



Cross-boundary Payment and Settlement Systems in the Greater Bay Area

Current Practices and Recent Developments

March 2023

Hong Kong Institute for Monetary and Financial Research
HKIMR Applied Research Report No.1/2023



Contents

	Pages
Foreword	2
Acknowledgements	3
Executive Summary	4
Chapter 1 Financial Integration in the Greater Bay Area (GBA) Hong Kong serves as a super-connector between the Mainland and international financial markets	7
Chapter 2 Overview of Payment and Settlement Systems Current status and challenges in international markets	13
Chapter 3 Cross-boundary Payment and Settlement Linkages Between Hong Kong and the Rest of the GBA Emerging technologies provide opportunities to strengthen financial connectivity	22
Chapter 4 Views from Market Participants in Hong Kong Our survey reveals a sustained interest in the GBA despite the challenges	34
Chapter 5 Reaping the Benefits of Financial Integration in the GBA Considerations towards a closer financial integration	44
Conclusions	50
Appendix A: Background of the GBA Survey	52
Appendix B: List of Abbreviations	53
Appendix C: Glossary of Technical Terms	55
Appendix D: References	57

Foreword

The Guangdong–Hong Kong–Macao Greater Bay Area (GBA) is composed of Hong Kong, Macao, and nine cities along the Pearl River Delta. With a population of more than 85 million and a combined gross domestic product of more than US\$1.6 trillion, the GBA is economically vibrant and provides Hong Kong’s financial services industry with an enormous potential to expand its businesses by taking advantage of the area’s vast market and pilot liberalisation initiatives, such as the Wealth Management Connect scheme. To foster financial connectivity within the GBA, it is important to understand the financial services industry’s current challenges, including those related to cross-boundary payment and settlement systems, and develop feasible solutions.

Recently, emerging technologies such as artificial intelligence and blockchain have prompted profound changes in the financial services industry. The Hong Kong Monetary Authority has launched a ‘Fintech 2025’ strategy, which aims to encourage the financial services industry to comprehensively adopt emerging technology by 2025 and to promote the provision of fair and efficient financial services for the benefit of Hong Kong. Some of these technologies could also reshape cross-boundary payment and settlement systems and promote financial development in the GBA.

This report examines the current status of cross-boundary payments and settlements within the GBA and provides an overview of recent developments in Hong Kong’s financial market infrastructure and in business opportunities in the GBA. Emerging financial technologies, including the Faster Payment System, Open Application Programming Interface for the banking sector, and digital identity, are

highlighted as useful approaches for improving the efficiency and quality of cross-boundary payments and settlements. Multilateral arrangements such as the mBridge and various cross-boundary investment schemes are also emphasised as important channels to increase the connectivity of financial markets. This report also discusses the results of a survey and interviews commissioned by the Hong Kong Institute for Monetary and Financial Research (HKIMR), which investigates market participants’ current practices and shows that the majority of the surveyed financial institutions highlighted the essentiality of cross-boundary payment and settlement systems in supporting their GBA outreach activities. The report concludes with considerations for facilitating cross-boundary payments and settlements in the GBA in both technology and non-technology-related areas in the face of major challenges.

By illustrating the importance of cross-boundary payment and settlement systems in the GBA and highlighting benefits and challenges shared by market participants and the implications of emerging technologies, we hope that this report provides useful insights that help the financial services industry and regulators in Hong Kong to further deepen financial integration in the GBA.

Mr Kwok-Chuen Kwok

Executive Director

Hong Kong Institute for Monetary and Financial Research

Chief Executive Officer

Hong Kong Academy of Finance

Acknowledgements



This report has greatly benefitted from the contributions of various external collaborators. We thank the Financial Services and the Treasury Bureau, the Insurance Authority, the Mandatory Provident Fund Schemes Authority, and the Securities and Futures Commission, and various departments and divisions of the Hong Kong Monetary Authority, including the External Department, the Financial Infrastructure Development Division, the Fintech Facilitation Office, the Hong Kong FMI Services Limited, and the Communications Division for their comments and suggestions. We are also grateful for our collaboration with PricewaterhouseCoopers Limited in designing and administering a survey entitled *Cross-boundary payments and settlements for a closer integration within the Greater Bay Area* from July to October 2022, and in conducting interviews with various market participants, including banks, insurers, and asset managers. Finally, we thank the HKIMR Council of Advisers for Applied Research for their continued support for and guidance of the research activities of the Institute.

Executive Summary

The Guangdong–Hong Kong–Macao Greater Bay Area (GBA) has been recognised for its strategic importance in supporting the growth and opening-up of the Mainland economy. Deepening financial integration within the GBA is essential for maximising the area’s advantage in supporting the country’s further development, and such integration is contingent on the establishment of a set of well-functioning payment and settlement channels to facilitate trade and capital flow across the boundary. By taking stock of current developments in cross-boundary payments and settlements, we aim to identify their associated challenges and consider how these may be mitigated by emerging technologies.

The report begins with an overview of the development of the GBA and various cross-boundary investment schemes, and explains why appropriate cross-boundary payment and settlement channels are key to financial integration in the area. It then offers a general introduction to payment and settlement systems, their linkages across boundaries, and associated challenges. It also describes Hong Kong’s payment and settlement systems, their cross-boundary linkages, and how they can be supported by emerging financial technologies. Moreover, based on a survey and interviews commissioned by the Hong Kong Institute for Monetary and Financial Research (HKIMR), it presents local financial institutions’ views on the challenges of cross-boundary payments and settlements and how these challenges can be mitigated using technologies and related initiatives. The report concludes by offering some considerations for facilitating cross-boundary payments and settlements and deepening financial integration within the GBA.

Benefitting from financial integration in the area, financial institutions in Hong Kong and

the rest of the GBA have significant opportunities to expand their cross-boundary financial services, which needs the support of appropriate payment and settlement channels.

The increasing popularity of cross-boundary investment schemes, such as Wealth Management Connect, Bond Connect, and Stock Connect, not only demonstrates the growing connectivity of Mainland and Hong Kong financial markets but also suggests there is rising demand for the establishment of efficient and secure channels that connect payment and settlement systems across the boundary.

Payment and settlement systems are a collection of arrangements that facilitate the transfer of funds and financial assets.

At the front end, payment systems handle the transfer of small-value funds among individuals and corporations. At the back end, settlement systems process the clearing and settlement of large-value payments among banks and other financial intermediaries. Payment and settlement systems from different jurisdictions are interconnected, which allows for financial transactions across boundaries. Commonly referred to as financial market infrastructure, these systems are crucial for maintaining the healthy functioning of the financial services industry, and their cross-boundary linkages are key to facilitating international trade and capital flow.

International studies identify common challenges associated with the use of cross-border payment and settlement channels.

The primary challenges are the high costs and low speed of transferring funds across borders, limited accessibility, and insufficient transparency about the status and outcome of fund transfers. These challenges may influence both service providers,

such as banks and asset managers, and end-users, such as individuals and corporations. Some of the root causes of these challenges are fragmented data and technology standards, legacy infrastructures, and long transaction chains.

Hong Kong has developed a set of multi-currency and multi-dimensional payment and settlement systems that are connected with the financial market infrastructures of other GBA cities to support cross-boundary financial services. At the front end, financial service providers have implemented various retail payment methods within the GBA. For instance, a cross-boundary electronic bill payment service allows customers in Hong Kong to make bill payments to merchants in Guangdong. At the back end, cash settlement systems in Hong Kong, namely Clearing House Automatic Transfer Systems (CHATS), are linked with the rest of the GBA to settle cross-boundary remittances. These linkages guarantee the smooth exchange of goods and services across the boundary.

Emerging technologies are being adopted to enhance Hong Kong's financial market infrastructure and strengthen financial integration within the GBA. These technologies include blockchain, artificial intelligence (AI)/Big Data (BD) technologies, digital identity technologies, electronic wallets, and data-sharing techniques. For example, blockchain can improve cross-boundary financial services by ensuring the accuracy and traceability of recorded data. E-wallets are a low-cost technology that increase the accessibility of cross-boundary payments, and some Hong Kong-based e-wallets can now be used for shopping and dining in Mainland GBA cities.

Over 90% of surveyed financial institutions in Hong Kong highlighted the importance of cross-boundary payment and settlement channels to their GBA outreach activities.

According to a survey commissioned by the HKIMR and conducted from July to October 2022, most of the surveyed banks, insurers, and asset managers intended to expand their involvement in cross-boundary investment schemes in the next 2 to 3 years. This demonstrates the essentiality of cross-boundary payment and settlement channels in supporting financial institutions' outreach activities within the GBA going forward.

The survey respondents reported experiencing various technology- and non-technology-related challenges when delivering cross-boundary financial services. On the technology side, the respondents noted that some cross-boundary financial transactions are still processed manually using traditional and paper-based methods, which reduces efficiency and increases the probability of errors. In addition, some respondents also mentioned that diverse standards in messaging formats and communication protocols, together with different data-sharing arrangements, prevent efficient and seamless cross-boundary information transmission. On the non-technology side, some of the respondents noted that different regulatory requirements have increased the complexity of their financial service offerings in the GBA. They also noted that risk management related to anti-money laundering (AML)/counter-financing of terrorism (CFT) checks in the cross-boundary context differed from those in the domestic context, and that there are bottlenecks related to limitations on cross-boundary investment quotas and remittances.

Digital ID, Open Application Programming Interface (API), and AI/BD technologies are the three most relevant technologies that the respondents identified as having the potential for improving payment and settlement processes in the GBA. The respondents remarked that the adoption of digital ID could improve the process of remote on-boarding and account opening by reducing the compliance costs of AML/CFT checks. The respondents also foresaw that Open API would facilitate the exchange of information and the execution of instructions for cross-boundary payments and settlements. Furthermore, they believed that AI/BD technologies had strong potential to address existing challenges, such as by streamlining compliance checks, detecting harmful activities, and improving risk management.

By taking stock of market perspectives and the experience of other jurisdictions, this report offers several considerations for facilitating cross-boundary payments and settlements. These include technology-related strategies, such as improving the functionality of payment and settlement infrastructures, promoting the adoption of emerging technologies, and encouraging the implementation of data-sharing arrangements. Non-technology-related strategies include fostering communication between regulators and the industry and expanding the accessibility of financial services across the boundary. Going forward, these considerations may contribute to further deepening of financial integration within the GBA.

Chapter 1

Financial Integration in the Greater Bay Area (GBA)

Hong Kong serves as a super-connector between the Mainland and international financial markets

HIGHLIGHTS:

- Financial integration within the GBA provides the financial services industry with new investment opportunities.
- Through a series of cross-boundary investment schemes, Mainland financial markets are opening up gradually and prudently, while global investors can continue to operate within their familiar legal and regulatory frameworks, market practices, and languages.
- The rising popularity of these investment schemes suggests an increased demand for efficient and secure cross-boundary payments and settlement channels going forward.

1.1. OVERVIEW OF THE GREATER BAY AREA

The Guangdong-Hong Kong-Macao Greater Bay Area (GBA) is composed of the two Special Administrative Regions of Hong Kong and Macao, and nine municipalities in Guangdong province (Guangzhou, Shenzhen, Zhuhai, Foshan, Huizhou, Dongguan, Zhongshan, Jiangmen, and Zhaoqing), as shown in Chart 1.1. The GBA has witnessed the reform and opening-up of the Mainland economy since the late 1970s and supported the strong economic growth in Mainland China for more than four decades.

In July 2017, the National Development and Reform Commission and the governments of Guangdong, Hong Kong, and Macao signed the 'Framework Agreement on Deepening Guangdong-Hong Kong-

Macao Cooperation in the Development of the Greater Bay Area' in Hong Kong.¹ This Framework Agreement specifies the important cooperation areas in the development of the GBA and establishes collaboration goals. Since then, the development of the GBA has been designated as a key strategic planning priority in national development blueprint, with significant implications for national implementation of innovation-driven development and commitment to reform and opening-up.

Since then, a series of policy papers have been issued by the Central People's Government to support the economic development and financial integration in the GBA. The promulgation of 'Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area' in February 2019 aims to promote greater cooperation within the GBA region. It confirms and supports Hong Kong's status as an international

Chart 1.1: Map of the GBA



Source: iStockphoto.

¹ National Development and Reform Commission, People's Government of Guangdong Province, Government of the Hong Kong Special Administrative Region & Government of the Macao Special Administrative Region (2017).

financial centre, a global offshore Renminbi (RMB) business hub, and an international asset and risk management centre. The promulgation of “Opinion on Providing Financial Support for the Development of the Greater Bay Area” in May 2020 supports promoting further financial liberalisation and innovation, deepening financial cooperation between the Mainland, Hong Kong and Macao, and elevating the role of the GBA in supporting and leading the country’s development and opening up.

