4 How can Blockchain ecosystems serve SMEs?

Blockchain applications for industrial use present distinct opportunities to SMEs. The chapter aims to identify potential benefits blockchain uptake could bring to SMEs as well as foreseeable challenges that could hinder small businesses from reaping the benefits of blockchain adoption. Findings from the OECD country cases studies on "Blockchain for SMEs and Entrepreneurs" in Israel and Italy provide an in-depth analysis of the characteristics and trends of country-specific blockchain ecosystems and industrial use cases. The chapter also provides an overview of blockchain-related policy and regulation trends as well as policy examples aimed at increasing awareness and supporting blockchain innovation activities beyond financial services.

In Brief

Highlights

- **Blockchain is at its core a secure decentralised database technology**. As such, blockchain-based products have the potential to become a widespread used tool to ensure protection of sensitive data, as well as to enhance accountability and trust among parties.
- **Blockchain-based applications are being developed in many sectors beyond financial services.** Multiple distributed ledger technology (DLT) applications are being developed in diverse sectors such as healthcare, business services, logistics and retail.
- **The majority of blockchain-related projects are still at an early or pre-commercialisation phase of development**. While the potential is high, no DLT-based application has had yet a widespread diffusion among businesses, including SMEs.
- **Blockchain technologies present distinct opportunities for SMEs and start-ups**. In particular, by reducing information asymmetries and transaction costs, they can help new and small businesses overcome long-standing challenges related to scale, opacity and lack of business history, facilitating trade and access to finance. SMEs and new firms can also benefit from greater efficiency and quality of products and services, enhanced supply chain management and blockchain-driven innovation in business models.
- **Complementary digital infrastructure and capabilities are required for blockchain adoption**. Access to broadband connection (fixed or mobile) is a pre-requisite to use DLT-based solutions. Uptake of complementary technologies might also be necessary, as for example supply chain management software and/or Internet of Things (IoT) systems for tracking and delivering.
- **There are significant challenges to the diffusion of technology among SMEs**. These include low awareness of salient features of blockchain, lack of interoperability across different systems, limited access to digital infrastructure (mobile and fixed high-speed broadband connection) and uncertainty over legal responsibilities.
- **Two country case studies, on Israel and Italy, were conducted with the aim to analyse the characteristics and trends of country-specific blockchain environments**. The studies leveraged original survey-data to analyse and compare the characteristics of national blockchain ecosystems. They show that, in both countries, SMEs and entrepreneurs are primary target clients for new blockchain-based products, with solutions reflecting the underlying economic structure and specialisation of the SME population.
- **While policy and regulatory attention first focused on digital assets, governments are increasingly looking at how to promote industrial applications of DLTs**. Policy measures aim to address regulatory uncertainties, develop the technical infrastructure, increase awareness among businesses and within government, adopt the technology to deliver public services, and support private sector innovation. Whole-of-government approaches are also emerging, through the design of national blockchain strategies.

Introduction

Distributed Ledger Technologies (DLTs[1]) and their financial applications have been at the centre of international attention in recent years. The analysis and debate have focused mostly on renowned crypto-currencies (e.g. Bitcoin, Ethereum) and on the role of inherently decentralised digital "currencies" in global financial markets. Other financial applications are being discussed, especially in relation to the possibility to "tokenise" financial (e.g. securities, commodities) and non-financial (e.g. real estate) assets. This might positively impact access to finance for SMEs by enhancing inclusiveness in markets that were previously restricted to larger or institutional investors (e.g. tokenisation of SMEs' equity or debt (OECD, 2020[1])).

However, the development of DLTs applications in areas outside financial markets is growing rapidly. Start-ups and innovative Small and Medium-sized Enterprises (SMEs) across the world are working on DLT-based applications to support businesses, individuals and governments in areas spanning from self-sovereign identity (SSI) to supply chain management and product tracing, from intellectual property (IP) and copyright protection to procurement, and many more.

The present chapter focuses on the features and challenges of non-financial applications of DLTs that are targeted to SMEs. The technology, which builds on decades of evolution of cryptographic research, creates decentralised, distributed systems where stored information are immutable, secure and transparent. This allows for disintermediation, enhancing trust between parties and unlocking efficiencies and cost reductions. While there are multiple applications of the technology that are being tested and commercialised, the market is still at the early stage of development, and relevant challenges exist that might hinder further expansion. Some of the obstacles are technological, such as, for example, the lack of interoperability between different blockchain infrastructures, which could lead to a fragmented ecosystem with limited economies of scale for applications. Other challenges are more structural to the business population, such as the lack of awareness and digital skills in SMEs, which may limit uptake of DLT-based solutions, even when these reach a mature stage.

The chapter discusses the emergence of national blockchain ecosystems, their relevance for SMEs, and policy approaches to ensure shared benefits, based on two case studies conducted in Israel and Italy in 2019 and 2020 respectively. These studies reveal that the type of DLT-based services being developed are largely tailored to the features of the countries' industrial structures (e.g. IT infrastructure and cybersecurity in Israel, supply chain and copyright protection in Italy). Original evidence from online surveys of entrepreneurs, as well as in-person and phone interviews with the main stakeholders in the countries, inform the analysis presented in this chapter.

The chapter illustrates policy experiences for the development of blockchain ecosystems and for fostering SME uptake of DLT-based applications across OECD and non-OECD countries. Approaches vary from structured national strategies to targeted programmes to enhance skills development or to develop specific areas of applications (e.g. trade, IP protection). Some governments are also looking at how DLTs can be leveraged to deliver public services and interact with SMEs more effectively.

Blockchain use by SMEs: Features and challenges

Blockchain is a secure decentralised database technology. As such, blockchain-based products can become a major tool to ensure protection of sensitive data, as well as enhance accountability and trust among parties. To put it in simple terms, distributed ledger technologies offer a set of unique features that are not available in any other type of existing computer networks. The most important example is the World Wide Web, which is based on a network of servers managed by mostly private internet operators storing data that can be copied and reproduced at will. Instead, data stored on the blockchain are not controlled

or managed by any single entity but are stored simultaneously in all nodes of the network (i.e. decentralisation), are time-stamped, cannot be modified and can be transparently checked by any given party (with some differences in permissioned and permissionless networks). This allows any data entry on the blockchain to become truly unique and not duplicable, which makes it possible for the first time in history to introduce the concept of "digital assets". A more technical description is offered in Box 4.1.

Box 4.1. Blockchain and Distributed Ledger Technologies

In its simplest definition, blockchain is a database that is replicated over a peer-to-peer (P2P) network. The technical structure of blockchain allows multiple parties (the "nodes" of the network) to continuously achieve consensus over creating new "blocks" of information that are then added to the "chain" of data. For the integrity of the "chain", data is immutable, meaning that it cannot be altered but only appended. The newly updated "chain" (i.e. database) is simultaneously stored in the nodes on the network, and the process of finding consensus can start on the next "block" of information. In this sense, it is often referred to as a distributed digital ledger, as it can be used to store any type of information (and so of transactions and value) in an unalterable public record that is distributed among all the nodes. Key technical components of the DLT have been developed in the areas of cryptographic research over the past decades, (e.g. merkel trees, hash functions, public-key cryptography and digital signatures).

While traditional databases are managed and maintained by a central operator with the data stored in its servers and data centres, blockchain-based databases distribute data among the nodes of a network.

This implies that the database is secure without requiring that no participant in the network trust another, as each of them stores the complete history of transactions.

This implies that the database is secure without requiring any participant in the network to trust any other, as each of them stores the whole history of transactions. Distributed storage thus ensures disintermediation (as no third party external to the network is needed) and increased security. Furthermore, the distributed nature of blockchain significantly reduces the problem of single point of failure, as multiple nodes retain the identical data. Transactions recorded on blockchain can range from simple (i.e. the transfer of the rights connected to digital assets from A to B) to more complex, as in the case of smart contracts, in which terms of agreement between parties are inscribed in the unmodifiable distributed ledger and are self-enforcing (i.e. with the automatic transfer of digital assets at the satisfaction of agreed-upon conditions).

Some experts refer to blockchain as a nascent "internet of value" and of the "token economy", as public permissionless ledgers allow for Byzantine-Fault Tolerance and prevent the double-spending problem. Different from traditional computer networks (including the global internet infrastructure), the cryptographic systems underpinning public permissionless ledger are able to ensure the uniqueness of digital items registered on the ledger, making double-spending impossible (i.e. transferring the same asset A to two or more different accounts on the ledger). In addition, such networks are able to solve the Byzantine General problem (known in cryptographic literature for decades (Lamport, Shostak and Pease, 1982[2])). The so-called "consensus protocol" ensures the integrity of the information written to the ledger at all times, regardless of the possibly malevolent motives of some of the actors in the network. This means that they allow all nodes to read or write on the ledger, but the so-called "consensus protocol" ensures the integrity of the information registered at all times, regardless of the possibly malevolent motives of some of the actors in the network. This means that it is nearly impossible[2] to tamper with information registered on the public ledger. This has led many entrepreneurs to look at how the creation of digital tokens representing any kind of asset might unlock a score of new economic and financial opportunities (OECD, 2020[1]).

Blockchain was developed to underpin an innovation in finance and the first initiatives at the global level were from this sector. The first and most renowned application of the technology was in the Bitcoin, a peer-to-peer electronic cash system, which aspired (and aspires) to create a new global payment system that would settle transactions while completely bypassing financial intermediaries (Nakamoto, 2008[3]). A large number of alternative cryptocurrencies have been launched since.[3] At a global scale, the subsequent emergence of various form of "virtual assets", whose property rights are cryptographically secured into the chains and can be accessed, shared and leveraged by corporations and citizens across jurisdictions, is opening the way for important innovations but also relevant risks. Regulators at the international level are working on limiting such risks, in particular regarding Anti-Money Laundering (AML) and Combating the Financing of Terrorism (CFT) practices (FATF, 2019[4]).

New trends in blockchain applications and uptake

The blockchain industry is developing rapidly in many sectors beyond financial services and blockchain applications have the potential to spread across the economy. Start-ups are developing Proof of Concepts (PoCs), Alpha and Beta version of blockchain solutions in multiple sectors, such as healthcare, environment, cybersecurity, supply chain management, international trade, digital identity, creative industry, voting and many more. These projects are B2C (Business to Consumer), B2B (Business to Business) as well as B2G (Business to Government).

Multiple DLT applications are being developed, with many projects still in an experimental phase. At the international level, there are projects to develop solutions in a multitude of functional areas from supply chain management to privacy and security, from certification to identity management, from intellectual property to human resources management. In turn, these applications target clients in sectors spanning from healthcare to finance, from energy to education, from high-end manufacturing to public administrations (Casino, Dasaklis and Patsakis, 2019[5]).

Start-ups are often key in the development of new solutions, both individually and in co-operation with SMEs, large operators and public administrations. The new entrepreneurial scene opened up by this technology brings together innovative entrepreneurs and experts from established companies and institutions. The flexibility of start-ups allows them to explore a wide range of applications, and often to provide innovative solutions to public administrations and large organisations lacking the skills internally. The emergence of "Blockchain-as-a-Service" providers (BaaS), which offer third-party cloud-based infrastructure and management for firms developing DLT applications, is enabling the development of new technology-driven ecosystems. BaaS providers run the back-end operations of blockchain systems, allowing entrepreneurs and start-ups to focus on the design and relevance of their applications. They also enable SMEs to benefit from the unique features of the technology, without need for large own investments in technology development, although awareness and understanding are pre-requisite for gaining trust and adopting. Box 4.2 illustrates an example of an SME providing BaaS infrastructure. Start-ups offering blockchain-based services are spurring across many diverse sectors. The cases of Israel and Italy, presented in this report, are illustrative of the vital start-up ecosystems that are emerging around the technology and its many possible market applications.

Box 4.2. Blocko, a case of blockchain-as-a-service (BaaS) for enterprise

Established in 2014, Blocko is a Korean blockchain enterprise servicing blockchain infrastructure. The company provides a blockchain-as-a-service, which is a cloud-based blockchain development platform that businesses can use to develop their own blockchain solutions. The platform was the first blockchain solution to receive the Good Software (GS) certification, which is a series of quality tests based on standards developed by the International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC). GS is a nationally recognised certification often used in procurement processes, including government purchases.

Blocko has worked with both the public and private sectors in developing blockchain-based services, with more than 2.5 million users accessing their infrastructure. Use cases include detection of website forgery, electronic document certification system and invoice issuing and tracking system. The company also provides development tools, such as application programming interface (API) and software development kit (SDK) for businesses that seek to build enterprise solutions on their open-sourced blockchain infrastructure.

