way these states evolve with respect to the full ecosystem. Evolution of states can follow different patterns of behaviour, and trying to understand behaviour is complex as it involves latent variables which might only be possible to infer by modelling complex decision processes involved in trades.

To obtain an initial understanding of this complexity, influences at two different levels of granularity are analysed:

- the features level: the most precise granularity level, where all the links between the numerical features of each trading platform (described in Table 2) are evaluated; this corresponds to the computing level of the analysis;
- trading platform level: the aggregated links between the trading platforms are created by summing up their outward influences.

To enhance this understanding, a graphic visualisation tool is employed to enable data analysts to explore the multi-dimensional relationships in a dynamic and interactive way.

In this exploration, different graphs were prepared to visually analyse a hypothesis on relationships between trading platforms. These graphs are shown later in this section.

Implementation

The influences are calculated by running the XGBoost gradient boosting method. Each distinct attribute, or feature, of each trading platform is predicted over a period of six months, using data from the IF-based outlier detection method presented in the section on the dataset. Each trading platform dataset is composed of the **N** semantically similar features. Each feature is independently predicted using dedicated XGBoost regression models. The predictors set is composed of all the other features of all the other trading platforms (**M** in total) as implemented in similar approaches.¹⁶⁴ The output of such a model is twofold:

• MxN prediction models for which we can estimate an error, serving as a confidence factor

¹⁶⁴ See Benatti, N (2019): "A machine learning approach to outlier detection and imputation of missing data", in Bank for International Settlements, Are post-crisis statistical initiatives completed? Proceedings of the Ninth IFC Conference in Basel, Switzerland, 30-31 August, 2018, IFC Bulletin, No 49.

 For each predicted feature, the respective feature importance of all the other Mx(N-1) features of all the other trading platforms used as predictors.

Using an ensemble of boosted trees enables us to grasp the relative importance of linear and non-linear relationships between features. While feature importance cannot be considered as correlations, they represent the influence one parameter has on defining another with respect to a set of other parameters.

The importance of a feature is technically calculated by evaluating the average gain of that feature; as for XGBoost (<u>https://github.com/dmlc/xgboost</u>), the setup to compute this metric is the default when using regression models (*importance_factor* = "gain"). The average gain of a feature represents its usefulness in splitting branches in the decision trees. This usefulness is greater for splits in decision trees that reduce the variance of samples in each branch when compared to the variance of samples in the parent branch.

9. Exploring the graph structure

3D dynamic graph

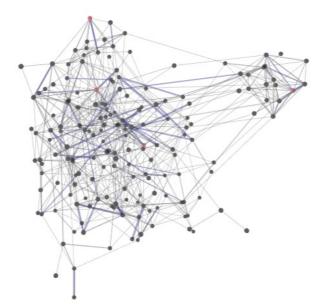
The most precise granular level of features and their relationships can be visualised in a 3D dynamic graph. While each node is a feature of a specific trading platform as described in Table 2, each edge is a directional link from the predictor to the target and it represents the importance of that link (the gain, as computed by XGBoost).

Screenshot of the 3D visualisation of features' importance

2010 1 2010

Graph 15

(January 2019 - June 2019)



Notes: Links of less than 0.06 importance are not displayed. Blue edges highlight strong edges with importance above 0.3. Nodes in red highlight features from the Bitstamp trading platform.

Source: ECB calculations.

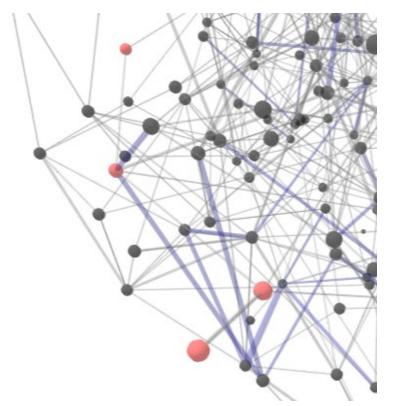
A 3D dynamic graph making it possible to **navigate from the outside to the inner graph structure** of the network enables us to easily identify the strongest links, for example (see Graph 15). Taking Bitstamp as an example, which is a trading platform included in the CCCAGG index (see Evaluation in Section 4), shows that nodes representing features from this platform are generally split across the graph of relationships. **Similar platforms generally labelled as inliers tend to have the same type of connectivity with minimum distance about 3**.

On the other hand, platforms considered as outliers by one or both of our outlier detection algorithms as well as excluded from the CCCAGG index have a different type of connectivity (see Graph 16). Nodes related to the outliers are generally directly connected, and they are certainly closer to each other than features of inliers.