Table 1.1 compares the GBA to other established bay areas with global economic significance, namely the San Francisco Bay Area, the New York Metropolitan Area, and the Tokyo Bay Area. The GBA outnumbers the other bay areas in terms of both land area and population, indicating that the GBA has a distinct advantage in the production factors that are essential for supporting economic growth. Moreover, as the GBA is ranked third in terms of gross domestic product (GDP), there is a large potential for economic development in the region going forward.

Table 1.1: Statistics of the world’s major bay areas

	GBA	San Francisco Bay Area	New York Metropolitan Area	Tokyo Bay Area
Land area (square kilometres)	56,098	17,887	17,312	36,898
Population (million)	86.70 ¹	7.76 ²	19.26 ²	44.37 ¹
GDP (US\$ billion) ⁴	1,668.86 ²	1,016.42 ²	1,809.32 ²	1,991.64 ³

Sources: The Hong Kong Trade Development Council and HKIMR staff compilation.

Note: ¹ 2021 figure; ² 2020 figure; ³ 2019 figure; ⁴ At 2021 market prices and converted using the yearly average exchange rates.

As a mature and leading international financial centre, a global offshore RMB business hub, and an international asset and risk management centre, Hong

Kong plays a critical role in supporting the development of the GBA, and it serves as a super-connector between the Mainland and international financial markets. With its prudent and robust financial regulatory regime, Hong Kong’s economy has been closely connected to the Mainland development over the past four decades. As the Mainland economy continues to grow, Hong Kong has fully exploited its considerable advantages by contributing to national development. Going forward, there is great potential for Hong Kong’s financial services industry, including banks, asset managers, and insurers, to further benefit from vast market and pilot liberalisation initiatives while servicing the burgeoning economic development within the GBA.

1.2. CROSS-BOUNDARY INVESTMENT SCHEMES

Against the background of the internationalisation of the Mainland capital markets, a series of cross-boundary² investment schemes have been implemented between Hong Kong and Mainland China. These schemes provide offshore investors with access to investment opportunities in Mainland China and onshore investors with access to international markets.

From a theoretical standpoint, these schemes increase the connectivity of financial markets and offer market participants additional channels to manage their portfolios and meet their investment needs. They also improve capital allocation efficiency, which benefits both Hong Kong and Mainland China. Through these investment schemes, Mainland investors can benefit from Hong Kong’s critical mass of liquidity, product diversity, world-class financial services and competitive financial infrastructure, and international investors can capture opportunities in the vibrant Mainland China markets while continuing to operate using their familiar legal and regulatory frameworks, market practices and languages.³

² Throughout this report, ‘Cross-boundary’ activities (e.g., investments and financial transactions) refers to activities conducted across the boundaries of jurisdictions within the GBA, whereas ‘cross-border’ activities refer activities conducted across country borders.

³ HKMA (2020a).

Table 1.2: Timeline of cross-boundary investment schemes

Year	Events
2002	Qualified Foreign Institutional Investor (QFII)
2006	Qualified Domestic Institutional Investor (QDII)
2011	RMB Qualified Foreign Institutional Investor (RQFII)
2014	Shanghai-Hong Kong Stock Connect
2015	Mainland-Hong Kong Mutual Recognition of Funds (MRF)
2016	China Interbank Bond Market Direct Shenzhen-Hong Kong Stock Connect
2017	Northbound Trading under the Bond Connect
2020	Qualified Foreign Investor
2021	Wealth Management Connect (WMC) Southbound Trading under the Bond Connect
2022	ETF Connect Swap Connect (announced)

Source: HKIMR staff compilation.

The initial opening-up of the Mainland capital markets and the early integration between Mainland China and Hong Kong's financial services industries took place in the early 2000s, with the introduction of the Qualified Foreign Institutional Investor, RMB Qualified Foreign Institutional Investor, and Qualified Domestic Institutional Investor schemes, which provided qualified offshore and onshore financial institutions with the opportunity to invest in onshore and offshore financial markets, respectively. There were several restrictions regarding investor eligibility and quota requirements. The second batch of schemes which was launched in mid 2010s included Stock Connect, Northbound Trading under Bond Connect, and the Mainland-Hong Kong Mutual Recognition of Funds (MRF) and China Interbank Bond Market Direct schemes, which increased the range of financial products available to a wider base of investors. The launch of these schemes deepened the internationalisation of the Mainland capital markets and financial cooperation between Hong Kong and the Mainland. More recently, additional investment schemes that have launched or are currently in the pipeline include the Qualified Foreign Investor, Wealth Management Connect (WMC), Southbound

Trading under the Bond Connect, ETF Connect, and the Swap Connect schemes. These investment schemes strengthen financial integration within the area over time (Table 1.2).

Meanwhile, the scope of these investment schemes has been progressively expanded over the past two decades in terms of the eligibility of investors, the availability of financial products, and the relaxation of investment quotas. The pool of eligible investors has gradually broadened from institutional investors to include retail investors. The financial instruments that are tradeable through these schemes have been extended from traditional securities, such as equities, to more sophisticated financial instruments that may be traded on over-the-counter (OTC) markets, such as swap contracts. Investment quotas are also gradually relaxed over time. These trends mark a gradual and prudent approach to increasing the connectivity of the two financial markets and the interaction of the financial services industries between Mainland China and Hong Kong while maintaining the stability of the Mainland financial markets.

1.3. IMPROVING CROSS-BOUNDARY PAYMENT AND SETTLEMENT CHANNELS TO SUPPORT FINANCIAL INTEGRATION WITHIN THE GBA

To further strengthen financial integration within the GBA, it is important to ensure that appropriate cross-boundary payment and settlement channels are in place.

Past trends suggest that, there has been a sustained increase in financial transactions over time after a cross-boundary investment scheme launched. In fact, a consistent growth in the buying of equities and holding of bonds through the Stock Connect and Bond Connect schemes occurred over the past decade.⁴ Besides, growth has also been observed for the number of participants who joined the WMC scheme since its launch in 2021.⁵ Overall, these trends suggest a greater demand for efficient and secure cross-boundary payment and settlement channels going forward.

Furthermore, several features of the investment schemes described above have implications for the design and operations of cross-boundary payment and settlement channels. For example, many of the cross-boundary investment schemes, adopt a closed-loop approach to managing cross-boundary funds flows. Under this approach, investors must open one bank account with a cross-boundary remittance function in their place of residence and one bank account with an investment function in the other jurisdiction. These accounts must be paired to ensure that the dedicated remittance account can serve as the sole source and destination of investment funds. The well-functioning of the closed-loop approach must be underpinned by appropriate settlement systems, which ensure that the dedicated remittance

and investment accounts are correctly matched and the cash settlement in the remittance account and the securities settlement in the corresponding investment accounts are executed consistently.

As another example, some investment schemes, such as the MRF, require participants to meet the eligibility requirements set by the relevant regulators in the host jurisdiction while operating in accordance with the laws and regulations in the home jurisdiction. The cross-boundary payment and settlement channels must be operated in a way that complies with the relevant regulations and facilitates the smooth flow of information across the boundary.

A set of efficient and robust cross-boundary payment and settlement channels is also fundamental for containing the common types of financial risks borne by these investment schemes. By their nature, cross-boundary investments are particularly vulnerable to liquidity risk, which arises from the uncertainty of depositing or withdrawing funds in a timely manner. For example, the financial transaction under some cross-boundary investment schemes may take more than one day to settle, which may delay the flow of funds and subsequently create settlement timing risk. Although this may provide investors with more flexibility in liquidity arrangement need, this problem may become systemic if cross-boundary payment and settlement systems are not resilient enough to withstand the negative impact associated with the settlement timing risk.

A set of efficient and robust cross-boundary payment and settlement channels is fundamental for containing the common types of financial risks carried by investment schemes.

⁴ For more information, refer to the HKMA's half-yearly monetary and financial stability report and the HKEX's report on the RMB bond primary market: Access channels and new initiatives.

⁵ See also an introduction to the latest development of the WMC (<http://guangzhou.pbc.gov.cn/guangzhou/129196/4332364/index.html>).

Well-established cross-boundary payment and settlement channels also provide further benefits. For example, the public health policies introduced since the onset of the COVID-19 pandemic have affected the transportation of people and goods within the GBA. The existence of flexible payment and settlement systems might have helped relieve physical constraints and support economic recovery. On an unrelated matter, the close monitoring of payment and settlement activities is essential for customer due diligence, which is key to reducing the risk of fraud and strengthening anti-money laundering (AML)/counter-financing of terrorism (CFT) measures across the boundary. Furthermore, efficient and secure cross-boundary payment and settlement systems facilitate trade and trade finance within the GBA.

Given the considerations discussed above, it is beneficial to continuously improve the cross-boundary financial infrastructure, with the aim of

lowering maintenance costs, boosting payment and transaction speed, streamlining clearing and settlement procedures, increasing information-processing capacity, ensuring seamless flows of information across the boundary, and maintaining efficiency and security throughout the process. In particular, cutting-edge financial technologies could be leveraged to strengthen the systems and address their associated challenges in a variety of ways.

The following chapters provide a general introduction to international payment and settlement systems, especially those that facilitate cross-boundary financial transactions and present the current state of Hong Kong's financial market infrastructure, including its various cross-boundary payment and settlement channels. They also discuss how innovative technology solutions can help address the challenges facing cross-boundary payment and settlement channels and support financial integration within the GBA.

Chapter 2

Overview of Payment and Settlement Systems

Current status and challenges in international markets

HIGHLIGHTS:

- Payment and settlement systems are financial market infrastructures that facilitate the transfer of funds and financial assets. They serve as the foundation of the financial services industry.
- Payment and settlement systems can be divided into three categories according to the function they serve: cash payment systems, cash settlement systems, and securities settlement systems.
- Cross-border payment and settlement channels play a vital role in facilitating international trade and capital flows. The majority of cross-border cash payments and settlements are supported by correspondent banks.
- The four challenges to cross-border payments and settlements internationally are represented by high cost, low speed, limited access, and insufficient transparency. Some of the root causes of these challenges include fragmented data and technology standards, legacy infrastructures, and long transaction chains.

To understand how cross-boundary payment and settlement channels work within the GBA and how emerging technology solutions may support these cross-boundary linkages, it is essential to have a broad understanding of payment and settlement systems, how they are linked together across borders internationally, and what major obstacles hamper cross-border payments and settlements. To provide that understanding, this chapter presents an overview of domestically operated payment and settlement systems, along with the channels that connect payment and settlement systems across the border and their associated challenges.

2.1. PAYMENT AND SETTLEMENT SYSTEMS

Payment and settlement systems are a collection of arrangements that facilitate the transfer of funds and financial assets. Commonly referred to as financial market infrastructures or financial market utilities, these systems are critical for maintaining the healthy functioning of the financial services industry, and they are fundamental to financial stability and economic development.

Payment and settlement systems are critical for maintaining the healthy functioning of the financial services industry, and they are fundamental to financial stability and economic development.

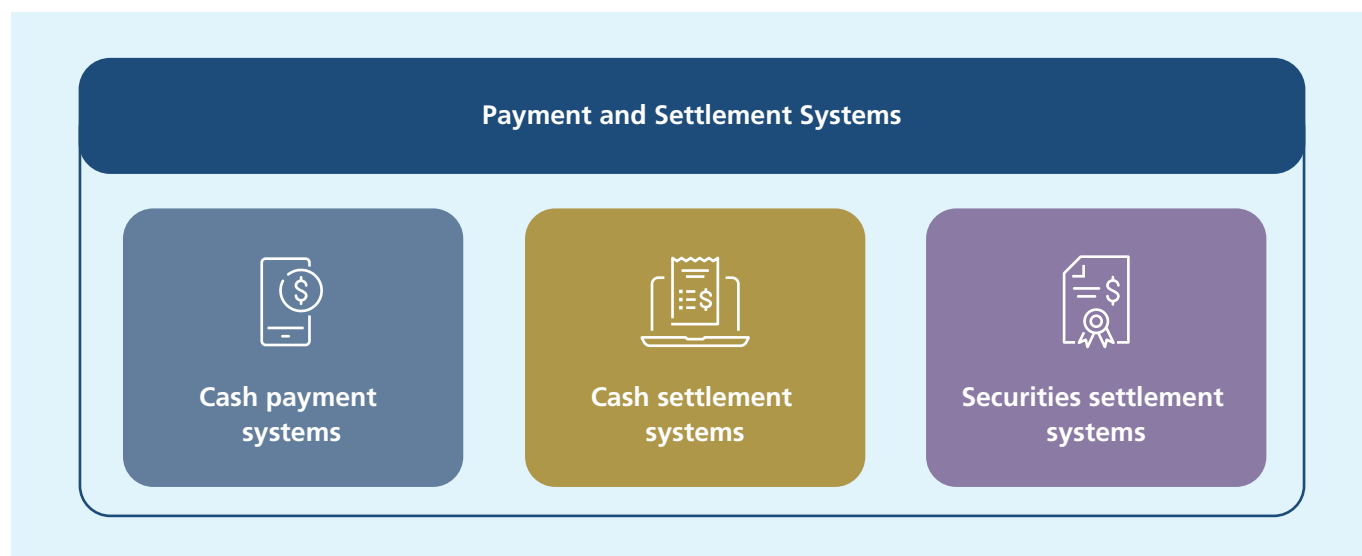
The transfer of funds or financial assets in these systems consists of two main steps: clearing and settlement. After a transaction is initiated, its details are reconciled and transmitted to a payment and settlement system for confirmation, a process known as clearing. This includes verifying that the relevant parties agree the terms of the transaction and have sufficient financial resources to meet their obligations. The clearing process is followed by the settlement process, which marks the final payment of funds or transfer of securities under the terms of the underlying contract, along with the discharge of the parties' obligations.⁶

Payment and settlement systems can be divided into three categories according to the function they serve: cash payment systems, cash settlement systems, and securities settlement systems (Chart 2.1).⁷

⁶ BIS-IOSCO (2012), Bech and Hancock (2020), and Bech et al. (2020).