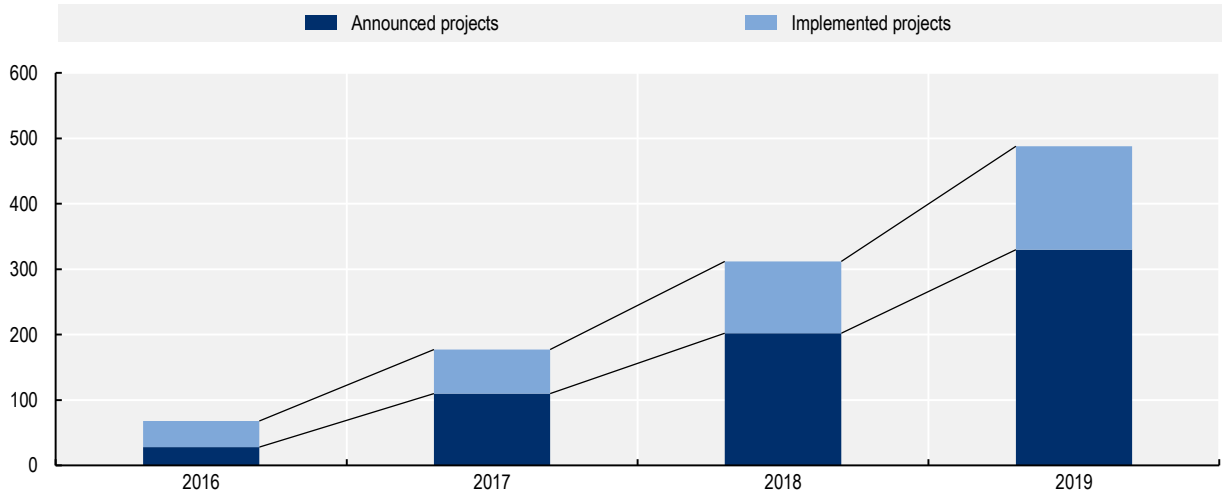
Source: Blocko website, https://www.blocko.io/ (accessed on 9 October 2020).

However, it would be difficult to point at a single DLT-based application that has already had a widespread impact on business practices. This follows the early stage of development of the technology, but also the fundamental architectural shift it implies in the storing, access and management of core data for an organisation. This reflects a cautious approach by stakeholders in the private and public sector before such solutions are adopted at scale. According to a 2019 survey of large firm executives around the world, "Implementation (replacing or adapting existing legacy system)" (30%), "Regulatory issues" (30%), and "Potential Security Threats" (29%) are the main barriers to adoption of blockchain solutions. Interestingly, these percentages are lower than they were in 2018 (respectively 36%, 39% and 35%), pointing at an increased trust in the new technology (Delotte, 2019[6]).

Many companies around the world are now looking at concrete application of the technology to their businesses. According to a recent global survey of 1 386 senior executives located in Brazil, Canada, China (People's Republic of), Germany, Hong Kong (China), Israel, Luxembourg, Singapore, Switzerland, United Arab Emirates, United Kingdom and United States, more than half (53%) consider the technology among the top-five strategic priorities for their firms, up from 43% in 2018. Importantly for SMEs, most executives in large organisation (85%) also acknowledge the fact that their suppliers, customers and/or competitors are working on blockchain solutions to challenges in the value chains that now serve their organisation. As also illustrated in the studies conducted in Italy and Israel, presented in the following section, a large number of projects are still at an early stage of development (alpha or beta versions). However, a strong acceleration of blockchain projects brought into production by companies has taken place in recent years, a jump from 23% in 2019 to 39% in 2020 (Deloitte, 2020[7]). Similarly, a research by the Polytechnic University of Milan (2020[8]) shows steady increase of blockchain projects at the global level since 2016: when considering both announced and implemented blockchain projects, the number increased six folds between 2016 and 2019 (Figure 4.1).

Figure 4.1. Blockchain projects at the international level

Number of blockchain and DLT projects, 2016-19



Source: Polytechnic University of Milan (2020[8]), Blockchain & Distributed Ledger: Unlocking the potential of the Internet of Value, www.osservatori.net/it/eventi/on-demand/convegni/convegno-risultati-ricerca-osservatorio-blockchain-distributed-ledger-2020 (accessed on 26 November 2020).

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Opportunities and challenges for SMEs' usage

Blockchain technologies present distinct opportunities for SMEs. In particular, blockchain applications can help SMEs overcome long-standing scale-related challenges and market failures that affect them disproportionately, such as those stemming from information asymmetry. Access to finance represents a case in point in this regard. Other examples are the protection of intellectual property rights and cybersecurity.

The adoption of blockchain applications, as with other digital technologies, is a matter of enabling conditions, capabilities and incentives, and can result in improved firms' productivity. Evidence suggests that the uptake of digital technologies (e.g. cloud computing, front and back-office applications) in an industry is associated with productivity gains at the firm level. However, technology adoption by firms crucially depends on access to enabling physical infrastructures (e.g. high-speed broadband internet) as well as on well-functioning product, labour and financial market settings. In addition, managerial quality, organisational capital and worker skills are important drivers of technology diffusion (Brynjolfsson and McAfee, 2014[9]; Draca, Sadun and Van Reenen, 2009[10]; Sorbe et al., 2019[11]; Andrews, Nicoletti and Timiliotis, 2018[12]). In this context, most of the new BaaS present features that make them particularly viable for applications by SMEs, as they manage all the back-end management and offer "ready-to-go" platforms without the need for complementary investments.

Reduction of transaction costs

One of the main features of blockchain technology is that it allows to reduce some types of costs for firms. Transaction costs and agency costs are the costs incurred in every economic exchange with partners (Sun et al., 2020[13]). While the former is due to market imperfections, the latter is caused by conflict of interest and information asymmetry. For many observers, reduction of costs is the main short-term gain from the uptake of blockchain-based systems for businesses, which drives operational efficiencies. Such a cost reduction is achieved by removing intermediaries and reducing the administrative

efforts for record keeping and transaction reconciliation (Carson et al., 2018[14]). Researchers have also identified other cost advantages from the technology: the reduced costs of verification (ability to verify the state of a transaction/data/digital asset) and the lower cost of networking (ability to bootstrap and operate a marketplace without assigning control to a centralised intermediary). These cost reductions allow for more efficient practices, for example, in data ownership, privacy, licensing and monetisation of digital content. In particular, the reduction in the cost of verification can have an immediate impact on SMEs' business processes (Catalini and Gans, 2019[15]).

Improved security of data allowing for synergies with Internet of Things and machine learning

Security of sensitive business information is becoming increasingly important for SMEs, even more so as the COVID-19 pandemic accelerates the digital transition for many firms. As discussed in Chapter 2, this has created an opportunity for malicious actors to intensify cyber-attacks, an increasing concern for entrepreneurs and policy makers alike. Blockchain applications provide for new methods to secure data storage and transfer, as the decentralised, trustless, peer-to-peer structure makes them inherently resilient to malevolent digital attacks. Blockchain technology also allows for the storage of time-stamped data/transactions in chronological order in distributed networks that are tamperproof and not-modifiable, as the information is stored/published separately in each single node of the network (Taylor et al., 2020[16]).

This feature makes blockchain particularly interesting for the wide range of Internet of Things (IoT) applications. In this regard**,** blockchain applications can become an important component in larger systems leveraging also other technologies (Minoli and Occhiogrosso, 2018[17]). For instance, applications to infrastructures (e.g. smart grid, intelligent transportation systems, and video-surveillance) or applications to business processes (e.g. logistics, contract law and insurance). And this is also true for the use of blockchain-secured data for analytical applications leveraging machine learning.

The secure and distributed storage of data is an attractive feature of blockchain that also has implications for machine learning applications. Machine learning is a methodology used to train Artificial Intelligence algorithm (for detailed information, see Chapter 5 on AI). The capability of the blockchain can offer an interesting setting for the controlled access to data and the applications of advanced AI for data analysis (Mamoshina et al., 2018[18]). Various attempts have been made at global level to leverage the security, transparency and immutability of data stored on the blockchain to perform advanced analysis through machine learning algorithms. For example, blockchain can be used to create a mutual trust data sharing framework, breaking data barriers between diverse actors (Zhang et al., 2018[19]). This structure has also been found to be effective also in dealing with privacy issues (Chen et al., 2019[20]; Dillenberger et al., 2019[21]). Privacy is an important aspect for example in biomedical research, where patients want to maintain a level of control on how their data are used in order to reap the benefits of health monitoring without incurring the risk of misuse of such personal information.

Enhanced supply chain management

Application of blockchain solutions in connection with IoT opens up opportunities especially in supply chain management. Documents and data stored in a blockchain are exchanged and tracked without the need to make electronic duplicates between the sender and the receiver, while ensuring immutability and transparency, hence trust. This makes the use of this technology in the supply chain particularly appealing. Some of the enabling elements of the use of IoT in supply chain management are RFID tags, Wireless Sensor Networks and data analysis platforms (Gubbi et al., 2013[22]). The high cost and the need for robust security standards for such IoT networks imply this is a very promising case for the application of decentralised peer-to-peer blockchain networks. Storing IoT devices' configurations through cryptographic hashes, avoiding the reliance and risk of bottleneck-effects on single servers and the possibility to design Machine-to-Machine (M2M) communication messaging channels through

automatic smart contracts all constitute interesting rationale for blockchain-based applications in supply chain management, which would also lower counterfeiting (Pournader et al., 2019[23]; Bahga and Madisetti, 2016[24]). One example is in the health sector, where the elimination of counterfeit medicine is a particularly important issue (Mackey and Nayyar, 2017[25]). In the United States, an open and decentralised blockchain network for the pharmaceutical supply chain is proposed by the MediLedger project, which was also accepted as a pilot study for the Food and Drugs Administration (FDA) to meet the 2023 requirements of the Drug Supply Chain Security Act (DSCSA) (Mediledger, 2020[26]).

The high-level of transparency of blockchain system can help meet stakeholders' needs along the supply chain. The use of systems based on this technology can include all stakeholders: suppliers and other upstream partners; customers; governments, regulators and public agencies; non-governmental organisations (NGOs); and trade associations. All participants have a clear and immediate understanding of the state and "history" of products and components throughout the process. This helps firms also to respond more effectively to public and political pressure and comply with regulations on environmental and social impact of their operations, demonstrating integrity and improving customer confidence. Applications have been tested in many industries with encouraging results (e.g. from mining to healthcare, from textile to food and beverage).

The technology can also increment operational efficiencies for SMEs' supply chains. The technology can help error elimination and streamline processes by making them more transparent, reducing physical documents and increasing consistency across information sources. Moreover, transparent access to real-time tracking allows for a more effective monitoring of the lifetime of products (Hastig and Sodhi, 2020[27]). The use of smart contracts to optimise order management, shipping and delivery times, administrative procedures, as well as to limit delays in collection of account receivables opens additional possibilities. Box 4.3 illustrates the case of an SME providing blockchain solution to facilitate supply chain logistics. However, to fully benefit from the use of blockchain in managing IoT devices, current limitations to blockchain, such as storage capacity and scalability need to be addressed (Reyna et al., 2018[28]).

Box 4.3. Wave, a case of logistic management through blockchain

Wave is an Israeli enterprise providing blockchain-based digital document exchange platform. Founded in 2015, the company operates a blockchain-based peer-to-peer network that connects various actors along the logistics chain, including banks, carriers, traders and other trade-related parties, and is one of the first companies to operationalise blockchain-based trade document exchange.

The company helps businesses digitalise their documents such as bills of lading, letters of guarantee and commercial invoices. Documents stored on blockchain are exchanged and tracked digitally, which increases process efficiency by reducing expenditures and workload related to handling paper documents. In addition, disputes from inaccurate data and risk of fraud are significantly lowered when compared with paper-based trade, as there is no redundancy, the need for manual data input in different systems.

Source: OECD Phone interview, Wave website, https://wavebl.com/ (accessed 12 October 2020).

Automatic enforcement of contract obligations

The use of smart contracts can enable SMEs to ease the enforcement of contracts with third parties. Smart contracts are software registered on the public blockchain ledgers (e.g. Ethereum) between two or more parties, stating reciprocal obligations. As a computational system, the use of cryptographic rules, mathematics and game-theoretical incentives of blockchain technology increase confidence in the

system operation (De Filippi, Mannan and Reijers, 2020[29]). An interesting feature of this application is that parties can agree that at the satisfaction of a certain requirement, the transfer of digital funds will be immediate. This "algorithmic enforcement" of contracts might represent a very interesting feature for SMEs, for example, for the management of their account receivables. Such contracts can be applied in many different areas, as to safeguard intellectual property rights or to issue digital certificate of authenticity.