Screenshot of the 3D visualisation focusing on a sample of trading platforms identified as outliers

Graph 16

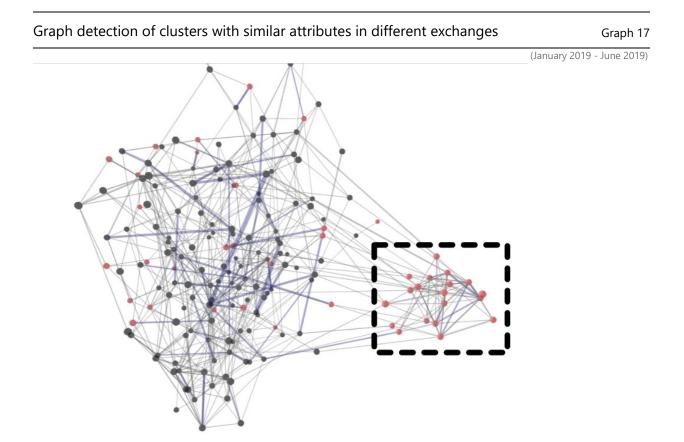
(January 2019 - June 2019)



Notes: Graph highlights features of a trading platform excluded from the CCCAGG index and considered to be an outlier by our two datadriven approaches. The features of this platform appearing as red nodes (outliers) are closer to each other, even directly connected. Blue edges highlight strong edges with importance above 0.3.

Source: ECB calculations.

The exploration of the graph makes the **clusters** easily identifiable. Graph 17 highlights nodes representing one feature across the different trading platforms by colouring them in red. One of the visually remarkable clusters, in the dashed square of Graph 17, is fully underlined by this colouring. This cluster, which was already structurally visible in Graph 15, gathers platforms that are not all marked as outliers. A closer look at it shows that the nodes with strong edges marked in blue, in the centre of this cluster, are edges between inlier platforms. In general, outliers are found lying in the periphery of clusters and they are connected by weaker links in all kinds of directions.



Notes: Trading platforms seem to be related to each other by the same feature. Blue edges highlight strong edges with importance above 0.3. Nodes referring to outliers marked in red.

Source: ECB calculations.

Turning to the graphical exploration of trading platform features detected as outliers, each marked feature shows similar characteristics:

- they have fewer links than their non-outliers neighbours,
- the strength of their links is rather weak, meaning influence is smaller.

2D dynamic graph

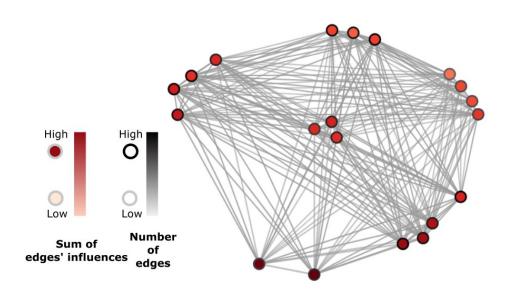
Trading platform-level aggregation can be more easily visualised in 2D. Graph 18 shows a simplified view of the network between platforms. Two colours are used to represent each node with:

- its central colour representing the sum of the outward influence; from light pink to very dark red, with the latter being the most influential,
- the stroke line colour of a node disc representing the number of outward links; from white for none and black for maximum number of links (ie number of trading platform minus one).

2D graph representing aggregated information between trading platforms

Graph 18

(January 2019 – June 2019)



Notes: Nodes are manually grouped by the user using colour cues of the centre and border of the discs. The two darkest nodes at the bottom represent two important inlier platforms.

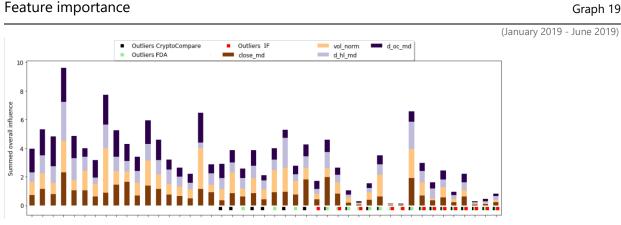
Source: ECB calculations.

Drawing on the graph structure and relationship observations, several assumptions have been built and tested, such as:

- outliers mostly interact with outliers
- inliers impact the whole network more than outliers.