⁷ The first two categories are named for the function that they serve (i.e., payment of cash and settlement of cash). Alternatively, they can be named for the size of funds they handle: retail payment system and wholesale payment system.

Chart 2.1: Categories of payment and settlement systems



Source: HKIMR staff compilation.

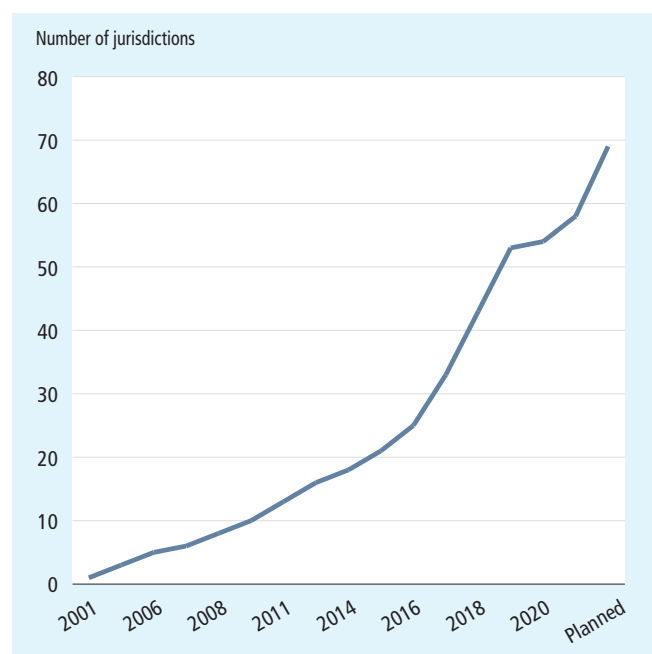
2.1.1. Cash payment systems

Cash payment systems generate the transfer of funds through transactions originated by various payment methods, such as cash and cheques, as well as credit and debit cards. New electronic-based payment methods, such as stored-value facilities (i.e., prepaid cards and electronic wallets (e-wallets)), also gained popularity in recent years. On the front end, these systems facilitate small-value fund transfers that are usually associated with the exchange of goods and services. On the back end, payments are cleared and settled by cash settlement systems.

One notable trend in cash payment systems is the development of fast payment systems that features instant fund transfers on a 24-hours per day, 7 days per week (24/7) basis.⁸ Fast payment systems increase the efficiency and accessibility of retail payment services but may also bring new challenges to existing cash settlement systems. Since early 2000s, fast payment

systems have been deployed or are being developed in many jurisdictions. By 2021, 58 jurisdictions had adopted fast payment systems (Chart 2.2).⁹

Chart 2.2: Jurisdictions adopting fast payment systems



Source: BIS (2021b) and HKIMR staff compilation.

⁸ 'Fast payment systems' is a general term. These systems have been developed in many jurisdictions. For example, the fast payment system developed in Hong Kong is known as the 'Faster Payment System' or FPS.

⁹ BIS (2016b).

2.1.2. Cash settlement systems

Cash settlement systems facilitate the transfer of large-value payments among financial intermediaries. They are the essential back-end infrastructure that supports cash payments, fund transfers, and securities settlements. Instead of settling payments bilaterally between two financial intermediaries, most cash settlements are processed through a centralised settlement agent. To make the system work, all of the participating institutions maintain an account with a settlement agent and use the agent's liabilities as the settlement asset. This role is often performed by central banks, with the settlement asset being the local currency.¹⁰

Two main types of cash settlement arrangements have been developed. In deferred net settlement (DNS) systems, payments are accumulated and netted off throughout a business day or other settlement period, and the settlement of the net amount only takes place at the end of that period. In real-time gross settlement (RTGS) systems, payments are continuously settled in real-time, and funds are transferred on the gross value without being netted off. Compared with DNS systems, RTGS systems significantly reduce the settlement risk participants face, possibly at the cost of requiring participants to maintain sufficient liquidity to settle payment on the gross value of their transactions. Many jurisdictions have adopted hybrid cash settlement systems, which are mainly built on RTGS systems but have various liquidity-saving features to reduce liquidity requirements.

2.1.3. Securities settlement systems

Securities settlement systems (SSS) refer to the financial market infrastructures that enable the transfer and settlement of financial securities, such as equity, debt, and derivatives. Many SSS operate under the delivery-versus-payment (DvP) mechanism such that the delivery of a security occurs if and only

if the corresponding payment is completed, reducing the settlement risk in transactions.

Central securities depositories (CSDs) and central counterparties (CCPs) are the two main types of SSS. CSDs record the issuance, ownership, and transfer of securities, in addition to providing centralised safekeeping of those securities. CSDs facilitate financial transactions by dematerialising financial securities, in that financial securities only exist as book entries in CSDs' accounts and can be conveniently traded without touching their physical form. CCPs place themselves between the counterparties to financial transactions, essentially becoming the buyer to every seller and the seller to every buyer. If one participant defaults, a CCP can fulfil its obligation by first resorting to defaulting participant's resources and then covering any residual losses with non-defaulting participants' resources.

2.2. CROSS-BORDER PAYMENT AND SETTLEMENT CHANNELS

2.2.1. Cash payments and settlements

Cash payments and settlements sometimes involve counterparties residing in different jurisdictions. Sustained growth in international trade and capital flow has contributed to the significant demand for cross-border cash payments and settlements. Payments and settlements processed across the border are usually more complicated than those processed domestically due to the different data standards, time zones, regulatory frameworks, market infrastructures, and currencies in circulation across jurisdictions. At the same time, innovative technologies are being developed and cross-border collaborations are being performed to facilitate cross-border payments and settlements.

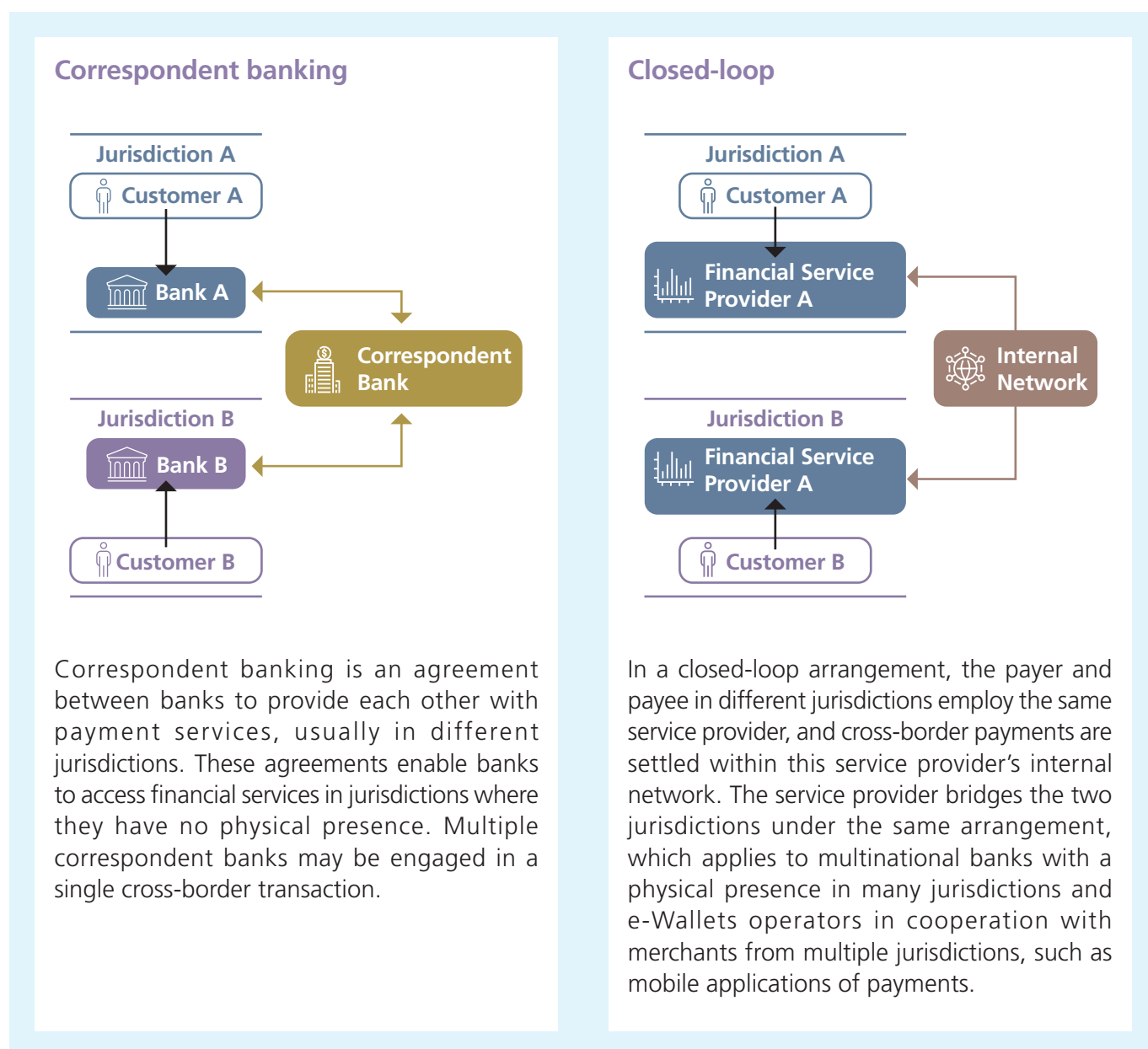
On the front end, cross-border cash payments are processed through channels that allow end-users to

¹⁰ Armour et al. (2016).

transfer funds across jurisdictions. Payment arises when, for instance, money is transferred to relatives or friends abroad, or goods are purchased from foreign merchants. A variety of methods is available, depending on the end-users' capabilities and requirements. For example, a payer may initiate an online payment through an Internet banking platform, and their payee may receive cash at a bank branch.

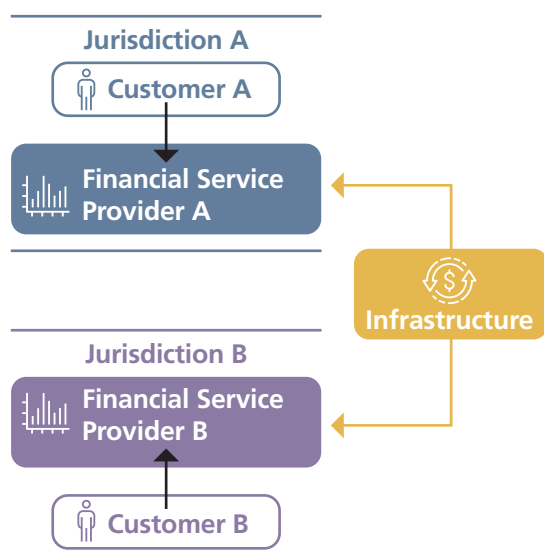
On the back end, international payments across borders are settled through one of the four models elaborated below: correspondent banking, closed-loop, infrastructure, and peer-to-peer arrangements (Chart 2.3). Correspondent banking is by far the most widely used model, but the use of other models is steadily increasing with support from emerging technologies and cross-border collaborations.¹¹

Chart 2.3: Cross-border cash settlement models



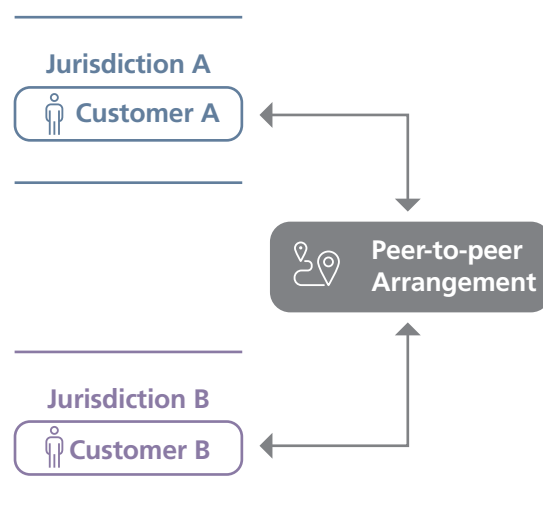
¹¹ BIS (2016a).