Challenges to SME adoption of blockchain

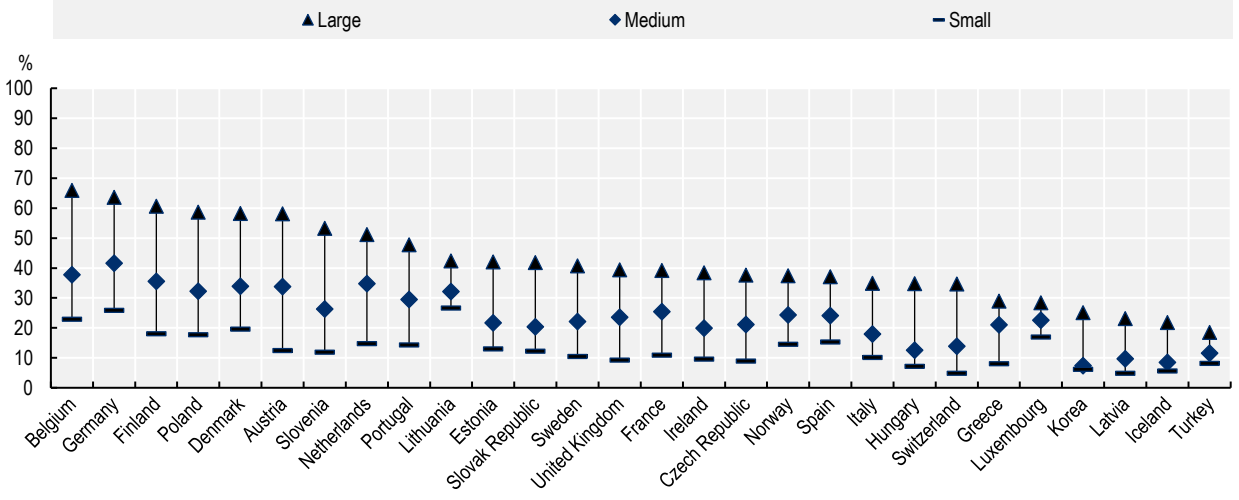
As blockchain is a technology that relies on a network, its potential benefits, such as reduction in cost of verification, can materialise when large scale adoption is attained (Morkunas, Paschen and Boon, 2019[30]). The broad adoption by small businesses is currently limited by a number of challenges (e.g. regulatory compliance, technical scalability, mistrust among consumers, and acceptance in well-established business practices) which are discussed below in more detail.

Access to digital infrastructures and digital business practices as a prerequisite for adoption

Integrity of DLTs depends on the connection of distributed ledgers, which is based on the internet. Broadband connection is a pre-requisite for businesses to be part of blockchain networks. Although more than 90% of SMEs in the OECD economies have access to the internet, accounting for both fixed and mobile connection, there remain businesses that are less connected or that lack adequate speed of connection for effective blockchain adoption. For instance, data show that access to high-speed connection (at least 100 Mbit/s) for European firms with more than 10 employees has risen from 7% in 2011 to 23% in 2018. However, the digital divide among small and large firms is widening. The largest gaps were recorded in Finland, Denmark and Slovenia, where 82%, 86% and 59% of large firms had access to high-speed connection in 2018, as compared to 26%, 40% and 15% of small firms respectively (OECD, 2019[31]). Complementary digital infrastructure is also required for adoption of blockchain in business processes, and SMEs do not always have easy access to them. For instance, Figure 4.2 portrays a noticeable gap between large and small businesses in the adoption of systems that enable sharing of supply chain management (SCM) data digitally. The gap amounts to 29% on average across the OECD area, and up to 40% in some countries.

Figure 4.2. Businesses sharing electronically SCM information with suppliers and customers

As a percentage of enterprises with ten or more persons employed, 2018 or latest year available



Source: OECD (2020[32]), OECD ICT Access and Usage by Businesses Database, http://stats.oecd.org/Index.aspx?DataSetCode=ICT_BUS (accessed 23 November 2020).

StatLink https://doi.org/10.1787/888934227640

In addition, the application of blockchain in supply chains demands the investment in Industrial Internet of Things (IIoT) and other digital technologies, to ensure the quality of data. Due to the immutable nature of blockchain, robustness of blockchain network depends on the quality of the data inputted on the ledger and thus on the generation of accurate data from the source. To reduce human errors and increase precision of data, such as temperature, time and location, the data need to be generated and inputted digitally, with the use of tamper-proof IIoT sensors. As blockchain-based supply chain tracing becomes widespread, lack of readiness for IoT adoption could add to the difficulties of SMEs in entering supply chains.

Lack of interoperability between systems might hinder scalability

As there is yet to be an industrial blockchain network that is adopted at a mass scale, the ecosystem remains fragmented. Current blockchain projects tend to be limited in scale, involving a small group of businesses and individuals. For example, supply chain tracking applications are often tailored for a client business that produces finished products, such as packaged food and fashion items. The applications track the supply chain of a product or products, while only covering actors that interact both directly and indirectly with the client. The vertical focus of such projects indicate exclusive nature of the applications, which can also be observed, for example, in projects in the agri-food sector. To illustrate, a number of companies focusing on the tracing of wine products through the use of blockchain work separately with a partnered wine brand, some with their own proprietary protocols.

Lack of interoperability between blockchain ecosystems can represent a heightened challenge for SMEs. Each blockchain has its own distinctive characteristics, such as consensus mechanism and governance mechanism, which restricts blockchain networks from “talking to each other” (Frezal and Garsous, 2020[33]; Morkunas, Paschen and Boon, 2019[30]). Although interoperability could be attained by utilising applications that make data readable in other networks, such as by using Application Programme Interfaces (APIs), businesses would still need to rely on intermediary entities to obtain and exchange data between networks. This is an important aspect influencing the creation of a true “internet of value”, and research institutions are working with the industry to examine the impact of enhanced interoperability across DLT applications and infrastructures (Polytechnic of Milan, 2020[34]). However, efforts are being made to enhance interoperability between v arying blockchain networks (Box 4.4). With blockchain projects conducted in siloes, it is possible that firms involved in different ecosystems would need to manage several applications, increasing workload for the small businesses. In addition, low substitutability between blockchain platforms could hinder businesses from switching to more attractive blockchain networks or other alternative technologies (Pike and Capobianco, 2020[35]).

Box 4.4. Efforts for interoperable blockchain networks

Blockchain projects have been developed by various entities around the world during the last decade. The lack of common standards has allowed innovation to spur in all directions, but has inevitably brought the problem of interoperability among systems relying on different and often incompatible blockchain platforms. This creates a challenge for SMEs and companies that might be interested in using different DLT-based products as they would usually not be able to make them "communicate" with each other, or with partners within or outside their supply chain using other DLT-products.

Non-governmental organisations (NGOs) and industry actors have been working to facilitate exchanges across blockchain networks. Standard setting is one way to achieve compatibility among various networks. At technical level, for instance, the International Standard Organisation (ISO), an international NGO, established a Technical Committee on "Blockchain and distributed ledger technologies" to provide technical standards of the technology, including security, smart contracts and identity. The Committee operates a working group dedicated to Interoperability, while leveraging its previous work on cloud interoperability standard. Similarly, GS1, an organisation that develops standards for business communication including bar codes, seeks to enhance communication between blockchain networks with the use of standardised identification data and data exchange protocols (e.g. Electronic Product Code Information Services).

Devising a framework supportive of interoperability could also enable different ecosystems to exchange data more easily. For example, the Responsible Minerals Initiative, an initiative focused on promoting responsible mining and due diligence in the mining sector, published the "Responsible Minerals Initiative Blockchain Guidelines", industry-wide guidelines that layout detailed information related to treatment of data to ensure integrity of mineral supply chain data between different blockchain platforms. The Guidelines also require technology providers to develop interoperable blockchain-based solutions.

Source: ISO (2020[36]), ISO/TC 307 Blockchain and distributed ledger technologies, www.iso.org/committee/6266604.html ; GS1 (2019[37]), *Traceability and Blockchain*, www.gs1.org/sites/default/files/gs1_traceability_and_blockchain_wp.pdf and Responsible Minerals Initiative (2020[38]), *Responsible Minerals Initiative Blockchain Guidelines: Second Edition*, http://www.responsiblemineralsinitiative.org/media/docs/RMI%20Blockchain%20Guidelines%20-%20Second%20Edition%20-%20March%202020%20FINAL.pdf.

Lack of awareness and skills

The lack of awareness about the possibilities offered by the technology might hinder its diffusion. While the benefits of some blockchain applications to reduce transaction costs and increase accountability can be relatively evident, it might be difficult to build trust among possible users. For example, for a blockchain system to become the standard in a supply chain, it must be ingrained into business processes by all stakeholders. In complex global value chains, this might mean dozens and dozens of entities, including small companies that often do not have the resources and capabilities to fully understand the system. This creates a strong barrier to unilateral adoption, and sometimes only the larger stakeholders might decide for a shift towards this kind of system and then introduce it for all other participants in the supply chain.

Uncertainty over legal responsibilities

DLTs make their security and transparency a clear strength, however, it is still possible that complications and fraudulent behaviour might arise. The protection of intellectual property and of sensitive data might become particularly challenging. The fact that blockchain relies on decentralised ownership creates also an important complication in case of a dispute, as it is challenging to identify the

responsible jurisdiction for something that has happened on a network distributed all around the world. The identification of legal responsibilities is made difficult also by encryption and possible user anonymity, two core features of the technology. For businesses, this implies that blockchain transactions of non-digitised assets require legal consideration of off-chain settlements, which can be especially burdensome for SMEs. In the case of smart contracts, algorithmic accountability and reliability of automated systems present additional challenges. While transparency is embedded in the system, it is still possible that disputes might arise and while blockchain technology increases security at the infrastructural level, the lack of proper technical knowledge on how to manage the system (e.g. bad key management) might lead to irreversible problems if something goes wrong, due to the tamper-resistance features of a blockchain.

Blockchain for SMEs and entrepreneurs: The cases of Israel and Italy

The present section provides insights from two country case studies, on Israel and Italy, conducted in 2019-20 with the aim to analyse the characteristics and trends of country-specific blockchain environments and the emerging opportunities for innovative start-ups and for SMEs.[4] The studies investigated the features and trends of start-ups developing blockchain-based services, opportunities and challenges to their business development, sectors and firms being targeted, the relevance to SME productivity and competitiveness, and the regulatory approaches and policies aimed at supporting the development and uptake of the technology (Bianchini and Kwon, 2020[39]; Bianchini and Kwon, 2020[40]).

The research methodology included an original survey and in-person and phone interviews of key actors in the blockchain ecosystems (e.g. entrepreneurs, experts, associations, regulators, policy makers), to enable an in-depth understanding of the role that blockchain technology might play in driving SMEs' digitalisation and competitiveness. The research focused on start-ups that are developing blockchain-based solutions, with a focus on industrial applications relevant for SMEs. Given limitations of standard sector nomenclatures to identify these businesses, the research leveraged information by local institutions, private sources, including LinkedIn and Crunchbase, as well as interviews.[5] Entrepreneurs focusing on blockchain were also given an opportunity to self-report their activities via an online survey.