Different histograms are built in order to check these assumptions, as they bring a more quantitative insight. The histogram shown in Graph 19 shows that with some exceptions, outliers (highlighted with some colour marks on the right of the x-axis) provide less gain in predictions of all other features of the entire network. The total importance seen on this graph is weighted by the share of the active¹⁶⁵ trading days of a platform in the overall period analysed, with the assumption that if a platform has fewer active trading days, it would have less impact on the other platforms.

¹⁶⁵ An active trading day is a day with non-zero trading volumes.



Predictors per trading platform ordered by outlier marks

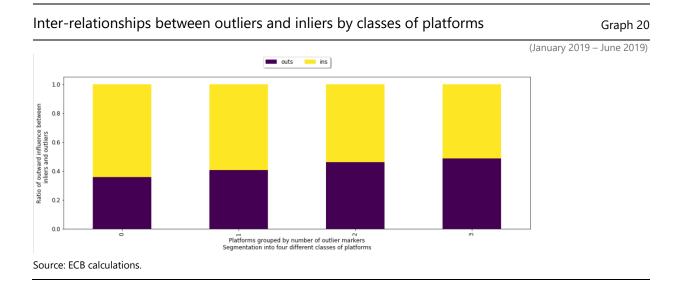
Notes: Each feature importance is stacked over their respective trading platform. The importance of each feature refers to the sum of all its XGBoost numerical gains when used to predict other features. Trading platforms (on x-axis) are ordered by their number of outlier markers (none on the left, maximum three on the right). The total importance is weighted by the share of the active trading days of a platform over the overall period analysed.

Source: ECB calculations.

Looking at the results shown in Graph 19, it is not possible to conclude whether features provide more prediction gains for inliers than for outliers or the other way around. To obtain some insight on this, platforms are aggregated by number of outlying marks, thus forming four classes:

- Class 0: inlier platforms only,
- Class 1: platforms marked by one of the methods (included in CCCAGG index, FDA or IF),
- Class 2: platforms marked as outliers by two methods,
- Class 3: platforms marked as outliers by all three methods.

Graph 20 shows that **outliers interact slightly more with other outliers than do inliers.** Inliers have an 0.35 importance measure to outliers while strong outliers (class 3) have 0.48 aggregated importance with any other outlier.



Dynamic graphs in both 3D and 2D are a valuable tool for gaining insight and understanding of the relationships between trading platforms. The graphs allow for easy navigation into each corner of the graph structure, identification of clusters and interaction with the network focusing on a selected group of trading platforms, eg outliers.

The network analysis showed that nodes related to the outliers are generally directly connected or very close to each other, while inliers tend to have the same type of connectivity with minimum distance of about 3. Furthermore, within mixed clusters, outliers are found on the periphery with weaker links in all directions. In general, the impact of the outliers on the overall network is smaller while they tend to interact somewhat more with each other than with the inliers.

Turning to future work, current analysis is based on a now-casting approach, and therefore does not consider any time dependencies. Future work includes engineering of features that represent the past of predictors in order to predict the targets values at present moment.

Moreover there might be multi-target relationships which are also ignored at this stage. Multi-target regression methods should be used to measure the importance of features to predict several targets at the same time. These predictions are more meaningful when they increase the prediction accuracy of the targets. Further analysis is needed to select which targets should be predicted together in order to avoid combinatorial explosion of computation.

Finally, graph algorithms can be used to automatize the analysis of the network with measures such as centrality, weighted centrality, connectivity and shortest paths used, including for anomalies detection and filtering out.

10. Conclusions and way forward

The first step in establishing the dataset and constructing the indicators has been completed, paving the way for further work on development of new indicators, expanding data sources and thereby closing data gaps. The new indicators need to correspond to changing monitoring requirements and risks. Key areas relate to linkages and gatekeepers. We will need to move towards more granular off-chain and on-chain data and explore various alternative data sources, with further work on data quality.

The issue of data quality must be tackled prior to analysing developments in the crypto-asset market, especially with regard to the need to identify and filtering out the anomalous observations.

The current method of harmonising units performs well for comparing cryptoassets and building aggregated indicators. As the current method is static, future work will need to cover further investigation and prospective application of the dynamic synthetic exchange rate with an expanded and flexible number of intermediary crypto-assets.

With regard to the two techniques analysed for outlier identification and filtering out, based on the FDA and IF, they have both made it possible to successfully unbundle observations on anomalous performance. Both techniques delivered stable results that were consistent with each other, as well as over time and with the monthly coverage of the CCCAGG index chosen as a reference. Filtering out identified outliers made it possible to enhance the robustness of pricing data with only non-invasive removal of underlying trading volumes. Being data-driven, agile and resourceefficient, both techniques analysed are suited to being part of the daily quality enhancement procedure, while future work may focus on further extensions of both methods and also on engineering some new features.