Infrastructure



Infrastructure refers to an arrangement in which a single cash settlement system operates in different jurisdictions, or in which cash settlement systems of different jurisdictions are linked together. This arrangement allows funds to be transferred from one jurisdiction to another within the same settlement system or through the linkages between the two systems.

Peer-to-peer



The peer-to-peer model refers to an arrangement in which one individual payer sends a payment to another individual payee without any involvement from financial intermediaries. Innovative technologies, such as blockchain, have created new applications that allow cross-border peer-to-peer payments to be settled and recorded in digital forms securely and efficiently.

Sources: HKIMR staff compilation.

2.2.2. Securities settlements

Cross-border securities settlement systems enable investors from foreign jurisdictions to trade financial securities in domestic financial markets, and vice versa. Apart from direct participation of foreign investors in domestic markets, two main settlement models have been developed over the years, namely custodian banking and infrastructure.

The most common channel for foreign investors to trade domestic securities is through custodian banks,

who have direct access to domestic CSDs. These custodian banks provide non-residents with various forms of custody services, such as securities safekeeping, collection of interest and dividends, and processing of corporate actions. It is convenient to use the services provided by custodians, but the complex chain of indirect holding may increase the risks associated with cross-border transactions.

There are two types of infrastructure that enables foreign investors access to domestic securities: linkages between foreign and domestic CSDs (CSD-

to-CSD links) and the international CSDs (ICSDs). While CSD-to-CSD links connect the domestic CSDs of two jurisdictions together, ICSDs connect with dozens of domestic CSDs from multiple jurisdictions together. Compared with access through custodians, these two types of infrastructure reduce the length of chains that connect foreign investors and domestic securities.

2.3. INTERNATIONAL CHALLENGES IN CROSS-BORDER PAYMENTS AND SETTLEMENTS AND THEIR ROOT CAUSES

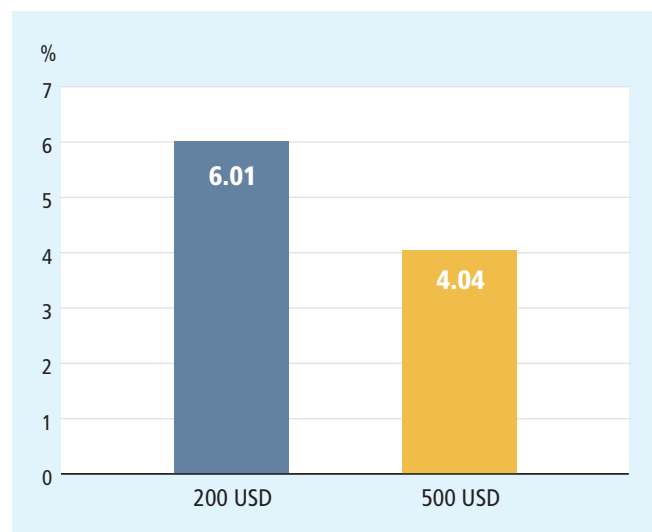
2.3.1. Four main challenges

Despite the continued increase in the volumes of payments and settlements across the border, various obstacles still hinder further improvements in the convenience, universality, efficiency, and transparency of cross-border payments and settlements worldwide. In turn, these obstacles hamper economic development and financial inclusion. This section discusses the four main challenges identified by the reports and studies from the Financial Stability Board (FSB) and other organisations as needing to be addressed to enhance cross-border payments and settlements worldwide.¹² The challenges are high cost, low speed, limited access, and insufficient transparency.

High cost: The challenge of high cost arises from various explicit and implicit costs that services providers and end-users must pay for their cross-border transactions internationally, including transaction fees, account fees, compliance costs, foreign exchange (FX) conversion fees, and liquidity costs for prefunding. For example, according to the World Bank, the average cost of international remittances of 200 and 500 US dollar (USD) in 2020

was 6.01% and 4.04% of the remittance amounts respectively (Chart 2.4).

Chart 2.4: Average costs of international remittance (200 and 500 USD)



Source: World Bank (2022) and HKIMR staff compilation.

Low speed: The challenge of low speed prevents the prompt execution of cross-border payments and settlements worldwide. Low speed may result from the existence of multiple intermediaries in a long payment and settlement chain or the lack of consistent data and technology standards. For example, cross-border payment transactions involving exchange of foreign currencies may take 48 hours or longer for a traditional corresponding bank settlement.

Limited access: The challenge of limited access includes limitations that prevent end-users in different jurisdictions globally from reaching payments and settlement services. These limitations result from various technical, financial, and institutional barriers. At this time, not all currencies are eligible to be settled in multilateral settlement systems.

¹² More details can be found in FSB (2020), BoC-BoE-MAS (2018) and Bindseil and Pantelopoulou (2022).

Insufficient transparency: This challenge refers to the high level of uncertainty about the status and outcome of international fund transfers and financial transactions across borders, which could pose additional challenges related to costs, speed, processing chains, and payment and settlement procedures for end-users and service providers. There is insufficient transparency about both the terms of the transaction, and the progress of the cross-border transactions.

2.3.2. Root causes of the main challenges

The challenges highlighted above are primarily driven by several root causes. Understanding these root causes is important to address the challenges discussed above, such as by applying the innovative technologies introduced in the following chapters (Chart 2.5).

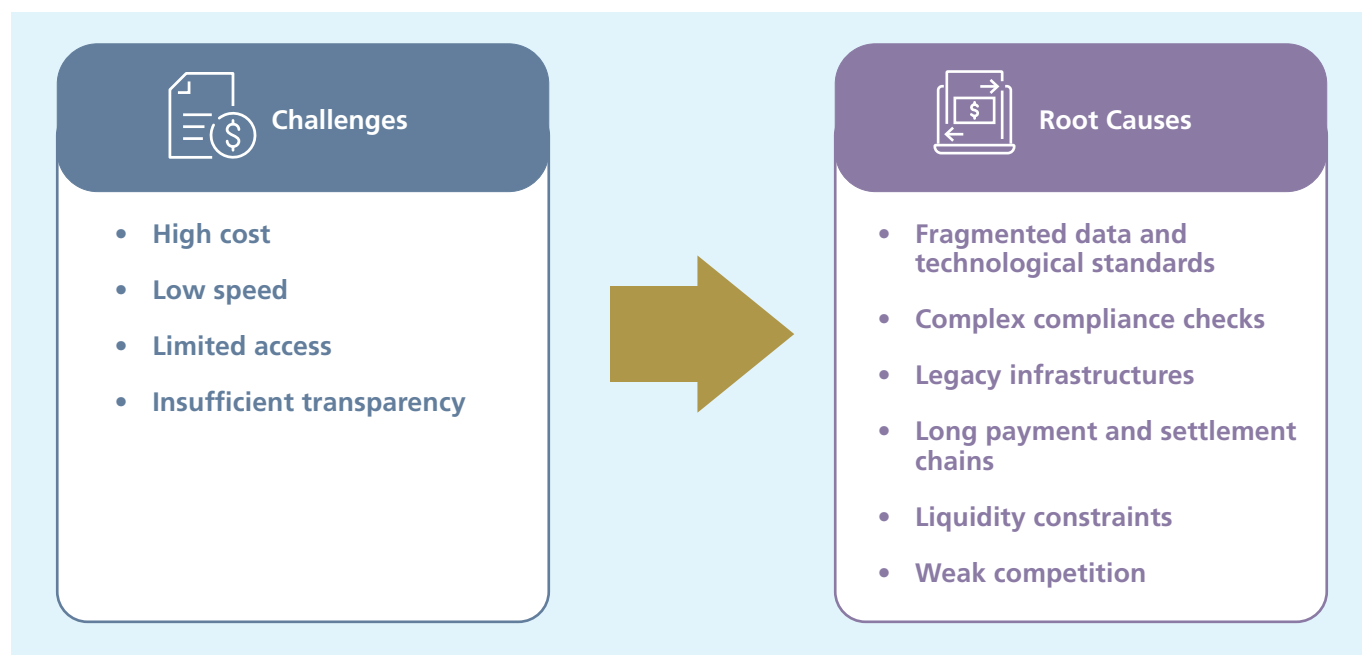
Fragmented data and technology standards

The data and technology standards adopted in different jurisdictions or infrastructures may vary substantially. This prevents the smooth and efficient transmission of information, and limits the transparency of the process as some information might be lost during the transmission. It also adds complexity to automating the payments and settlement processes. Furthermore, a complicated data transmission process may increase the likelihood of errors, creating even higher costs and delays for cross-border payments and settlements.

Complex compliance checks

Compliance checks for cross-border financial transactions are complex and resource-consuming because regulatory requirements for AML/CFT checks, data protection, and sanction screening vary across jurisdictions. Both service providers and end-users may need to spend time and effort on documentations, information verification, and validations to fulfil these requirements. These issues not only raise costs but also make the validation procedure prone to errors.

Chart 2.5: Mapping challenges to root causes in cross-border payments and settlements internationally



Source: FSB (2020) and HKIMR staff compilation.

Legacy infrastructures

Legacy technologies for cross border payment and settlement channels could be outdated or paper-based with a primary emphasis on the local market. The drawbacks of legacy systems, such as the lack of capacity to monitor and process transactions in real time, pose threats to the healthy functioning of cross-border payment and settlement channels. This problem leads to costs and delays in cross-border payments and settlements, constrains the accessibility of related services, and slows down the automation of transaction processes.

Long payment and settlement chains

Cross-border fund transfers largely depend on correspondent banks, which usually need at least two intermediaries to complete the payment or settlement procedure.¹³ The chain can become even longer if additional intermediaries are involved in the process. These lengthy and complicated execution chains increase the transaction costs for end-users. They also limit the speed and transparency of cross-border payments and settlements. Furthermore, these long chains create substantial uncertainty about the payment and settlement process, while increasing the credit risks and counterparty risks of the intermediaries involved in completing cross border payments and transactions.

These lengthy and complicated execution chains increase the transaction costs for end-users. They limit speed and transparency of transactions. The involvement of multiple intermediaries in the process elevates credit risk and counterparty risk.

Liquidity constraints

Funding and liquidity requirements for cross-border payments and settlements, especially for transactions involving the exchange of multiple currencies, could be an issue. To ensure the smooth processing of cross-border funds transfers and securities settlements, intermediaries may have to hold sufficient foreign currencies for precautionary funding, which would increase the overall transaction cost and risk exposure (including credit, market, and FX risks) borne by the stakeholders involved.

Weak competition

The high costs and risks discussed above may lead to significant entry barriers for intermediaries seeking to provide cross-border payment and settlement services. Insufficient transparency may also compound the difficulty of assessing the costs and benefits for providing their services. This problem reduces the incentives or even creates obstacles for the industry to upgrade existing market infrastructure and institutional arrangements.

¹³ For fund transfer through a correspondent banking model, it usually involves two correspondent banks. For securities settlement through custodian services, it involves at least a custodian bank and a CSD.

Chapter 3

Cross-boundary Payment and Settlement Linkages Between Hong Kong and the Rest of the GBA

Emerging technologies provide opportunities to strengthen financial connectivity

HIGHLIGHTS:

- Hong Kong has established multi-currency and multi-dimensional payment and settlement systems that handle real-time transactions in the Hong Kong dollar and major foreign currencies and also cover diverse financial intermediation channels including banking, equity and debt securities.
- Cross-boundary payment and settlement linkages have been established between Hong Kong and the rest of the GBA, and these channels facilitate the transfer of funds and financial assets within the area.
- Emerging technologies, such as blockchain, artificial intelligence (AI)/Big Data (BD) technologies, and data-sharing techniques, are increasingly used to support the modernisation of Hong Kong's financial market infrastructure and strengthen its financial integration within the GBA.

This chapter describes the existing payment and settlement systems linking Hong Kong to the rest of the GBA. It also provides a brief overview of emerging financial technologies and discusses their potential for improving cross-boundary payments and settlements in the area, with examples of their applications in Hong Kong.