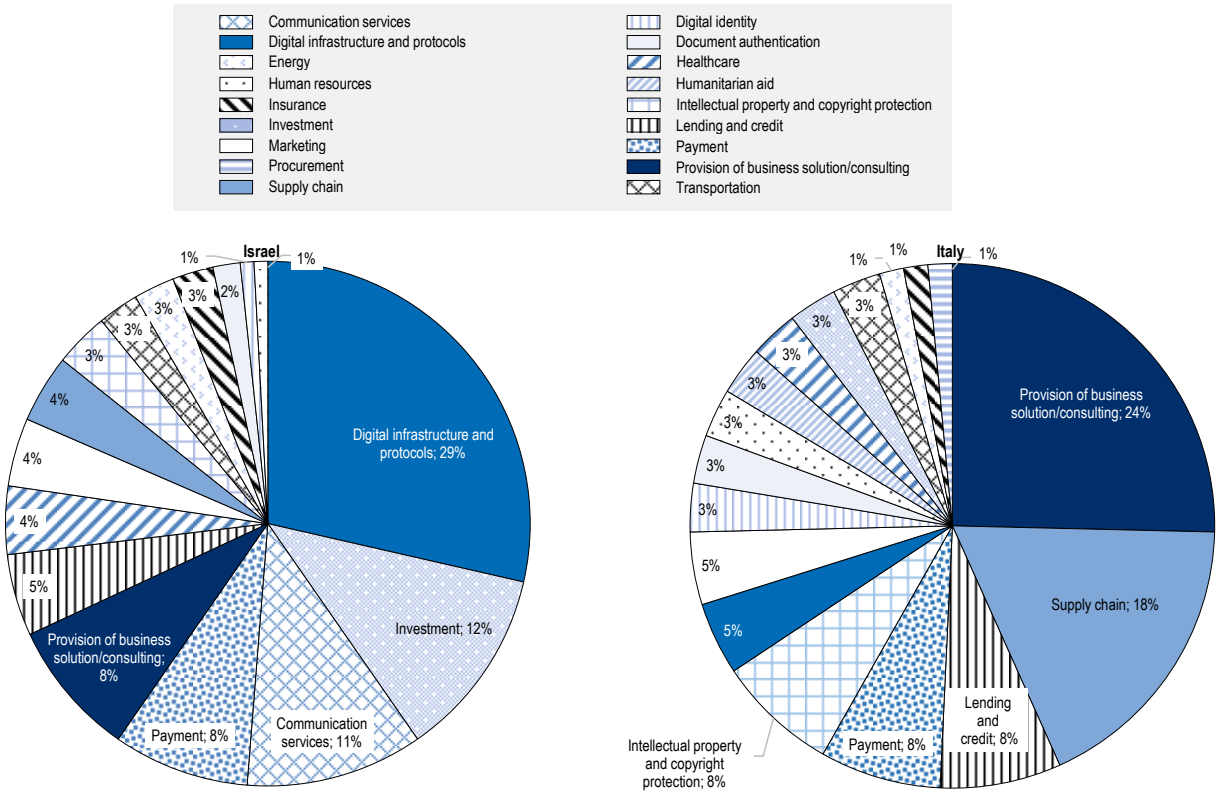
Landscape of businesses offering blockchain-based applications

The research identified 119 Israeli and 67 Italian SMEs and start-ups as blockchain businesses during the first half of 2019 and the second half of 2019 respectively. These numbers exclude cryptocurrency exchanges, where blockchain technology-based virtual currencies such as Bitcoin and Ethereum are traded, as the study intended to focus on the use cases of the technology. However, other financial applications of the technology, for instance, payment system for retail businesses, are included in the study, as they leverage the technology to provide specific services to SMEs. Since the majority of blockchain companies identified are early stage start-ups, and given the novelty of the technology, business demography is rather volatile. Nevertheless, the identified populations provide an interesting snapshot of the trend concerning blockchain applications and insights about current and future relevance to SMEs.

Blockchain enterprises are categorised based on the main activity for which blockchain technology is used. As most of the blockchain businesses are start-ups, their product portfolio generally consists of single product or multiple products sharing similar characteristics, making the classification of the type of services offered relatively straightforward. As Figure 4.3 illustrates, the main types of blockchain-based solutions offered by start-ups are rather diversified, ranging from supply chain and communication services to health care and marketing.

Figure 4.3. Blockchain companies by type of service offered

Share of blockchain companies in Israel and Italy



Note: Total value slightly exceeds 100% due to rounding of values.
Source: Authors' calculation based on publicly available information.

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Interestingly, the relative development of these use applications differ between the two countries, reflecting underlying structural differences in their economy and sectoral specialisations. In the case of Israel, the top five use cases are digital infrastructure and protocols (29%), investment (12%), communication services (11%), provision of business solutions or consulting (8%), and payment (8%). To illustrate, around a third of Israeli blockchain companies develop underlying decentralised technology, on which applications could be built, with particular emphasis on security. Use of blockchain in investment activity typically involves servicing tokenisation of assets, including real estate. There are also companies that offer tailored services to businesses seeking to implement blockchain-based solutions within their process.

In comparison, 24% of the blockchain companies in Italy offer blockchain-based enterprise software or consulting for more bespoke business solutions according to each clients' needs. This is followed by supply chain-related solutions (18%) with particular emphasis on traceability of products. Noticeably, 7 of the 12 companies providing such application explicitly target agro-food industry, aiming at connecting agricultural goods producers to food manufacturers to final consumers. Other applications relate to intellectual property and copyright protection, payment services,[6] and lending and credit,[7] each accounting for 8% of the companies. In contrast to Israel, only 5% of the Italian blockchain companies work on the development of blockchain infrastructure.

The use cases of blockchain companies seem to reflect the needs of domestic industries. The companies are providing blockchain solutions aimed at solving challenges and supporting the country's key strategic industries. Interestingly, most of Israeli blockchain companies working to develop blockchain protocols highlighted the enhanced digital security that blockchain adoption could bring. Israel is a prominent player in the cybersecurity sector, where the country is responsible for 5% of the global market share in terms of annual revenue, only second to the United States, and the start-ups in the sector attract 20% of the global Venture Capital (VC) investments in cybersecurity (Start-up Nation Central, 2019[41]; The World Bank, 2016[42]).

On the other hand, in Italy, around a quarter of blockchain entrepreneurs are focusing on protecting Italian goods and intellectual property rights, leveraging the immutable and traceable nature of blockchain. Italy is the third most targeted country for IP rights infringement, after the United States and France (OECD/EUIPO, 2019[43]). It is estimated that forgone sales of Italian businesses due to counterfeited goods amounts to EUR 24 billion in 2016 alone (OECD, 2018[44]). Affected industries are characterised by a large proportion of SMEs, which include the clothing/footwear sector and food and beverage sector. Counterfeiting and piracy practices have significant impact beyond forgone revenue of the enterprises, as this results in lost jobs and reduced tax revenue. Box 4.5 presents an Italian blockchain company that works to tackle counterfeited goods.

Box 4.5. Certilogo, a case of blockchain-based product authentication

Certilogo, an Italian enterprise that began operation in 2006, uses blockchain and other complementary technologies for its product authentication platform. Specialised in authentication of fashion and luxury goods, the company partners with more than 100 brands globally. Originally focused on the use of Artificial Intelligence for its authentication solution, the company acquired a blockchain IoT start-up in 2018 and incorporated the technology into its service.

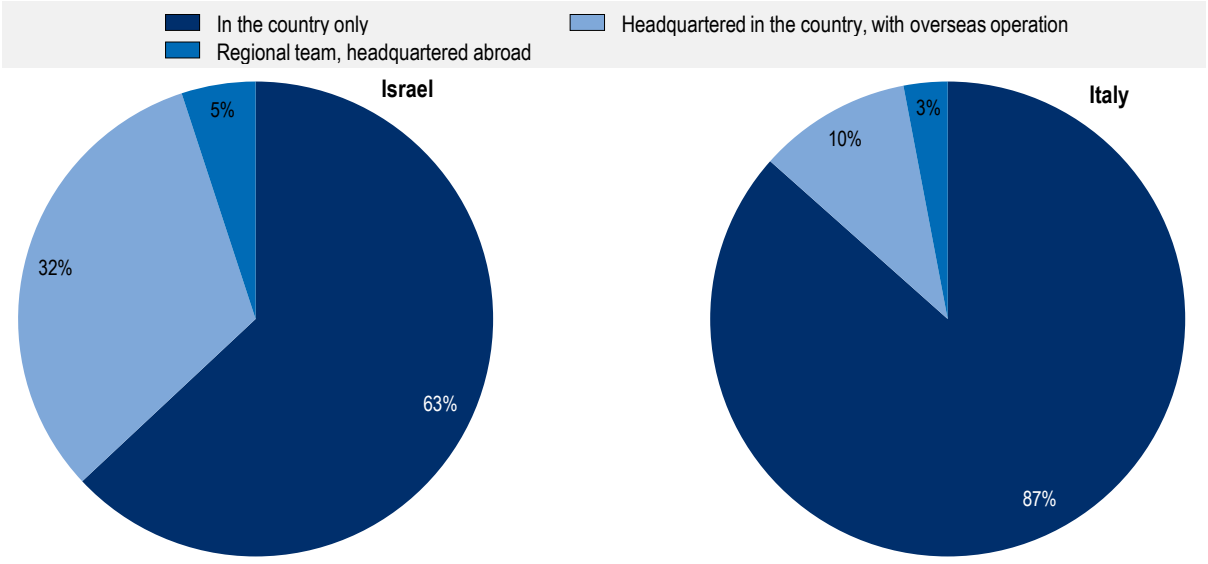
The company offers brands various means of authentication, such as RFID tag, QR code and serial number, with product information stored on blockchain. For authentication process, the company provides mobile application that customers can use. Genuineness of a product can be verified multiple times along the product's life, including when a product changes hands, which also enables brands to track distribution of their products. In addition, in the case of identification of a forged tag, Certilogo provides complimentary report that customers could use to file complaints and seek refund of their purchases.

Source: Certilogo website, https://discover.certilogo.com/en (accessed on 12 October 2020).

In both countries, most of the blockchain companies conduct their entire operation within the country. Based on self-declared information, 63% of the Israeli blockchain companies have their company located only in Israel, which is lower compared to that of Italian enterprises (Figure 4.4). Approximately a third of Israeli companies have overseas operations while having their headquarter in Israel, with most of the businesses located in the United States. On the other hand, 10% of Italian businesses have international presence. The percentage of companies based abroad with regional teams in Israel and Italy account for 5% and 3% respectively.

Figure 4.4. Blockchain companies by type of business operation within country

Share of blockchain companies in Israel and Italy



Source: Authors' calculation based on publicly available information.

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Box 4.6. Regional distribution of blockchain companies in Italy

In Italy, blockchain companies are largely concentrated in two regions. Out of the 67 companies identified, 35 of the firms are headquartered in Lombardy, and 11 in Lazio. While 29 of the 35 blockchain enterprises in Lombardy are situated in Milan, with the rest scattered in the neighbouring provinces, including Como and Mantua, all of the firms in Lazio operate in Rome. Trentino-South Tyrol and Emilia-Romagna regions host five companies each. As illustrated in the figure below, there are few number of firms operating in the south of Italy.

Blockchain companies are mostly located in metropolitan regions: approximately three quarters of the companies operate from areas defined as Nomenclature of Territorial Units for Statistics (NUTS) - 3 regions with at least 250 000 inhabitants.

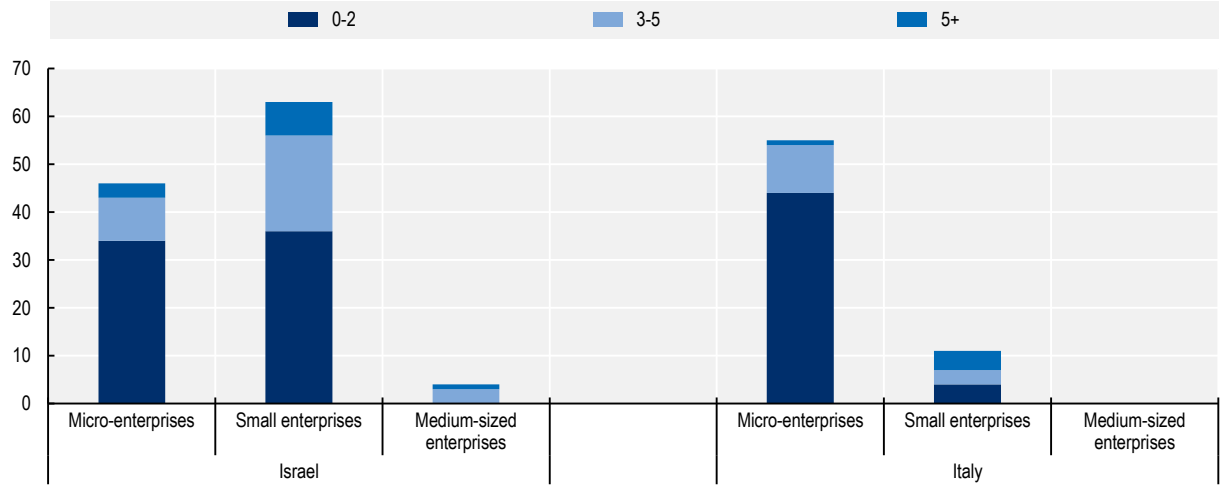
A number of businesses are located close to universities, which presents advantages, particularly to high-tech start-up firms, such as access to knowledge spillovers and to high-skilled human capital with relatively low skill premium (Audretsch, Lehmann and Warning, 2005[45]; Feng and Valero, 2019[46]). The survey of blockchain entrepreneurs (Figure 4.10) further highlights the links between blockchain businesses and Higher Education Institutions. About one-fifth of Italian blockchain companies mention co-operation with local universities, in the form of R&D collaboration or operation within university-sponsored start-up incubators.

Note: Colour shade on the right figure indicates the number of blockchain companies in each region, from 0 (grey) to 35 (dark blue).
Source: Authors' calculation based on desk research.