The dependency network analysis supported with the powerful 3D and 2D graphs proved valuable for gaining insight and understanding of the relationships between the trading platforms. The network nodes related to the platforms identified as outliers were generally directly connected with measure of distance close to 1. Outliers were found on the periphery with weaker links in all directions. In general the impact of the outliers on the overall network is smaller while they tend to interact somewhat more with each other rather than with the inliers. The future work will gravitate towards exploring time dimension for the predictions, multi-target relations and the automation of the graph analysis for the anomalies detection and filtering out.

11. References

Arribas-Gil, A and J Romo (2014): "Shape Outlier Detection and Visualization for Functional Data: The Outliergram", *Biostatistics*, 15(4), pp 603-19.

Benatti, N (2019): "A machine learning approach to outlier detection and imputation of missing data", in IFC, "Are post-crisis statistical initiatives completed?", *IFC Bulletin*, no 49.

Blockchain Transparency Institute (2019): Market Surveillance Report, April.

Boumghar R, A Donati, R Madeira and I Angelis (2019): "Enhanced awareness in space operations using web-based interactive multipurpose dynamic network analysis", in H Pasquier et al (eds.), *Space Operations: Inspiring Humankind's Future*, Springer, pp 795-810.

Chen, T and C Guestrin (2016): "XGBoost: A scalable tree boosting system", in Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge, Discovery and Data Mining – KDD'16, *ACM Press*, pp 785-94.

Crypto Exchange Ranks (CER) (2019): "Trading inside the spread" and "Volume manipulation by immediately filled orders".

ECB Crypto-Assets Task Force (2019): "Crypto-assets: Implications for financial stability, monetary policy, and payments and market infrastructures", *Occasional Paper Series*, no 223, ECB, Frankfurt am Main, May.

European Central Bank (2019: "Understanding the crypto-asset phenomenon, its risks and measurement issues", *Economic Bulletin*, issue 5.

Hougan, M, H Kim and M Lerner (2019): "Economic and non-economic trading in bitcoin: exploring the real spot market for the world's first digital commodity", Bitwise Asset Management, May.

Kaufmann, D, A Kraay and M Mastruzzi (2011): "The Worldwide Governance Indicators: Methodology and Analytical Issues", *Hague Journal on the Rule of Law*, vol 3, no 2, pp 220-46.

Liu, F T, M Ting, K and Z-H Zhou (2008): "Isolation forest", in F Giannotti et al, 2008 Eighth IEEE International Conference on Data Mining, IEEE, pp 403-12.

Makarov, I and A Schoar (2019): "Trading and arbitrage in cryptocurrency markets", *Journal of Financial Economics*, July.

Pedregosa, F et al (2011): "Scikit-learn: Machine Learning in Python", *Journal of Machine Learning Research*, vol 12, pp 2825-30.

Ramsay, J O (2004): "Functional data analysis", in S Kotz et al, *Encyclopedia of Statistical Sciences*.

Sun, Y and M G Genton (2011): "Functional Boxplots", *Journal of Computational and Graphical Statistics*, 20(2), pp 316-34.

Sun, Y, M G Genton and D W Nychka (2012): "Exact fast computation of band depth for large functional datasets: How quickly can one million curves be ranked?", *Stat*, vol 1, no 1, pp 68-74.

Tarabelloni, N et al (2017): "Roahd: robust analysis of high dimensional data", *R package version*, vol 1.

Zhen L, X Liu, J Ma and H Gao (2018): "An Optimized Computational Framework for Isolation Forest", *Mathematical Problems in Engineering*, vol 2018, article ID 2318763.

Annex

Algo	rithm 1 FDA iterations
1: pi	rocedure FDAITERATIONS $(data, \theta, fb_0, fo_0, s_b, s_o)$
2:	$range \leftarrow compute_range(data)$
3:	while $range \ge \theta$ do
4:	$outliers \leftarrow functionalboxplot(fb_0)$
5:	if no outliers then reduce fb_0 by s_b
6:	else remove outliers
7:	range $\leftarrow compute_range(data)$
8:	if range $< \theta$ then return data
9:	outliers $\leftarrow outliergram(fo_0)$
10:	if no outliers then reduce fo_0 by s_o
11:	else remove outliers
12:	range $\leftarrow compute_range(data)$
13:	return data