3.1. PAYMENT AND SETTLEMENT SYSTEMS IN HONG KONG WITH ITS CROSS-BOUNDARY LINKAGES

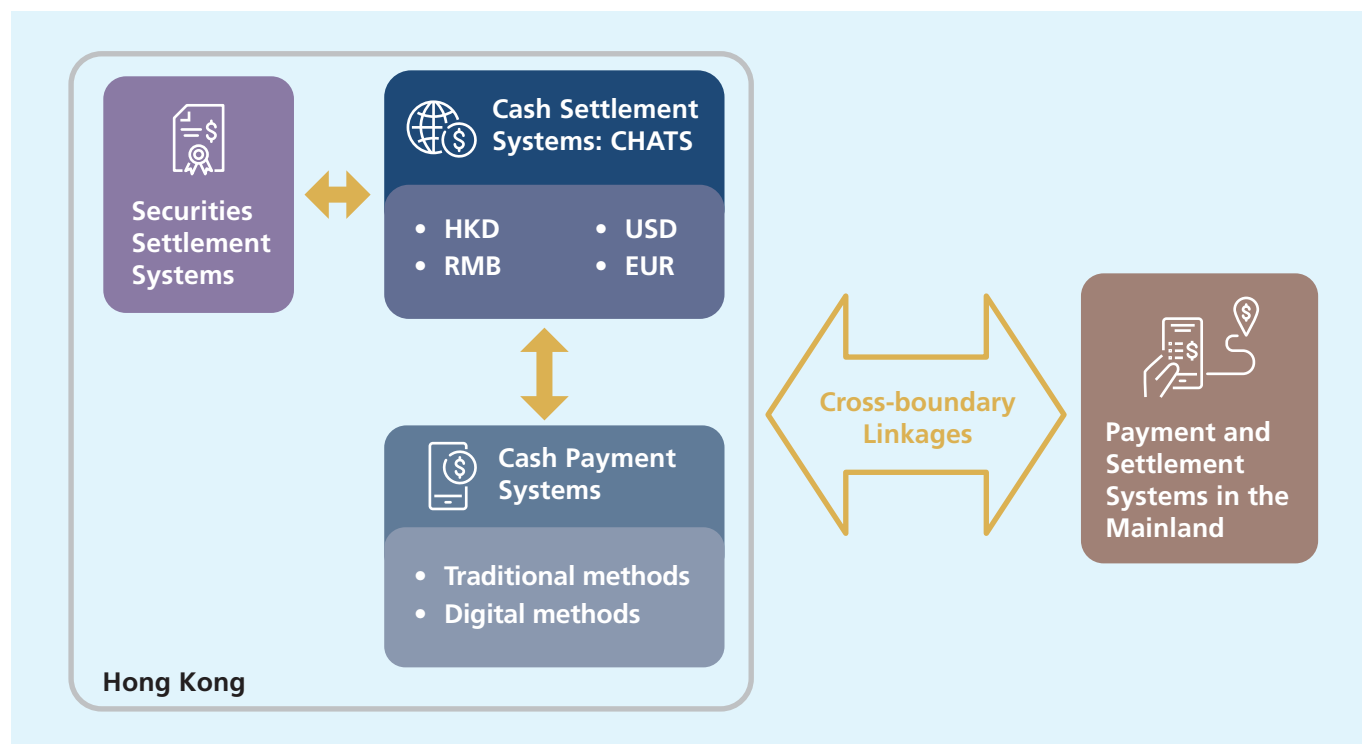
Chart 3.1 provides an overview of Hong Kong's payment and settlement systems and their linkages with the rest of Mainland China. The remainder of this section provides detailed explanations.

3.1.1. Cash payment systems

Cash payments in Hong Kong are made through traditional methods, such as cash, cheques, direct debits, credit cards, and debit cards, along with digital methods, such as, multi-purpose Stored Value Facilities (SVFs), Faster Payment System (FPS) and Electronic Clearing Services (ECGs),¹⁴ which include electronic bills (e-Bills), Autopay¹⁵ and electronic cheques (e-Cheques).

Significant features of Hong Kong's new payment methods are highlighted as follows. Multi-purpose SVFs are used to pay for a variety of goods or services or to make person-to-person payments. They include physical methods (e.g., the use of prepaid cards) and non-physical methods (e.g., the use of e-wallets). Octopus card is one example of

Chart 3.1: Cross-boundary payment and settlement linkages between Hong Kong and the Mainland



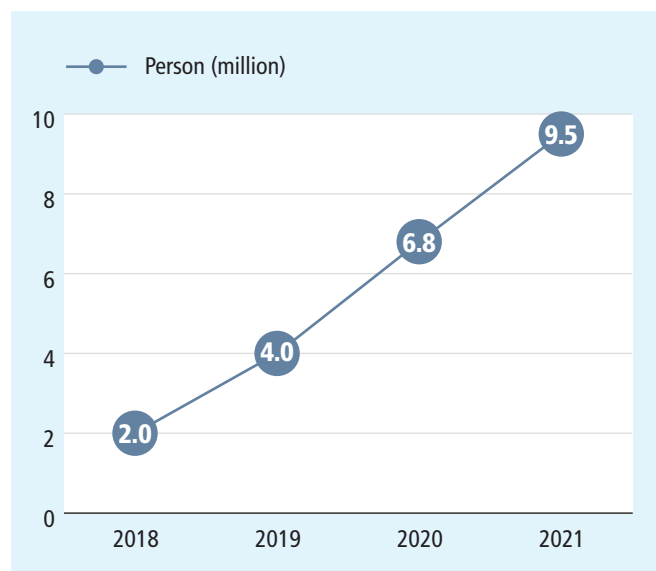
Source: HKIMR staff compilation.

¹⁴ ECGs are a service for clearing and settling various types of small-value electronic payments.

¹⁵ Autopay is to transfer money repeatedly to an account under users' authorization through a bank account or a credit card. For more information about Autopay, please refer to the following website: <https://www.hkma.gov.hk/eng/smart-consumers/autopay-services>

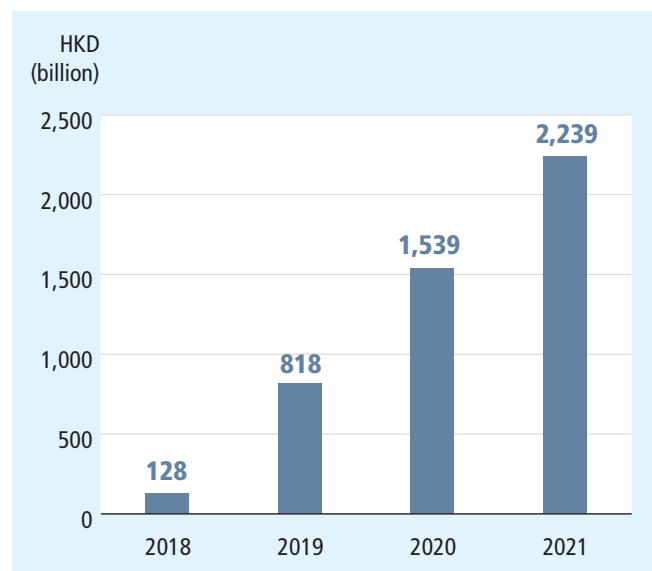
Chart 3.2: Development of FPS

(a) FPS Addressing Service Registrations



Sources: HKICL and HKIMR staff compilation.

(b) Turnover of FPS payment in HKD



those widely used physical SVFs. It was initially designed for paying public transportation fares but has over the years been extended for use in a wide range of non-transport-related applications. Non-physical SVFs allow people to store money and make payments mainly through smartphones and computers. Users simply need to tap their prepaid cards or scan their smartphones at the point of sale to complete the payment.

Introduced by the Hong Kong Monetary Authority (HKMA) in September 2018, the FPS supports instant payment in Hong Kong dollar (HKD) and RMB using mobile phone numbers, email addresses, Hong Kong Identity Card numbers, or FPS ID, and it achieves full connectivity among banks and SVF accounts. Payments made through the FPS are in real time on a 24/7 basis. As shown in Chart 3.2, the number of registrations has increased steadily from 2 million in 2018 to 9.5 million in 2021, while the turnover of the FPS payment in HKD has increased threefold.

The e-Cheques service, which was launched in December 2015, is an electronic counterpart of paper cheques and moves the writing and depositing

of cheques online. The Electronic Bill Presentment and Payment (EBPP) platform, which was launched in December 2013, is a multi-currency and multi-functional platform that enables users to receive, manage and schedule payments for e-Bills through their Internet banking accounts.

3.1.2. Cash settlement systems

Cash settlement is conducted by the Clearing House Automated Transfer System (CHATS), which is a set of RTGS systems in Hong Kong that handle large-value interbank transfers denominated in HKD, USD, Euro (EUR), and RMB. The HKD CHATS system, which was introduced in 1996, enables safe and efficient settlement of interbank payments denominated in HKD. In addition to settling large-value payments on a real-time and gross basis, the system handles the bulk clearing and settlement of cheques, equity market-related payments, and other small-value bulk electronic payments. Over the past decade, the daily average turnover value of HKD interbank RTGS payments in the CHATS has increased from approximately HKD 500 billion to more than HKD 900 billion (Chart 3.3).

To facilitate the settlement of other actively traded currencies, the USD, EUR, and RMB CHATS systems were launched in 2000, 2003, and 2007 respectively. Similar to their HKD counterpart, these systems process both large-value CHATS transactions and small-value bulk clearing items.

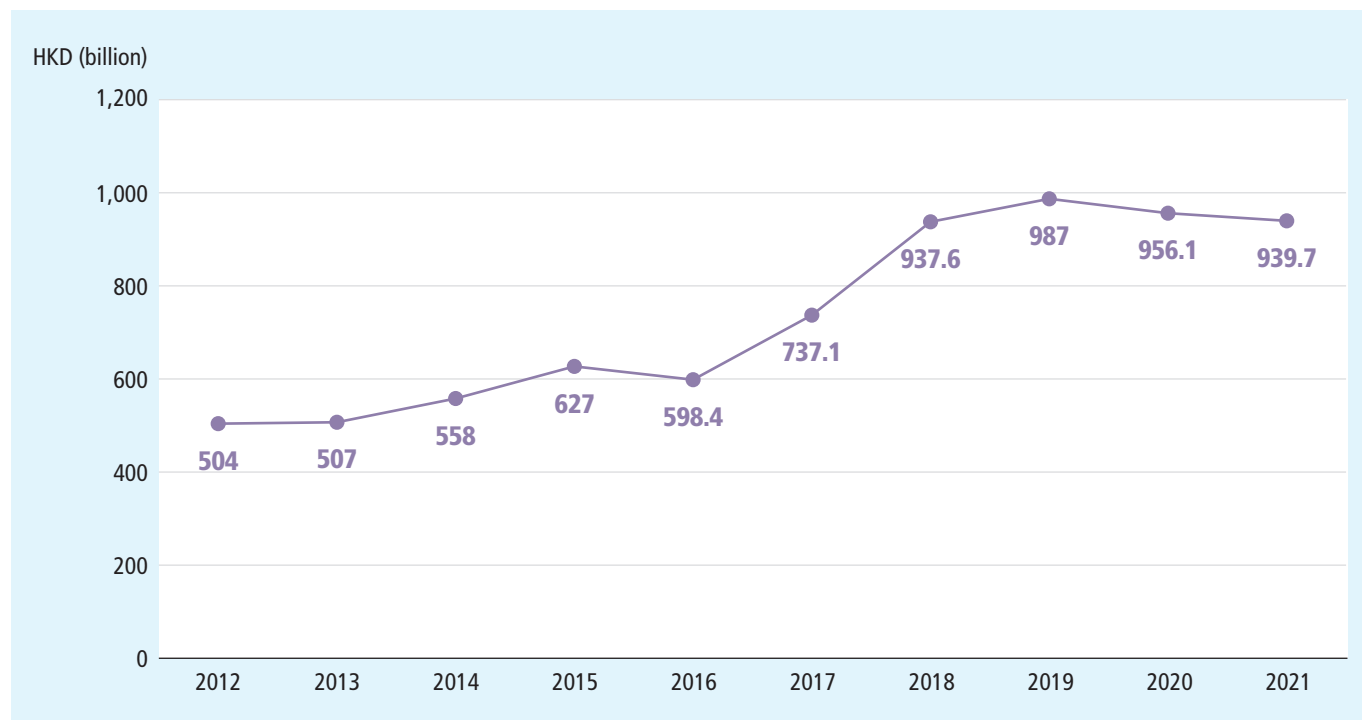
These four CHATS systems are interlinked to enable participants to settle foreign exchange transactions between any two currencies. This feature improves settlement efficiency and eliminates the settlement risk arising from time lags in transactions and from time-zone differences. The systems are also linked to SSS, such as the Central Moneymarkets Unit (CMU), to ensure that securities denominated in the respective currencies are settled on a DvP basis, in which payment follows the delivery of securities. For example, in the context of RMB settlements, the RMB CHATS turnover value has grown rapidly over the past decade. (Chart 3.4).