Around 90% of the blockchain companies are small and young firms. Based on the data available, 89% of the companies in Israel have less than 5 years, and 60% are under 2 years (Figure 4.5). In comparison, Italy presents a larger share of new firms of less than 2 years (72%). Size wise, 57% of Israeli blockchain companies are small enterprises, employing between 10-49 persons, whereas in Italy micro-enterprises account for a much larger share (82%). While young companies are mostly likely to be blockchain-native, that is, they utilise blockchain as their core product from inception, older firms show a tendency to incorporate blockchain solutions in their pre-existing offerings.

Figure 4.5. Size and age of blockchain companies

Number of blockchain companies in Israel and Italy



Note: Micro-enterprises refers to businesses employing 1-9 persons, small enterprises 10-49 persons and medium-sized enterprises 50-249 persons.
Source: Authors' calculation based on publicly available information.

StatLink https://doi.org/10.1787/888934227697

Survey of blockchain entrepreneurs

An online survey was devised in order to gather further information from "blockchain entrepreneurs" and validate information collected through desk research. The survey mainly covered five dimensions relevant to businesses providing blockchain products:

- *Company information*: e.g. number of employees, year of establishment.
- *Product*: e.g. stage of product development, type of blockchain architecture applied.
- *Business process*: e.g. source of finance, co-operation with other actors.
- *Clients*: e.g. type and location of target clients.
- *Policies*: e.g. opinions on the main barriers to business and suggestions for improvement.

In the case of Israel, responses were collected between May and June 2019, where 20 respondents provided their input (close to 20% of the sample). In the case of Italy, 30 blockchain entrepreneurs answered the survey between September and November 2019 (around 40% of the sample). Based on the responses, follow-up interviews were conducted with entrepreneurs, mostly CEOs or company founders that offer B2B solutions to SMEs. Complementary information obtained from the interviews contributed to a deeper understanding of opportunities and challenges faced by blockchain companies. The following section presents highlights from the survey.

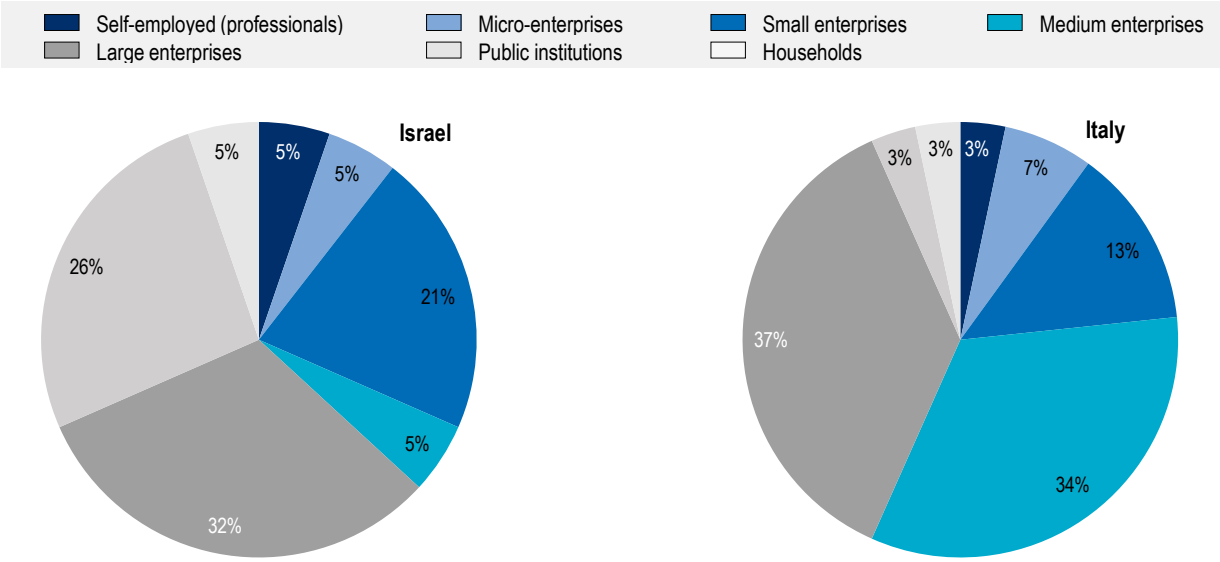
In terms of service offer, the distribution of the sample largely mirrors that of the population. Among Israeli respondents, 35% are focusing on blockchain infrastructure and protocols and 10% utilise the technology in investment activities, which generally involve investment in tokenised assets. Likewise, 27% of the Italian companies surveyed provide blockchain-based business solutions or consulting, followed by 17% in supply chain-related use cases.

SMEs and entrepreneurs are primary targets of blockchain enterprises. Businesses with less than 250 employees, including self-employed professionals, account for 36% of Israeli and 57% of Italian companies' primary target customer base respectively (Figure 4.6). Interestingly, while most of the companies are developing B2B services, 26% of Israeli firms indicate public institutions as their main segment, which consists largely of blockchain infrastructure providers.

Israeli companies are looking outwards, while Italian entrepreneurs are focusing on the national market. When inquired about the geographical focus of their offer, 70% of the Israeli blockchain companies indicated they are targeting mostly overseas markets, which include the United States, Europe and Russia. In Italy, companies have a strong focus on the domestic market, with 73% of the companies aiming to serve primarily Italian clients. Most of the other companies mentioned targeting other countries in the European Union.

Figure 4.6. Blockchain entrepreneurs' survey: Primary market target

Share of blockchain companies in Israel and Italy



Note: Based on responses from 20 and 30 entrepreneurs in Israel and Italy respectively. Total value of Israel is slightly below due to rounding of values.
Source: Authors' calculation based on the OECD survey of blockchain entrepreneurs.

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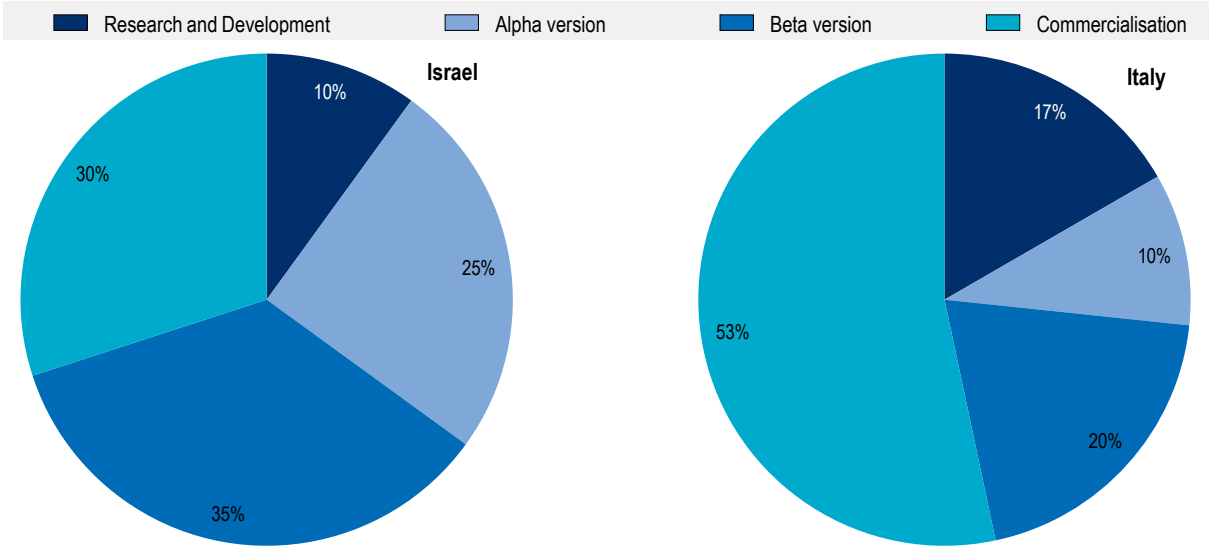
Most of the solutions developed by the blockchain companies are at late development or early commercialisation stage. Around 65% of Israeli and 73% of Italian blockchain companies stated to have operational products. The result reflects the technological development at the global level, where the applications are being rolled out in varying phases. Figure 4.7 illustrates the distribution of companies according to their development stages, defined as follows:

- Research and Development (R&D): Early research of technical structure and delivery of service, including feasibility test of the idea.
- Alpha version: First trials of the prototype software, which is usually limited to the employees of the company or a few selected stakeholders. Products at this stage generally are unstable, but presents features that could be further developed at later stages.
- Beta version: Trial stage involving software with complete features, where the developers share and allow larger groups of controlled stakeholders outside the company to access the software, with intent to receive feedback, understand the issues related to scale before its general release, and garner customer base.
- Commercialisation: Official release of the software.

Figure 4.7. Blockchain entrepreneurs' survey: Development stage of the solution

Share of blockchain companies in Israel and Italy



Note: Based on responses from 20 and 30 entrepreneurs in Israel and Italy respectively.
Source: Authors' calculation based on the OECD survey of blockchain entrepreneurs.

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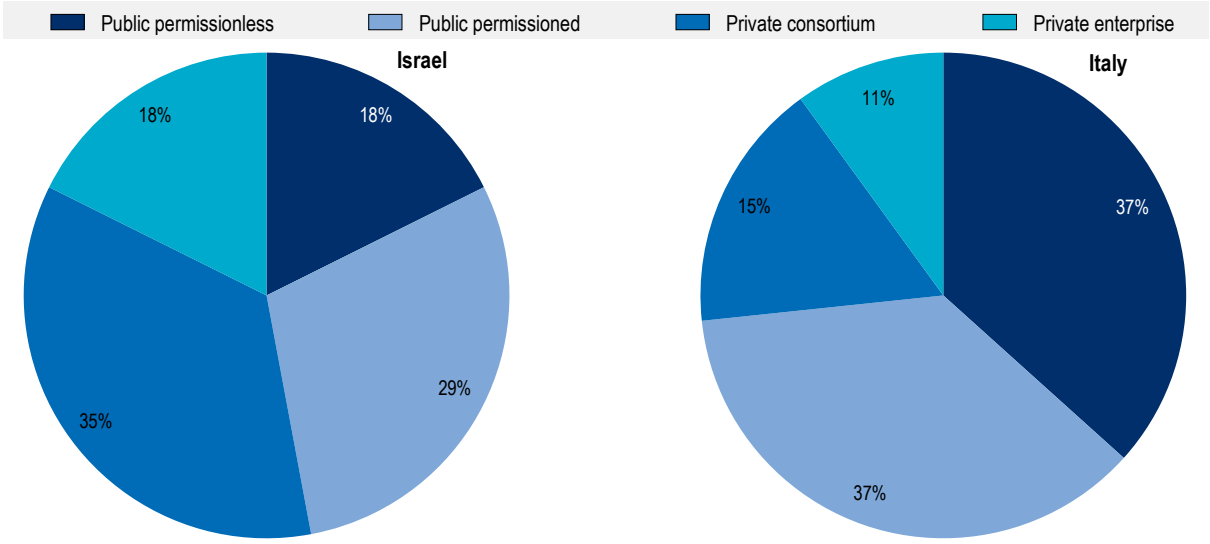
Permissioned blockchain architecture is a widely adopted form of blockchain architecture in the two countries. Of the surveyed businesses, 82% and 63% are using such architecture in Israel and Italy respectively (Figure 4.8). Box 4.7 provides an overview of the varying blockchain architecture. While public permissionless blockchain, with Bitcoin as a notable example, allows anyone participating in the network "to read and to write" on blockchain, permissioned (i.e. public permissioned and private) architecture restricts the rights to authorised participants. Permissioned system makes compliance with data regulation possible as it requires central administrator by nature (EU Blockchain Obervatory and Forum, 2018[47]). In Italy, a large share of businesses using public permissionless architecture leverage existing blockchain infrastructure (often Bitcoin or Ethereum) to store timestamps of data validation. Anecdotal evidences further suggest that businesses also use hybrid architecture, connecting private blockchain to public networks.

Figure 4.8. Blockchain entrepreneurs' survey: Blockchain architecture

Share of blockchain companies in Israel and Italy



Note: Based on responses from 20 and 30 entrepreneurs in Israel and Italy respectively. Categorisation based on (Hileman and Rauchs, 2017[48]).
Source: Authors' calculation based on the OECD survey of blockchain entrepreneurs.

StatLink https://doi.org/10.1787/888934227754

Box 4.7. Categorisation of blockchain architectures

Businesses that develop blockchain-based applications can adopt different blockchain protocols and architectures. Blockchain can largely be classified by whether the network can be accessed by public (permissionless) or closed to defined participants (permissioned), with the latter category having a centralised entity governing protocols. Hileman and Rauchs (2017[48]) suggest categorising blockchain into four types, as presented below. However, the categorisation is not always clear-cut, as hybrid architectures are also possible, depending on business needs.