To ensure adequate liquidity for FPS payment transactions, a sweeping mechanism is in place to support banks' liquidity transfer between their CHATS and FPS accounts. Specifically, during the opening hours of the HKD CHATS, banks can transfer liquidity between their HKD CHATS and their FPS accounts. When the HKD CHATS closes, all of the remaining balances in the HKD CHATS account are automatically transferred to the HKD FPS account to provide liquidity for the HKD FPS.

3.1.3. Cross-boundary cash payment and settlement linkages

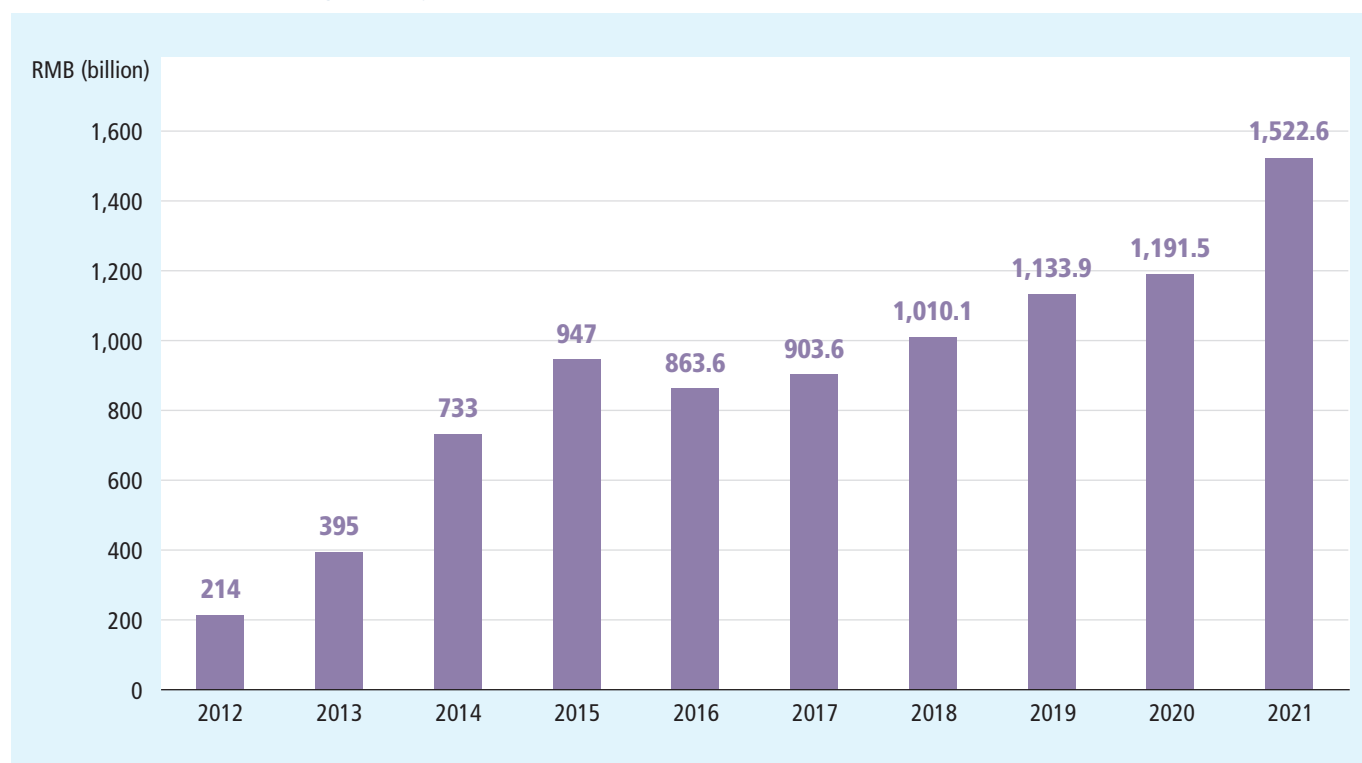
For cash payment systems, a joint e-Cheques clearing service has been implemented between Hong Kong and Mainland China. Under this arrangement, e-Cheques issued by banks in Hong Kong and deposited with banks in the Mainland are settled on the next business day. Moreover, there is a cross-

Chart 3.3: HKD average daily turnover in CHATS



Sources: HKICL and HKIMR staff compilation.

Chart 3.4: RMB average daily turnover in CHATS



Sources: HKICL and HKIMR staff compilation.

boundary EBPP between Hong Kong and Guangdong province, aiming to allow customers in Hong Kong to make bill payments in RMB to merchants in Guangdong province over the Internet or mobile banking platforms. In addition to e-Cheques and bill payment services, financial service providers have implemented various cross-boundary retail payment methods within the GBA. For example, some Hong Kong-based e-wallets can be used in Mainland GBA cities. The Hong Kong Octopus card is also accepted in Shenzhen.

For cash settlement systems, the CHATS systems are connected with their corresponding systems in Mainland China for settling fund transfers in various currencies. For settling payments and clearing cheques in RMB, the systems include the Cross-

border Interbank Payment System (CIPS), China National Advanced Payment System (CNAPS), and Shenzhen Financial Settlement System (SZFSS). It also includes the China Domestic Foreign Currency Payment System (CDFCPS) for settling cash payments in HKD, USD, and other major currencies. In addition to these linkages with the Mainland, there is a one-way joint facility established between Hong Kong and Macau for clearing cheques in HKD and USD.

Besides the cash payment and settlement systems discussed above, securities settlement systems are another important component that contributes to Hong Kong's financial infrastructure. A brief introduction to Hong Kong's securities settlement systems is provided in Box 3.1.

Box 3.1: Securities settlement systems in Hong Kong

This box introduces the securities settlement systems in Hong Kong, including its cross-boundary linkages. Two main systems process the settlement of securities in Hong Kong: the CMU and the CCASS.

The CMU, which is maintained by the HKMA, provides clearing, settlement, and custodian services for securities including Exchange Fund Bills and Notes, bonds, and debt securities. It also provides a standardised platform for processing investment fund transactions. Supported by a seamless interface between the CMU and the CHATS systems, the CMU system can provide its members with real-time DvP settlement services.

The Central Clearing and Settlement System (CCASS) is operated by the Hong Kong Securities Clearing Company Limited (HKSCC) for clearing and settling exchange trades of securities listed or admitted to trading on the Stock Exchange of Hong Kong (SEHK). The HKSCC acts as both a CSD and a CCP and there is an interface in CCASS linked in the CHATS system. It is conducted on a DvP basis. Exchange trades executed on SEHK are cleared and settled 2 days after the trade day (i.e., on a T+2 basis). The Derivatives Clearing and Settlement System (DCASS) and the OTC Clearing and Settlement System (OCASS) are the systems used for clearing and settling derivatives contracts traded in the exchanges and OTC markets, respectively.

Under the Bond Connect scheme, the CMU and two Mainland CSDs have opened nominee accounts in each other's systems. These CSD-CSD links enable Mainland investors to trade, hold, and settle debt securities in Hong Kong's bond market, and vice versa. Cross-boundary cash settlement is completed through CIPS. The CMU also provides a platform to issue debt securities in Hong Kong. Furthermore, under the MRF scheme, the CMU is linked with transfer agents and fund houses on the Mainland to facilitate cross-boundary investment fund order routing services.

Under the Stock Connect scheme, the HKSCC, the operator of the CCASS in Hong Kong, and the corresponding operator providing settlement services for the Shanghai and Shenzhen Stock Exchanges in Mainland China have opened securities accounts in each other's system. Southbound Trading is settled in the CCASS, and Northbound Trading is settled in the corresponding Mainland CSDs following the settlement procedure in the corresponding local markets.

The Swap Connect scheme upon launch will allow overseas investors to participate in the onshore interest-rate swap market during the initial stages of Northbound Trading. A system linkage is expected to be built between the OCASS, operated by a subsidiary of the Hong Kong Exchanges and Clearing Limited and by the Shanghai Clearing House, for settling OTC derivatives transactions.

3.2. EMERGING TECHNOLOGIES TO SUPPORT CROSS-BOUNDARY PAYMENTS AND SETTLEMENTS IN HONG KONG

This section provides a brief overview of the emerging financial technologies that can potentially support cross-boundary payments and settlements in the GBA, including the blockchain, AI/BD technologies, data-sharing techniques, digital identity (digital ID), and e-wallets. These technologies have been researched by local financial regulators and related applications have been implemented to support the modernisation of Hong Kong's financial market infrastructure and strengthen financial integration within the GBA (Table 3.1).

3.2.1. Blockchain

A ledger system is a collection of financial accounts that records asset ownership, financial transactions, or contract agreements. Traditionally, it is maintained

by a central organisation. The invention of blockchain allows information to be accessed simultaneously, validated and updated across a network spread across multiple entities or locations without the need of a central organisation. The information stored using blockchain is permanent, unalterable, and can be traced to the original source. The transparency and traceability of blockchain records are conducive to cross-boundary payments and settlements.

Blockchain can facilitate cross-boundary payments and settlements through a variety of applications. For example, it lays the foundation for the issuance and use of central bank digital currency (CBDC), which can be used in cross-boundary payments to shorten intermediation chains, increase transaction speeds and decrease transaction costs.¹⁶ The BIS Innovation Hub, the Digital Currency Institute of the People's Bank of China (PBC), the Central Bank of the United Arab Emirates and the HKMA are working on a joint Multiple CBDC Bridge (mBridge) project to explore the potential of using CDBC's and

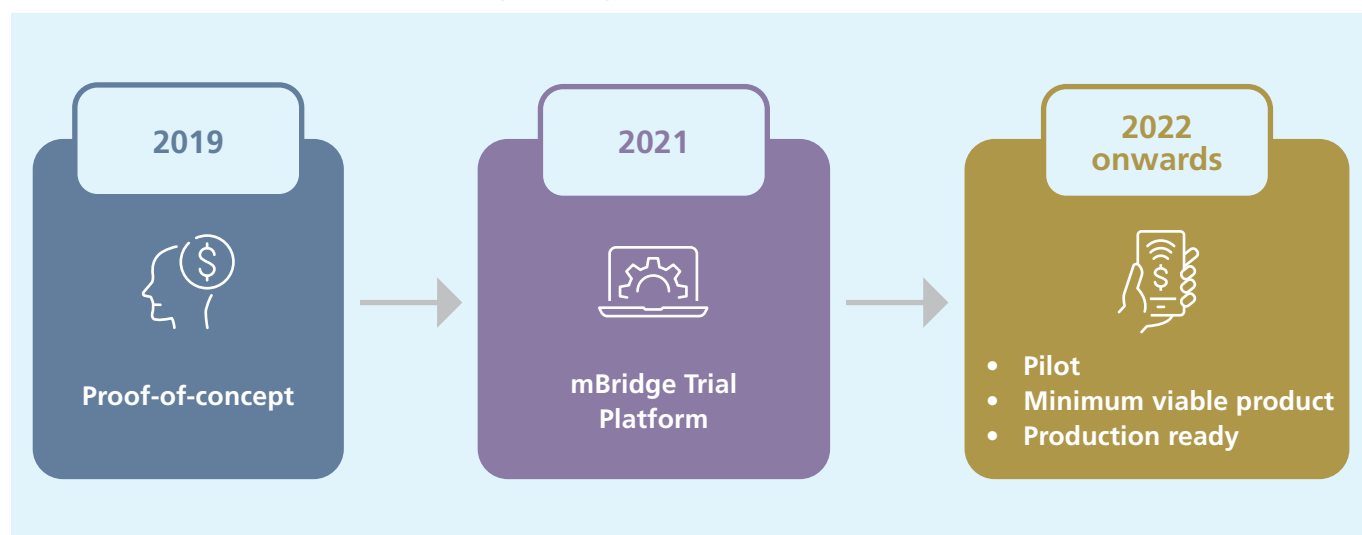
Table 3.1: Emerging technologies and their applications in Hong Kong

Technology	Application(s) to benefit cross-boundary payments and settlements
Blockchain	– Multiple CBDC Bridge
AI/BD technologies	– Fintech Supervisory Sandbox – GBA Fintech Pilot Trial Facility
Data-sharing techniques	– Commercial Data Interchange – Open API adoption
Digital identity (digital ID)	– iAM Smart – Remote on-boarding
Electronic Wallets (e-Wallets)	– Hong Kong e-wallets in Mainland China – e-CNY

Source: HKIMR staff compilation.

¹⁶ BIS (2021a).