- **Public permissionless**: Anyone can become a node of the network and read/write on the network. Modification of the blockchain would be in any case regulated by a defined "consensus protocol", which guarantees the integrity of the open chain. Examples are Bitcoin and Ethereum.
- **Public permissioned**: Open to be "read" to the public, but only authorised stakeholders can become "nodes" and "write" on the blockchain (e.g. generate a transaction). Examples include Sovrin and European Blockchain Services Infrastructure.
- **Consortium**: Open to "read" and "write" only to partners in a consortium. Unlike public architecture, decision-making process is centralised, which leads to reliable and easily scalable protocol but losing completely the features of decentralisation. Examples are Hyperledger Fabric and Quorum.
- **Private permissioned ("enterprise")**: Generally constitutes corporate databases internal to a group, where the central administrator confers both the possibility to "read" and "write" on the blockchain. Typical examples are tailored blockchain solutions for use within an enterprise.

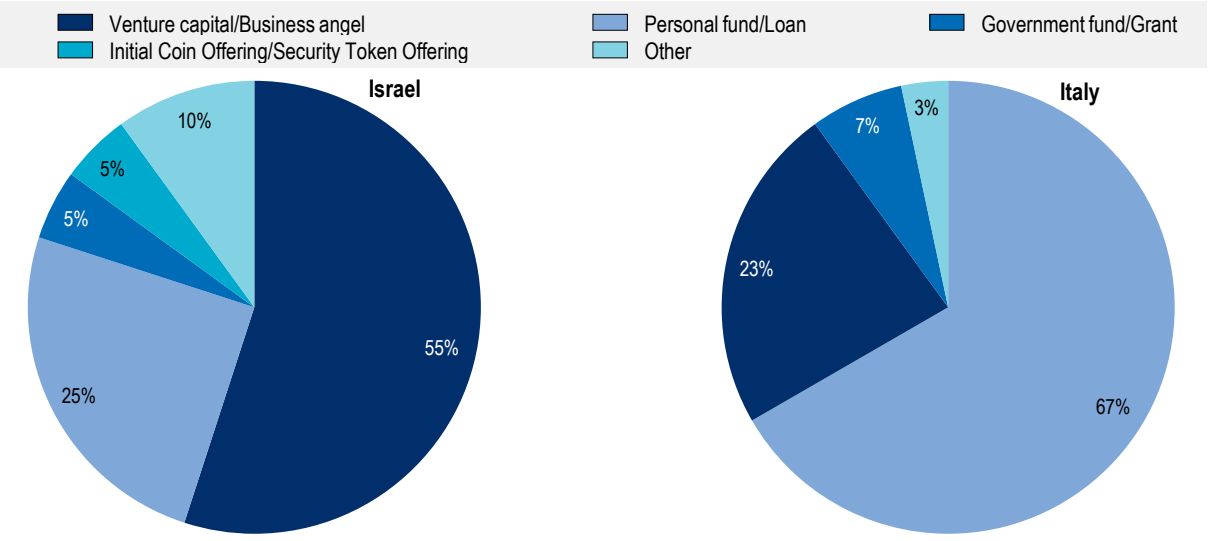
Note: There exist contrasting perspectives on whether enterprise blockchain should be categorised as a separate category. In the present study, the authors follow the approach identified by Hileman and Rauchs to allow for a detailed categorisation and ensure consistency of the results of the survey in different countries.

Blockchain companies tap into different sources of financing in each country. Responses from the surveyed blockchain companies reflect the main financing sources available to start-ups in the countries. In Israel, 56% of companies obtained financing mainly from VC. Israel has a well-established VC industry, presenting the highest share of VC investment with respect to GDP across the OECD economies (OECD, 2017[49]). VC investments are the drivers of growth for early and later stage start-ups, which may not have the capacity and resources to obtain debt financing. Furthermore, equity investment provides start-ups an opportunity to access regional and global networks on which the companies can capitalise to grow (Falik, Lahti and Keinonen, 2016[50]).

The case of Italy illustrates a different picture, since 67% of the firms used personal financing or debt-financing as their primary funding source (Figure 4.9). Despite doubled size of VC market in the past decade between 2009 and 2019, the volume of VC investments in Italy as a percentage of GDP remains low at 0.01%, against an OECD average of 0.08% (OECD, 2020[51]), with relatively small average size of VC funding rounds (Taboga, 2019[52]).[8]

Figure 4.9. Blockchain entrepreneurs' survey: Principal source of finance

Percentage of total number of blockchain companies in Israel and Italy



Note: Based on responses from 20 and 30 entrepreneurs in Israel and Italy respectively.
Source: Authors' calculation based on the OECD survey of blockchain entrepreneurs.

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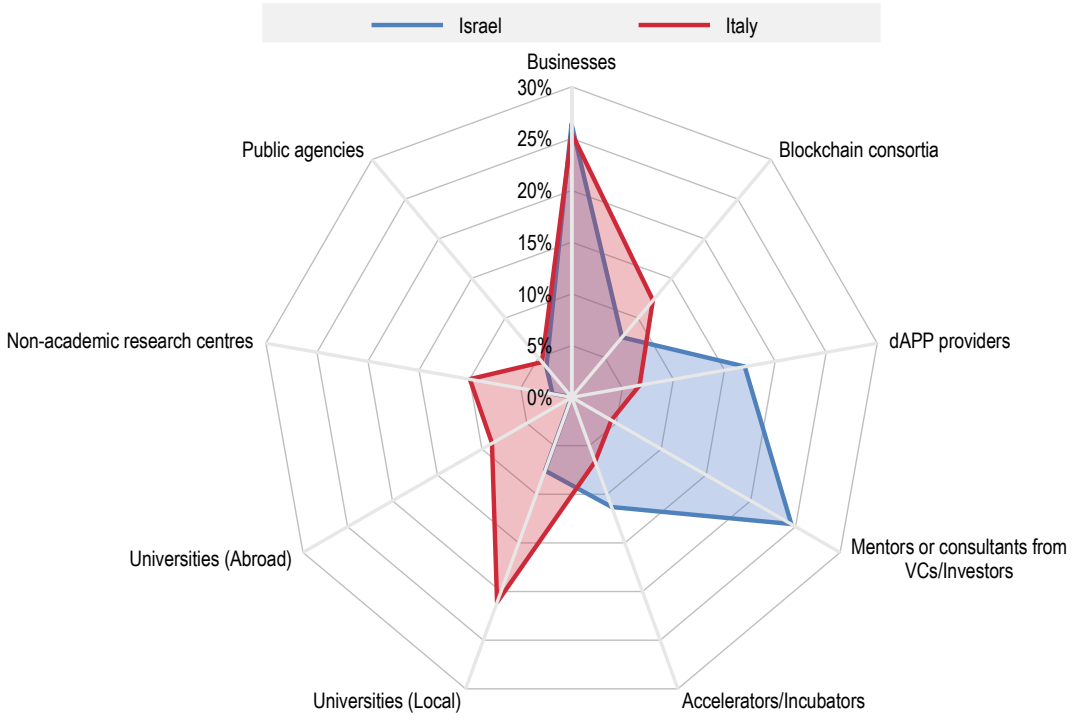
In terms of co-operation with stakeholders, in both countries companies work mainly with other businesses (26% each). Considering that the blockchain companies are developing B2B services, as observed from Figure 4.6, their co-operation with potential customers is essential. In addition, Israeli blockchain entrepreneurs mentioned mentors or consultants from investor companies (25%) and decentralised application (dApp) providers (17%) as their second and third main reference for co-operation (Figure 4.10), which could partly be related to the large role of VCs in the country. In Italy, Higher Education Institutions represent the second most important partner for co-operation (21%). Working closely with universities, entrepreneurs can access experts, talents, physical infrastructure (such as office spaces in incubators), as well as mentorship from academia. In addition, 10% of the companies indicated their co-operation with non-academic research institutions.

Figure 4.10. Blockchain entrepreneurs' survey: Main actors of co-operation

Share of blockchain companies in Israel and Italy



Note: Based on response from 20 and 30 entrepreneurs in Israel and Italy respectively. Maximum of three responses allowed per company.
Source: Authors' calculation based on the OECD survey of blockchain entrepreneurs.

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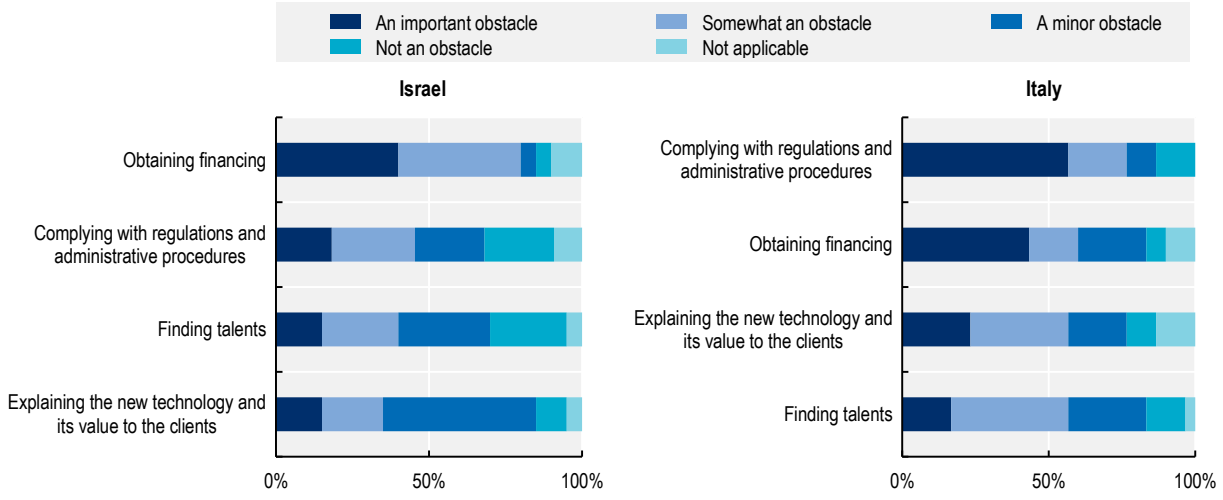
Barriers to business development experienced by blockchain companies in the two countries differ markedly. The responses reflect both common barriers experienced by businesses at the early stage, as well as technology-specific barriers. In the case of Israel, obtaining financing represents the main business barrier, with around 80% of the entrepreneurs indicating it as either an important or somewhat an obstacle (Figure 4.11). Despite the vibrant VC market in the country, anecdotal evidences suggest that uncertainty on financial regulations for entities dealing with decentralised digital currencies limit prevent businesses' access to finance and, in particular, interaction with banks.

Complying with regulations and administrative procedures is also a cause of concern for Israeli blockchain businesses. In particular, tax compliance represents the main challenge. This is especially true for companies that often engage in transactions of cryptocurrencies, as the Israeli government regulates virtual currencies as assets, which are subject to capital gains tax.

Figure 4.11. Blockchain entrepreneurs' survey: Business barriers

Share of blockchain companies in Israel and Italy



Note: Based on responses from 20 and 30 entrepreneurs in Israel and Italy respectively.
Source: Authors' calculation based on the OECD survey of blockchain entrepreneurs.

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Italian blockchain entrepreneurs indicated "complying with regulation and administrative procedures" as the main barrier to business development. Around 80% of the firms surveyed reported it as a business obstacle, with more than half of the businesses expressing it as an important obstacle. The challenges for compliance largely stem from the issues that are specific to the technology.

Ambiguous legal framework on the use of smart contracts, an integral function of the technology, represents one of the main issues. Albeit Italy is one of the first countries to have provided a formal definition of smart contract and recognised the legal validity of the technological feature as a form of contract, the technical guidelines that should support the implementation of the legal recognition are still missing.

Data regulation compliance represents an additional challenge for blockchain entrepreneurs at large. As data regulations, such as the European Union's General Data Protection Regulation (GDPR), are in general conceived with consideration of conventional centralised systems, businesses are in some cases required to alter their systems to have a viable blockchain-based service.

"Obtaining financing" is reported as the second most important obstacle by Italian entrepreneurs. 40% of the respondents highlighted access to finance as an important business barrier, with a total of 60% stating it is an obstacle. In the case of blockchain companies, the challenges that are common to start-ups and SMEs in the lending market are compounded by the prevalence of intangible assets, which cannot be valued easily by financial institutions (Bronzini, Caramellino and Magri, 2017[53]).

"Explaining blockchain and its value to the clients" and "finding talents" represent less important barriers in both countries. Still, more than 50% of Italian businesses mentioned these two business aspects as obstacles, compared to less than 40% in Israel. For blockchain companies that aim at providing blockchain-based products to other small businesses, including in traditional sector, a low business demand for innovative goods or services can represent an important limitation to growth (Menon et al., 2018[54]). The tendency is more evident among Italian SMEs, where family-owned or family-managed businesses, which typically exhibit higher risk aversion and are less likely to procure innovation from external sources, are more prevalent (Nieto, Santamaria and Fernandez, 2013[55]).