Chart 3.5: Roadmap of the mBridge design



Sources: BIS and HKIMR staff compilation.

blockchain for delivering real-time, cheaper, and safer cross-boundary payments and settlements among the first projects involving multiple CDBC. In Q3 2022, the project entered the pilot phase, which involved conducting more than 160 payment and foreign exchange transactions totalling more than HK\$171 million. Ultimately, the development of Project mBridge will continue until it is a production-ready system. (Chart 3.5)

3.2.2. AI/BD technologies

AI refers to technologies that mimic human cognitive functions, such as problem-solving, decision-making, and translation,¹⁷ whereas BD enables the analysis of large volumes and a variety of data.¹⁸ New techniques in AI/BD technologies include machine learning, computer vision, natural language processing, distributed computing, and Map Reduce techniques. AI/BD technologies can help to automate compliance checks and has strong potential to address various pain points in cross-boundary

payments and settlements, such as risk management, risk disclosure, fraud detection, Know Your Customer (KYC), and AML/CFT controls.

In September 2016, The HKMA launched its Fintech Supervisory Sandbox, which enabled participants to roll out fintech initiatives earlier, at a lower cost, and with better quality upon full product launch.¹⁹ The Sandbox was upgraded in 2017 to enable Chatroom function and then evolved into the third phase to facilitate funding support (Chart 3.6). The Sandbox was linked up with the PBC's Fintech Innovation Regulatory Facility in October 2021 and officially available (as GBA Fintech Pilot Trial Facility) in February 2022 for financial institutions and technology firms to pilot test their cross-boundary fintech initiatives concurrently in Hong Kong and GBA cities, which provides "one-stop platform" for participants to expedite the application of AI/BD for cross-boundary payments and settlements within the GBA.

¹⁷ HKMA (2020c).

¹⁸ BIS (2020c).

¹⁹ HKMA (2022b).

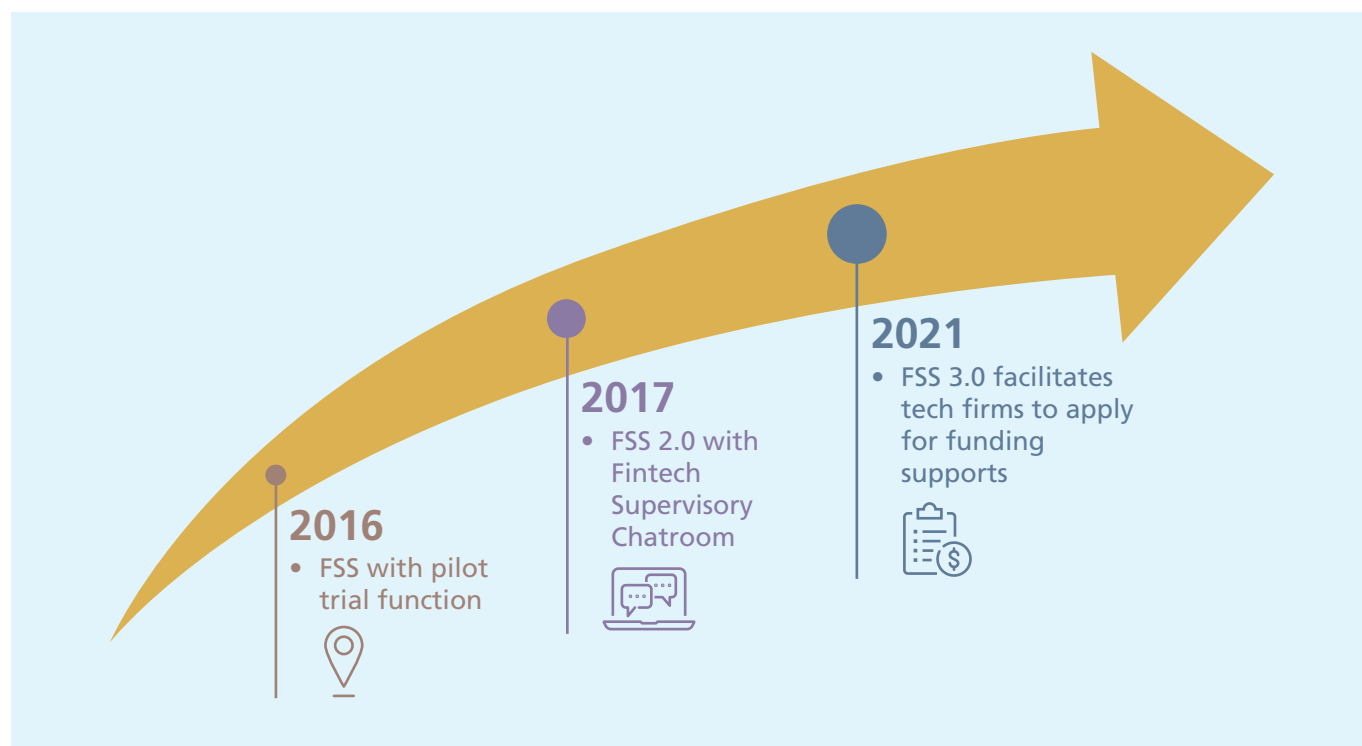
3.2.3. Data-sharing techniques

Data-sharing techniques have been emphasised in the G20 roadmap as one of the building blocks for enhancing cross-border payments worldwide.²⁰ One promising direction in data-sharing techniques is the promotion of Open Application Programming Interface (Open API) protocols. APIs are programming tools that allow the exchange of information and execution of instructions across different computer systems. APIs can service a broad range of functions in payment processing and value-added payment services.

The HKMA has been promoting the adoption of Open API for banks in Hong Kong. Open APIs are APIs that

allow third-party service providers (e.g., web-hosting platforms, data-driven marketing agencies, and software services) access to an organisation's systems. Financial institutions can open their internal systems and data to third-party service providers through Open APIs in a secure and controlled manner. The HKMA published the Open API Framework for the Hong Kong banking sector and recommends prevailing international technical and security standards to ensure its rapid and safe adoption. Beginning in 2019, Hong Kong's banking industry launched different phases of banking Open API with respect to different functions. The growth rate of registrations with access to banking Open APIs more than doubled from 2019 to 2020 (Chart 3.7).²¹

Chart 3.6: Development of Fintech Supervisory Sandbox (FSS)

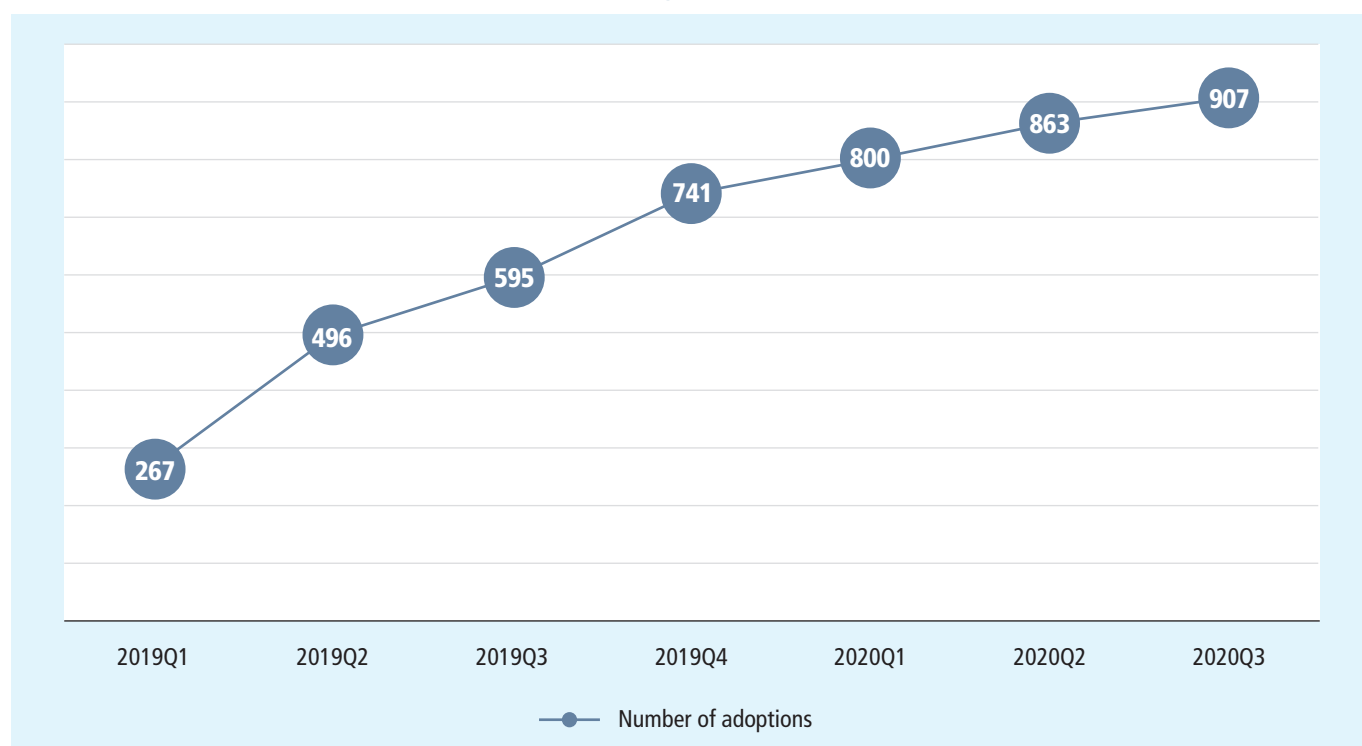


Sources: HKMA(2021) and HKIMR staff compilation.

²⁰ BIS (2020b).

²¹ In addition, IA has adopted Open API framework and started to replace the framework with Insurtech Sandbox to assist market participants to tackle regulatory issues.

Chart 3.7: Open API adoptions in the banking sector



Sources: HKMA (2021) and HKIMR staff compilation.

As an important part of HKMA's "Fintech 2025" strategy,²² a next-generation financial data infrastructure, Commercial Data Interchange (CDI), was launched in October 2022. By providing a centralised platform with standardised APIs and data models, it allows banks to establish connections with various data providers in an efficient and scalable manner with minimal effort, eliminating the need to build and customise connectivity for each data provider.²³

3.2.4. Digital ID

Digital ID refers to the attributes and credentials representing a person, an organisation, or a device that is stored electronically in computer systems and can be authenticated via digital channels. A person's digital ID usually consists of biographic and biometric data, and a corporation's digital ID contains attributes

that uniquely identify and verify it, such as its registration numbers, business licenses and sector memberships. For individuals, digital ID can reduce the need to physically appear at a location for identity authentication. Digital ID also saves time and simplifies the compliance process.

In December 2020, the Hong Kong Office of the Government Chief Information Officer (OGCIO) launched "iAM Smart", which provides all Hong Kong residents with a single digital ID and authentication to conduct online government and commercial transactions. As of October 2022, more than 1.6 million users have registered for the "iAM Smart" one-stop personalised digital service platform, which now provides access to more than 220 commonly used government, public and private online services (Chart 3.8).

²² For more detail on HKMA's "Fintech 2025" strategy, please refer to the following website: <https://www.hkma.gov.hk/eng/news-and-media/press-releases/2021/06/20210608-4/>

²³ For more detail about CDI, please refer to the website: <https://www.hkma.gov.hk/eng/news-and-media/press-releases/2022/10/20221024-3/>

The popular services to which iAM Smart provides access include checking COVID-19 electronic vaccination records, using eHealth services, and filing tax returns with eTAX.²⁴ Financial regulators, including the HKMA, the Securities and Futures Commission (SFC), the Insurance Authority (IA), and the Mandatory Provident Fund Schemes Authority (MPFA) have encouraged the local financial services industry to adopt iAM Smart to enable customers to use online services and conduct online transactions more conveniently and efficiently, without compromising statutory and supervisory requirements.²⁵ In particular, the OGCIO and the Cyberport introduced a Pilot Sandbox Programme for iAM Smart that allows financial institutions intending to adopt iAM Smart to test their applications in an integration testing environment.