Development of blockchain-related policies in Israel and Italy

As with other types of technological innovation, development of blockchain and its ecosystems have largely been influenced by governments' stance towards the technology and their subsequent policies. The following section presents incremental development of blockchain-related policies from the case studies on Israel and Italy.

Over the past decade, blockchain-related policies have initially focused on understanding and regulating the exchange of crypto-assets, as the first widely used applications of blockchain technology were in the financial sector. Hype-driven investments on blockchain-based virtual currencies exposed investors to volatility risks and frauds related to the issuance as well as the exchange of coins and tokens. For example, Israeli and Italian authorities issued statements on the development of the virtual currencies market in 2014 and 2015 respectively. Authorities underlined inherent risks that investors could be exposed to when purchasing or selling so-called cryptocurrencies. Despite being called "currency", most countries, including Israel, have issued explicit guidance indicating that the crypto-assets do not constitute a fiat currency (OECD, 2020[56]).

Financial regulators then aimed at defining their position towards crypto-currencies in relation to the existing regulatory framework and sought to update or modify existing regulations to ensure compliance with AML and know your customer (KYC) requirements for the new type of investment (FATF, 2019[4]).

In Israel, as the need for a co-ordinated approach in addressing cryptocurrencies was increasingly perceived, the "Inter-Ministerial Committee for Regulatory Coordination of Virtual Assets" was established. Led by the Bank of Israel and assembled relevant public authorities,[9] representatives from the member agencies convened regularly in the Committee to develop a whole-of-government strategy to gather information on the barriers in dealing with virtual assets and respond to the increasing demand for regulatory guidance from the industry (e.g. SMEs and start-ups working on blockchain technology).

In the case of Italy, the regulators made efforts to align their position with other institutions abroad. In addition to making contributions in establishing regulatory guidance on crypto-assets, Italian government bodies consulted decisions and legal framework provided by both European regulators, including European Banking Authority (EBA) and European Securities and Markets Authority (ESMA), and international authorities, such as Financial Action Task Force (FATF), in areas where there were no comprehensive regulations.

In addition to the efforts to provide clear guidance on the crypto-asset-related activities, through reports resolutions and circulars, financial regulators in both countries also explored the possibility of creating additional systems to accommodate the new type of asset. Such examples include creating a dedicated disclosure regime for entities issuing crypto-asset to enable compliant activities and relaxing restrictions by establishing a framework for regulatory sandbox (Israel) and creating new public registries to ensure AML/KYC compliant virtual currency-related activities (Italy).

However, in recent years, with the introduction of diverse DLT applications beyond the financial sector, governments are increasingly taking nuanced policy approaches to promote innovative use cases in industries. While acknowledging blockchain as a type of technological innovation, Israel has taken technology-neutral approach for its innovation programmes. To illustrate, the Israel Innovation Authority (IIA), a publicly funded agency, oversees innovation policy and provides grants to promote R&D activities in the country. The Authority operates incentive programmes, conducting calls for proposals, across a number of topics such as technological infrastructure and advancements in manufacturing. Between 2017 and mid-2019, the IIA has provided financial support to around 10-15 blockchain projects, with an investment grant of around NIS 30 million (USD 8.5 million), which reflects growing interest in the application of the technology.

Interestingly, Italy has taken a step further to recognise legal validity of blockchain. Italian parliament approved a decree providing definition of DLT and recognising the legal validity of smart contracts.

Proposed by the Italian senate and adopted in February 2019, the amendment states that DLTs have the legal effect of an "electronic time stamp", while smart contracts satisfy the same requirement of the written contract. With technical standards being laid out by a working group, the decision provides a groundwork for creating an environment for blockchain innovation.

At various levels, the Italian government has made efforts to broaden the understanding of DLT and to explore the use cases, and the benefits, beyond financial applications, from cloud computing to academic credentials. Since 2018, the Ministry of Economic Development (MiSE) has undertaken actions to participate in European Blockchain Partnership and created a high-level expert group to establish a national blockchain strategy, with the aim to develop a comprehensive strategy to foster development and uptake of blockchain in the Italian economy.

Policy approaches to foster blockchain for SMEs

As the hype on crypto-assets ease and financial regulators have begun clearing out uncertainties regarding digital assets, governments are shifting focus on industrial applications of DLTs, and on strategies to support firms in unlocking the benefits of the blockchain technology, while addressing possible risks. The following section discusses key policy trends in this area, providing examples from both the OECD members and non-member countries, with a specific focus on measures intended to foster industrial applications of blockchain technology and on implications for SMEs and entrepreneurs.

Increasing awareness

Among businesses

Lack of awareness and understanding of blockchain technology and applications represent a key obstacle to adoption, in particular by SMEs. Despite the introduction of use cases beyond cryptocurrencies, trust in the technology is being affected by booms and bursts, as well as frauds associated with virtual assets. Wider technology adoption crucially depends on entrepreneurs' understanding of the potential benefits, use cases, as well as challenges of blockchain applications. **Australian** Skills and Quality Authority (ASQA), for example, accredits courses that aim to train entrepreneurs on blockchain and related business models.[10]

In addition, governments can leverage digital innovation diffusion channels at hand to inform businesses about the technology and provide assistance to businesses that have an interest in implementing blockchain applications in their business process. This is the case, for instance, of the Digital Innovation Hubs operated by the **European Commission.**[11]

Within governments

Policy makers also need to nurture basic knowledge of blockchain technology. By demystifying the technology, the public sector would be able to compare blockchain with other technologies that are readily available. Establishing expert groups and advisory boards can help government officials in broadening their knowledge on the technical issues. In general, governments gather a group of experts knowledgeable of the technology to learn from the field and to have a deeper understanding of the implications the technology has on policy making before formulating national strategies.

International organisations can also play a role in facilitating understanding and fostering policy exchanges regarding blockchain. For instance, the OECD Blockchain Policy Centre designs and provides tailored blockchain trainings to policy makers from governments and public agencies across OECD countries. The courses provide a general understanding of the technical characteristics of the technology, as well as an overview of its main application and of the most relevant policy experiences around the world.

Promoting policy co-ordination and long-term vision

National strategies can reflect the interest and commitment in the development of a technology, with the government setting high-level objectives and principles to provide guidance in a whole-of-government approach. National blockchain strategies have emerged in recent years, which aim to evaluate the specific opportunities of the technology in relation to countries' specific economic structures. Strategies also seek to leverage the use of other complementary technologies such as AI and 5G networks.

In February 2020, **Australia**'s Department of Industry, Science, Energy and Resources announced the National Blockchain Roadmap, which is set to continue until 2025. The Roadmap states three main areas for the country's strategic focus, which are "regulation & standards", "skills, capability & innovation" and "international investment & collaboration". The National Blockchain Roadmap Steering Committee, an advisory group consisting of members from both the public and private sector and academia, has been established to provide guidance on the advancement of the Roadmap. As a part of the effort to identify possible use cases of the technology, the Roadmap highlights the country's wine sector and suggests potential adoption of blockchain solutions to track Australian wine exports.

In **France**, the Ministry of Economy and Finance published the country's National Blockchain Strategy in April 2019, based on a consultation with national experts, from entrepreneurs to non-profits, on non-financial uses of the technology. The Strategy builds on the government's previous efforts to regulate digital assets within its financial framework, which included recognising Initial Coin Offerings (ICOs), issuance of cryptographic tokens, as an alternative financing method for SMEs. The Strategy lays out four main areas of work, which are "strengthening the excellence and structuring of the French industrial sectors in order to initiate projects", "fostering innovative projects", "being on the cutting edge in tackling the major technological challenges" and "assisting blockchain project initiators with their questions, especially legal and regulatory issues".

Led by the Federal Ministry of Economic Affairs and energy, **Germany** adopted Blockchain Strategy of the German Federal Government in September 2019. The Strategy provides 10 principles for its implementation, which includes guaranteeing stability, strengthening sustainability, and making environment for fair competition among technologies, while creating a technology-neutral environment. Following the Strategy, 44 measures are presented in five main areas of activity, which include: "Securing stability and stimulating innovations: blockchain in the finance sector", "Bringing innovations to maturity: advancing projects and regulatory sandboxes", "Making investments possible: clear, reliable framework conditions", "Applying technology: digitised public-administration services" and "Distributing information: knowledge, networking and co-operation". Measures examining potential industrial applications of the technology are also provided, such as the use of technology in tracing product lifecycle with a case from the aircraft industry and the development of effective maritime logistics governance structure.

Introducing technical infrastructure

Governments have also taken action to introduce blockchain-related infrastructure to facilitate uptake of the technology, including by SMEs. Such infrastructure includes a public sector-backed blockchain protocol that could be easily used by various actors, as well as technical foundation, e.g. computing capacity and network connection, to make it easy for individuals and organisations to create and use blockchain applications.

The European Blockchain Partnership (EBP) was established in April 2018 with the goal to foster co-operation in realising the potential of blockchain applications that can bring value to citizens, society and economy. As of mid-2020, 30 member states from both European Union (EU) and European Economic Area (EEA) have joined the initiative. Under the Partnership, the member states are working towards building the European Blockchain Services Infrastructure (EBSI), the EU-wide blockchain infrastructure that will allow delivery of cross-border public services. Nodes are distributed across Europe and maintained

by the European Commission (EC), national governments, and knowledge institutions.[12] Four use cases have been tested in 2019, which are notarisation, education credentials, self-sovereign identity, and data-sharing among customs and tax authorities in the European Union. It is also projected that private entities will be able to leverage the infrastructure to create business applications.

In **China**, the government is fostering development of a technical infrastructure to facilitate blockchain adoption. The State Information Centre (SIC), an e-government network advisory body operating within the Ministry of Industry and Information Technology (MIIT), developed the Blockchain-based Service Network (BSN) in co-operation with private sector entities including China Mobile and Union Pay. BSN was inaugurated in April 2020 with global footprint, through 128 public nodes[13] located in different cities, of which eight are located outside of China. The network of public infrastructure hosts prefabricated code mechanism, functioning as a one-stop blockchain environment that developers from the private sector can leverage. The government projects that the Network will lower barrier to entry for developing blockchain applications, and offer cost-efficient deployment of blockchain-based services, especially for SMEs.

Adopting blockchain to deliver public services

Blockchain adoption can be part of governments' digital transformation efforts. Governments' adoption of technology can provide use cases to businesses and further send signals to businesses seeking blockchain adoption. For example, establishment of distributed ledgers by the government could represent an alternative means to central databases, which would contribute to breaking data siloes between government bodies. Such a system would streamline exchange of information between government functions, reducing the time and burden businesses face regarding administrative procedures. E-procurement is another area where the technology could be used to enhance transparency of the government process and gain the public's trust.

However, in order to have a solution that reflects implementation requirements, public organisations embracing pilot projects need to have the capability to make detailed design decisions. A study from the OECD Observatory of Public sector Innovation (OPSI) finds that the viability of government-driven blockchain projects are influenced by some key success factors, such as having a clear value proposal and identifying and managing relevant stakeholders, as well non-success factors, including disruptiveness and limited scalability of the projects (Ubaldi et al., Forthcoming[57]).

Led by **Singapore**'s Infocomm Media Development Authority (IMDA), a statutory board under the Ministry of Communications and Information (MCI), TradeTrust is a framework conceived to support exchange of electronic trade documents. Use of blockchain to verify authenticity of trade documents facilitates digitisation of document exchanges, reducing time and cost associated with document processing, as well as risk of fraud. After a pilot project in 2019 involving Maritime Port Authority of Singapore, Singapore Customs and the Singapore Shipping Association, the multilateral trading system expanded its reach, with 17 international corporations and International Chamber of Commerce (ICC) as members in the consortium.

In **Korea,** the Ministry of Science and ICT (MSIT) and Korea Internet and Security Agency (KISA) co-operates with actors from the public sector, from ministries to regional governments, to identify demand as well as potential use cases of blockchain technology within government. Referred to as "public sector-led blockchain pilot projects", the process for public procurement of blockchain solutions began in 2018, following the Blockchain Technology Development Strategy laid out in the same year. Pilot projects generally last one year, testing prototypes to test wider adoption. Initially started with six projects proposed by MSIT to ministries, the projects transitioned to demand-driven approach with request for proposal the year later, presenting twelve pilot case studies in 2019 and 2020.

In addition, governments can adopt e-procurement practices that allow broadened participation, especially by SMEs, thanks to lowered cost barriers (OECD, 2018[58]). Blockchain can enhance

transparency and thus trust in the procurement process from businesses. In 2020, the Office of the Inspector General of Colombia partnered with the World Economic Forum and Inter-American Development Bank (IDB) to examine the adoption of blockchain in the country's public procurement system. While implementation of blockchain-based public procurement systems is expected to enhance fairness of the process, feasibility of implementation is to be tested on the country's public school meal programme.

Hosting hackathons can provide innovative solutions to the challenges that governments are facing. Some countries have invited innovative minds to blockchain-focused hackathons, which offers governments the chance to explore possibilities of the technology up close. For instance, in line with the National Digital Strategy, **Mexico**'s Ministry of Public administration jointly hosted Blockchain HackMX with Campus Talent Mexico, a training centre on digital skills. With the focus of the hackathon on creating blockchain-based applications for the public sector, the winning team developed a public tender process that incorporates evaluation of social benefits.

The Ministry of Economics of **Latvia** organised ".tax" hackathon in 2019, which called for ideas on blockchain pilot project for the State Revenue Services (SRS). The event gathered over 100 experts working on blockchain from more than 11 countries. Participants from large companies provided advice to the participating teams. Proposal for tax fraud avoidance solution, which uses blockchain for storing electronic signatures from traditional systems, such as Enterprise Resource Planning (ERP) and cash register systems, was awarded the prize. The Ministry of Economics and the SRS have been co-operating to scale up the prototype, which would include changing relevant regulatory requirements.

In **Ireland**, the Department of Public Expenditure and Reform and Department of Finance co-hosted "Blockchathon". The hackathon, which took place in 2019, was based on the work conducted by the interdepartmental working group on blockchain and virtual currencies led by the Ministry for Finance. Ideas presented included tracking State Aid payments for Enterprise Ireland, and were made public for other developers.

Supporting private sector innovation through partnerships

As it is largely the private sector that provides applications for other businesses, support is being provided in some countries to foster co-operation between businesses developing solutions, especially start-ups, and various actors in the blockchain ecosystem, including universities and other public research centres.

In particular, efforts have been made to establish networks for public-private partnerships to steer development of the blockchain industry. For instance, in the **Netherlands**, the Dutch Blockchain Coalition (DBC) was created to bring together actors from government, knowledge institutions, and industry. Founded in 2016 as a joint venture from the partners, the multiple stakeholder group aims at facilitating exchange of knowledge and experience between the public and private actors and create synergies between blockchain initiatives in the country. The DBC further engages with international stakeholders, such as the EC and the ISO, for standardisation on the norms and governance of the technology. The DBC identified six use cases for collaboration, which are self-sovereign identity, logistics, academic credentials, pensions, government subsidies and mortgages.

Conducting pilot projects is another way for the governments to explore and test innovation from the private sector. Pilot projects are small-scale projects conducted over a short period of time, usually with limited investments, to test the functionalities and applicability of solutions based on DLTs. They offer a way to experiment and identify issues prior to a full-scale adoption, which could minimise risks. By providing testbeds, government bodies and application developers have the opportunity to work side-by-side, in a co-operative environment in which all actors can widen their understanding of the capabilities, challenges, and potential applications of the technology.

The Innovation, Science, and Economic Development **Canada** (ISED) is seeking to implement blockchain-based supply chain tracing system for the steel industry. As the industry does not have a standardised information-sharing mechanism, the goal of the project is to provide a solution that enables real-time tracking of inputs and outputs along the steel supply chain, leveraging blockchain and AI. The ISED issued a call for tender worth CAD 300 000 via Innovative Solutions Canada, which is a federal programme for procuring innovative solutions from Canadian small businesses to solve government challenges.

The **United States** Food and Drug Administration (FDA) launched a pilot project to track and trace medicines. Track-and-trace system to be implemented in 2023. The project has been carried out in accordance with the Drug Supply Chain Security Act (DSCSA), which calls to build an interoperable electronic system for the pharmaceutical distribution supply chain by 2023, which is also dubbed as the DSCSA Pilot Project. The FDA expects that the new system would contribute to reducing diversion of domestically distributed drugs, and detecting counterfeit drugs in the supply chain.

Addressing regulatory uncertainties

Regulatory incertitude always follows technologies in its early stage, which also applies to blockchain. Before a common consensus is reached, interpretation on where the technology stands in the existing framework may vary, which exposes both developers and users to regulatory uncertainties, as observed in governments' reactions to crypto-assets. Possibility of industrial mass adoption of blockchain could also be affected by governments' stance on the technology. A typical example is whether data stored on blockchain could be recognised as a valid electronic time stamp, which is used to verify integrity of a document. Recognising regulatory equivalence between the technological guarantees provided by blockchain technology and current regulatory objectives could contribute to improving regulatory compliance through technology, thereby reducing the uncertainty and the regulatory burden imposed on these actors, and by doing so, encouraging regulatory-compliant innovation in the field. Here the concept of "functional equivalence" and "regulatory equivalence"[14] could be particularly relevant in the blockchain context (Collomb, De Filippi and Sok, 2019[59]). As mentioned above, **Italy** has amended legislation to acknowledge legal validity of blockchain-based timestamping. In addition, due to decentral nature of blockchain, which is especially the case with permissionless networks, how disputes can be resolved remains uncertain.

Regional and local-level policy initiatives

Regional and local-level governments can also play an active role in driving blockchain development and promoting adoption of blockchain technology. In **California**, following the state Assembly Bill, a Blockchain Working Group was established to identify potential use cases and their benefits, as well as the risks of blockchain to the state government and businesses based in California. The Working Group published a blockchain roadmap and proposed several pilot projects, which include building a blockchain platform to tack a vehicle's lifecycle and food supply tracking to allow rapid tracing of the food-borne contamination source.

The government of **British Columbia**, in collaboration with government of **Ontario** and **Canada** initiated an open-source project to create a blockchain-based network for self-sovereign identity Named Verifiable Organisations Network (VON), the project aims at providing organisations, especially businesses, a secured network on which they can, for example, store their credentials, or acquire licenses or permits verified by government services. Servicing of the network would drastically shorten the time needed to verify information and eliminate the need to type in information repeatedly for different government services.

To address fragmented data ownership between different parts of government, **Lombardy** regional government in Italy created a blockchain-based system that could store credentials of the citizens. The

pilot project “Nidi Gratis” focused on access to child care. Instead of developing a dedicated blockchain infrastructure, the system uses existing blockchain network, which lowers system development and maintenance costs. When individuals obtain certifications from government bodies, the proof of certification is issued to the individuals’ account, which can be accessed by other government functions. With use of the automated system, both citizens and businesses are freed from the burden of sending duplicate documents to multiple public bodies. The regional government began using the system in 2019, where the government benefited from reduction of thousands of hours’ worth of administrative work.

Conclusion

Blockchain has the potential to become an important tool to ensure integrity and security of data while enhancing accountability and trust among stakeholders. Transaction history is distributed to the participating nodes of a network, reducing the need to rely on intermediaries and other types of centralised actors. Immutability of data contained in blockchain further increases transparency of the system. The DLT industry is moving beyond financial services and many applications are being developed across multiple sectors.

Blockchain-based software presents distinct opportunities to SMEs and start-ups, as its applications can help new and small businesses overcome size-related challenges, such as those related to information asymmetry and opacity, reduce transaction costs, improve efficiency in processes and quality in products, enhance supply chain management, and spur innovation in business models. However, SMEs also face challenges related to blockchain adoption: for example the need to invest in other complementary technologies and the low interoperability of blockchain solutions sourced from different providers.

The OECD country case studies on “Blockchain for SMEs and Entrepreneurs”, conducted in Israel and Italy, provide in-depth understanding of both the opportunities and challenges faced by businesses working on blockchain innovation, and on the development of the blockchain ecosystems at large. Interestingly, the products developed by “blockchain companies” reflect to a large degree the economy’s structure and sectoral specialisation of the SME population, being largely targeted at addressing the needs of domestic industries. Moreover, in both countries, the majority of enterprises developing DLT-based services target SMEs as primary clients. The activities of “Blockchain businesses” are influenced by the general domestic business environment, including regulation, access to finance and to talents, but also by blockchain-specific issues, such as the legal validity (or lack of) of smart contracts.

Blockchain-related policies have initially focused on understanding and regulating the exchange of crypto-assets, but, in recent years, governments have increasingly taken nuanced policy approaches to promote innovative use cases in industries. The chapter provides examples of policies aimed at, for example: increasing the awareness of DLT among businesses and within public administration; introducing national strategies to pursue a whole-of-government approach; integrating blockchain within public services; conducting pilot tests in co-operation with the private sector to support DLT innovation; building public blockchain infrastructure; reducing regulatory uncertainty; and providing services at regional and local level. These policy initiatives can provide use cases and send positive signals to SMEs seeking or considering blockchain adoption, while addressing some of the main challenges for a broader diffusion of the technology, such as lack of awareness and skills, lack of interoperability between systems, and lack of access to digital infrastructure.

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Notes

[1] For simplicity, in this chapter the terms "DLTs" and "Blockchain" will be used interchangeably, even if the latter is actually a sub-set of the former.

[2] A few types of attacks are still theoretically possible. For example, the "Proof-of-work" consensus protocol used by the major cryptocurrencies (Bitcoin and Ethereum) could be the object of a "51% attack", where the new block of information is tampered with the malevolent consensus of at least 51% of the network. However, this would require a malevolent actor to invest at least 51% of the computer power ("mining power") of the whole network, which in a large global networks would be nearly impossible to be done or to go unnoticed.

[3] The discussion on how such cryptocurrencies should be recorded in the System of National Accounts is still open at international level (OECD, 2018[63]).

[4] The two case studies on Israel and Italy were carried out in co-operation with, and at the request of, the Small and Medium Business Agency of the Ministry of Economy and Industry and the Digital Israel National Bureau of Israel and the Ministry of Economic Development of Italy, respectively.

[5] Start-Up Nation Central, a non-profit organisation that keeps track of innovative businesses, and Israeli Blockchain Association provided data on small businesses developing blockchain in Israel. In the case of Italy , the research leveraged the "Startup and innovative SMEs" database, a special business register created through co-operation between the Ministry of Economic Development (MiSE) and Italian Chamber of Commerce, and the database of the Blockchain Observatory of Polytechnic University of Milan.

[6] Payment service refers to offering businesses an option to accept cryptocurrencies as payment, notably Bitcoin.

[7] In relation to lending & credit, blockchain companies provide peer-to-peer (P2P) financing with transactions recorded on blockchain.

[8] In 2020, the Italian government has introduced a large public sector-backed fund of funds to sustain the growth of equity financing in the country. The "Fund of Funds Private Equity Italia" is controlled by Italian public bank "Cassa Depositi e Prestiti" (CDP) and has a target of EUR 600 million to support the development of the Italian SME market through investments in private equity funds. CDP's overall commitment to the fund reached EUR 300 million in 2020.

[9] The list of regulators is as follows; the Ministry of Finance, the Ministry of Justice, the National Economy Council of Israel, the Israel Securities Authority (ISA), the Israel Tax Authority (ITA), the Capital Markets, Insurance and Savings Authority (CMISA), the Israel Money Laundering and Terror Financing Prohibition Authority (IMPA), the Israel National Cyber Bureau (INCB), and the Israel Innovation Authority (IIA).

[10] "Diploma of Applied Blockchain" and "Advanced Diploma of Applied Blockchain" are the two accredited courses on blockchain, which include modules on developing blockchain business model, and strategies in developing blockchain projects (ASQA, 2020[61]).

[11] At the time of writing, there are 32 Digital Innovation Hubs that focus on blockchain, such as Frankfurt School Blockchain Center (FSBC) in Germany, and Future Position X in Sweden (European Commission, 2020[62]).

[12] In Italy, for example, three nodes are located, which are managed by Infratel (an in-house company of the Ministry of Economic Development), INPS (social security authority) and the Polytechnic University of Milan.

[13] The official name is public city node. Although the term "node" is used, it is not to be confused with the concept of node used to describe blockchain networks. The term used in the project refers to cloud-computing data centres that provide storage and computing power. In other words, the public city node is not a blockchain node, and the service network itself is not a blockchain infrastructure. (Blockchain Service Network Development Alliance, 2020[60]).

[14] *Functional equivalence* allows to establish equivalence between an object already within the realm of a legal rule and another object not yet encompassed by it. Through functional equivalence the "means" by which a regulated activity will be considered as compliant with the law can be broadened (e.g. an electronic signature that complies with specific requirements is held to be functionally equivalent to a qualified signature). *Regulatory equivalence* allows to establish equivalence between the function of a legal rule and the function of a technology. Through regulatory equivalence the realm of "activities" for achieving a policy objective of any given law can be broadened, as some technology can have features that automatically comply with the policy objective (e.g. publicity of information, which in the case of open blockchains is intrinsically achieved).