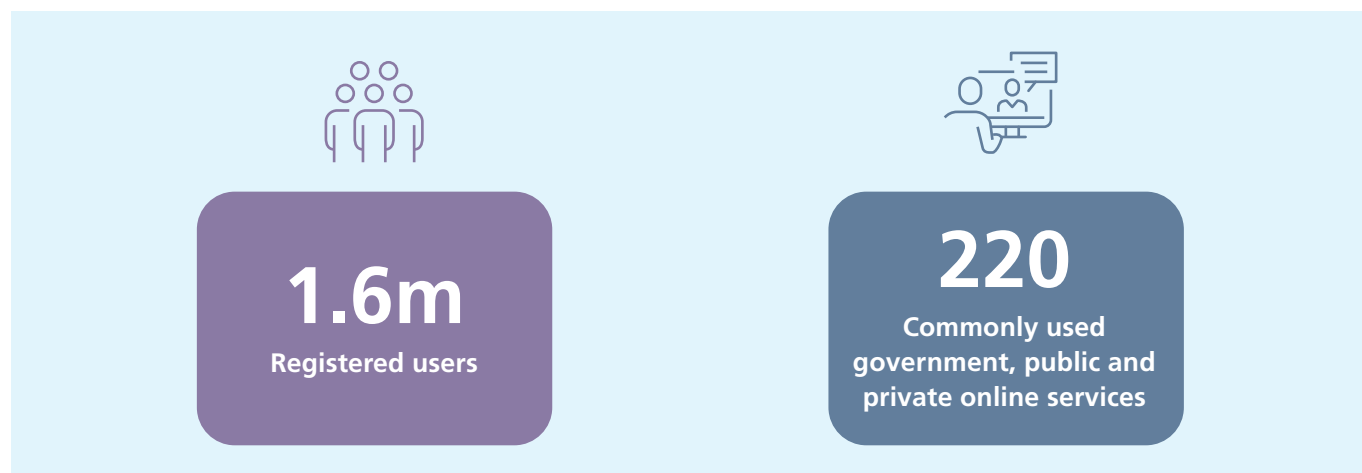
Digital ID is useful in remote on-boarding, which refers to the establishment of a business relationship with a customer solely through an electronic channel. Remote on-boarding may present risks of being deceived by someone pretending to be another customer. Therefore, due diligence for identity verification requires the use of extensive procedures for remote on-boarding. To enhance the

effectiveness of identity authentication and matching, the HKMA has encouraged the wider adoption of iAM Smart in remote on-boarding arrangements.²⁶ Digital IDs such as iAM Smart would help verify the identity of customers and reduce the risk of money laundering. The adoption of digital ID is particularly pertinent given the travel restrictions related to the COVID-19 pandemic. In March 2019, a Hong Kong bank launched a pilot scheme for Hong Kong permanent residents to remotely open Mainland personal bank accounts in the GBA. As the demand for remote on-boarding services continues to grow, digital IDs such as iAM Smart will increase accessibility and contain risks for cross-boundary payments and settlements in the GBA.

3.2.5. E-wallets

E-wallets are payment arrangements that allow customers to securely access, manage, and pay for products and services electronically without exchanging cash through an application or website. They can be used to support traditional payments through credit cards and fund transfers, and they are also essential for innovative payment instruments such as e-money and CBDCs.

Chart 3.8: Adoption of “iAM Smart”



Sources: OGCIO (2022) and HKIMR staff compilation.

²⁴ For more detail on iAM Smart, please refer to the following website: https://www.ogcio.gov.hk/en/our_work/community/iam_smart/

²⁵ See circulars by the HKMA (2020b), the SFC (2020), the IA (2020), and the MPFA (2020).

²⁶ HKMA (2021e).

E-wallets are beneficial for cross-boundary payments and settlements, as they remove the barriers that prevent individuals and corporations, especially small- to medium-sized enterprises, from accessing low-cost cross-boundary payments and settlements services at low cost.

E-wallets facilitate cross-boundary payments and settlements by reducing physical transaction barriers. Popular e-wallets could be some mobile applications of payments used by residents of the GBA.²⁷ Since 2018, Hong Kong e-wallets have been widely accepted in Mainland GBA cities. The HKMA has cooperated with the Digital Currency Institute of the PBC in the technical testing of the cross-boundary use of the e-CNY. The cross-boundary use of the e-CNY will promote the financial connectivity of the GBA and improve the efficiency and user experience of cross-boundary payments. The technical testing has entered the second phase, focusing on using FPS to top up the e-CNY wallet.²⁸ These developments will facilitate the accessibility of cross-boundary payments and settlements in the GBA.

²⁷ Statista (2021).

²⁸ More information can be seen in an *inSight* article on FPS (<https://www.hkma.gov.hk/eng/news-and-media/insight/2022/09/20220909/>) and a white paper on e-HKD released in September 2022.

Chapter 4

Views from Market Participants in Hong Kong

Our survey reveals a sustained interest in the GBA despite the challenges

HIGHLIGHTS:

- Financial institutions expect to expand their participation in cross-boundary investment schemes in the next 2–3 years, with the number of participants in the WMC scheme expected to grow by more than 70%. This reflects a rising interest in engaging in cross-boundary activities in the GBA.
- More than 90% of the financial market participants surveyed agreed that cross-boundary payment and settlement channels are essential for their GBA outreach activities, highlighting the crucial role of these channels in facilitating cross-boundary financial services.
- Diverse standards, legacy technologies, and different regulatory requirements are among the major challenges to cross-boundary payments and settlements reported by the survey respondents.
- The survey respondents consider Open API, digital ID, AI/BD technologies as the most important technologies for improving cross-boundary payments and settlements.

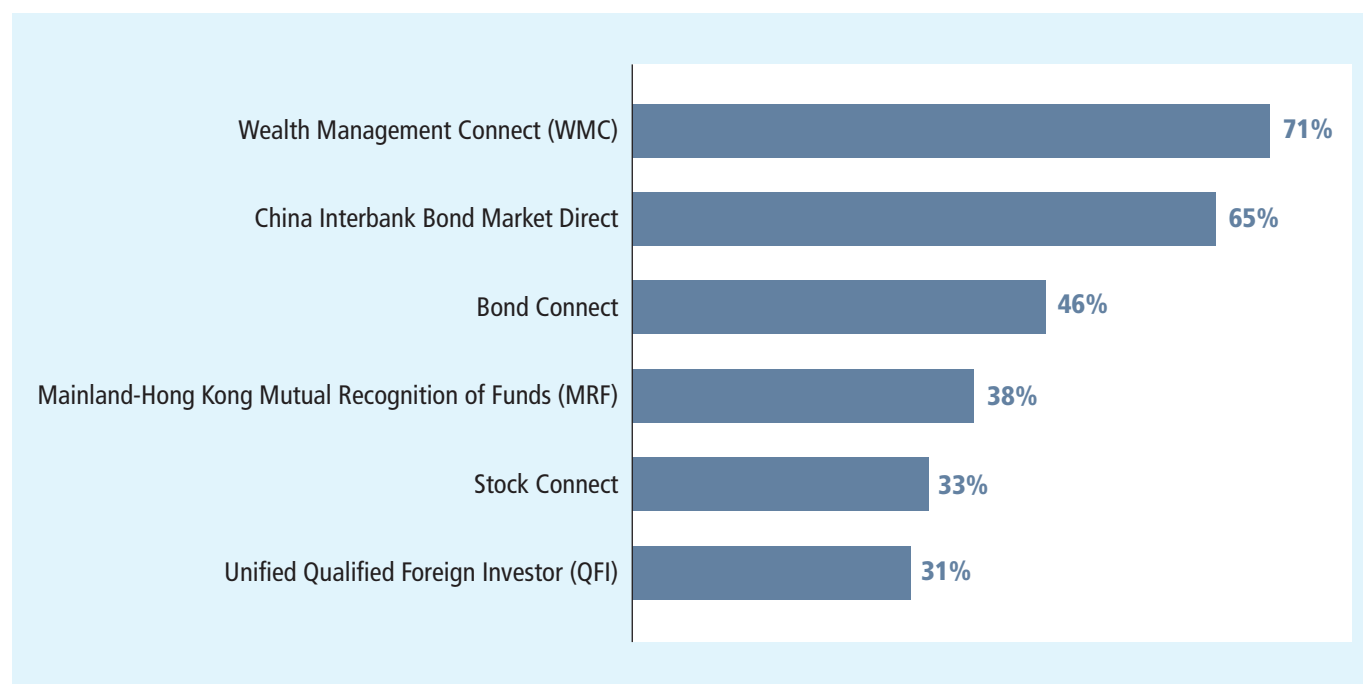
The Hong Kong Institute for Monetary and Financial Research (HKIMR) commissioned a survey entitled *Cross-boundary payments and settlements for a closer integration within the Greater Bay Area* (the GBA survey), which was conducted from July to October 2022. The survey aimed to understand cross-boundary payment and settlement practices within the GBA, the major challenges facing Hong Kong's financial institutions when undertaking cross-boundary payment and settlement activities, and the potential strategies to address these challenges with the help of emerging technologies. 58 financial institutions from the 3 main sectors (banking, insurance, and asset management) of Hong Kong's financial services industry participated in the survey. In addition, the executives of some of the surveyed institutions shared their in-depth views and suggestions in personal interviews. This chapter presents the key insights distilled from the survey and interviews.

4.1. FINANCIAL INTEGRATION WITHIN THE GBA AND CROSS-BOUNDARY PAYMENT AND SETTLEMENT PRACTICES

To examine the extent of financial integration in the GBA, the survey respondents were asked about their current and planned participation in the cross-boundary investment schemes connecting the financial markets of Mainland China and Hong Kong (Chart 4.1).

The respondents expressed a strong interest in increasing their participation in various investment schemes in the foreseeable future. The number of financial institutions participating in the WMC scheme will increase by 71% in the next 2–3 years. In addition, the financial institutions' participation

Chart 4.1: Hong Kong financial institutions' increased participation in cross-boundary investment schemes



Sources: HKIMR staff compilation based on the GBA survey.

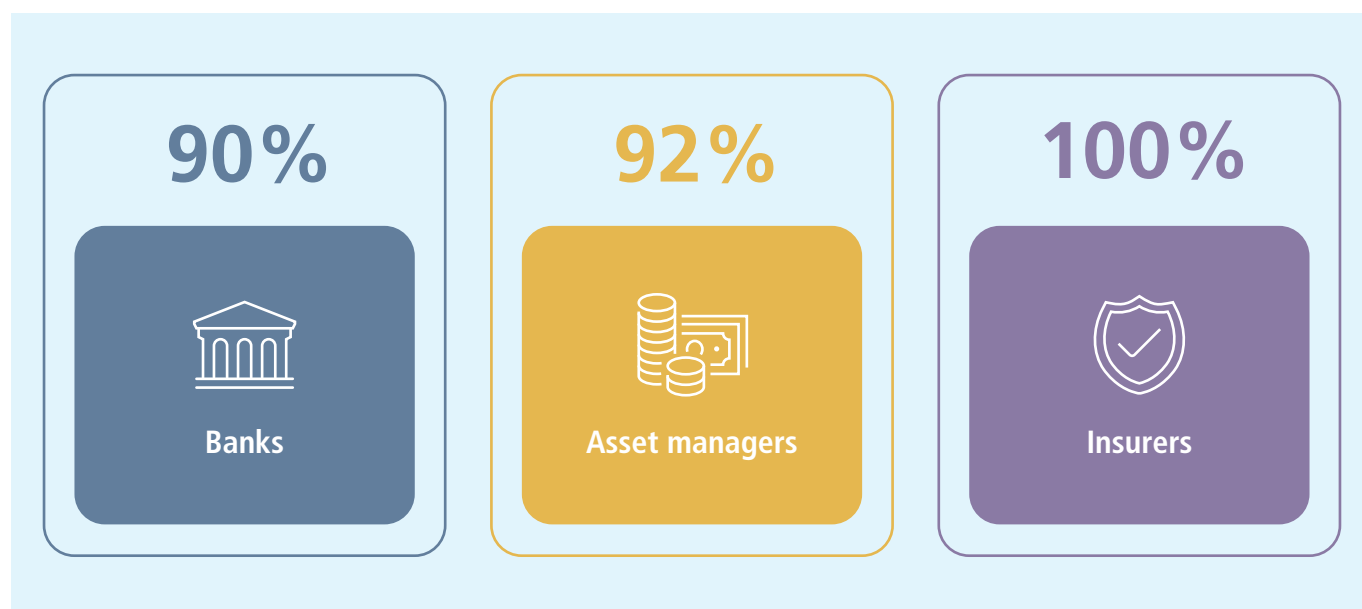
Note: The figures refer to the expected percentage increase in the participants in each respective scheme in the next 2–3 years.

in other schemes, including Bond Connect and Stock Connect, will be at least 30% higher over the next 2–3 years. These findings indicate a substantial increase in the number of financial institutions interested in engaging in cross-boundary activities.²⁹

In addition, the survey respondents expressed their willingness to participate in schemes that were either forthcoming (e.g., Swap Connect) or expected by market participants (e.g., Insurance Connect).³⁰ 57% of the insurance company surveyed expected to actively participate in Insurance Connect after its launch. 38% of the asset managers surveyed anticipated their participation in Swap Connect, which is expected to be launched in 2023.³¹

With increasing financial connectivity in the GBA and rising participation in cross-boundary investment schemes, the survey respondents highlighted the importance of cross-boundary payment and settlement channels. The vast majority of the respondents believed that these channels were essential to support their GBA outreach activities (Chart 4.2).³² As the surveyed financial institutions expressed strong interest in expanding their participation in various cross-boundary investment schemes in the future, cross-boundary payment and settlement channels are expected to continue to play an essential role in facilitating financial activities across the boundary going forward.

Chart 4.2: Essentiality of cross-boundary payment and settlement channels for GBA outreach activities



Sources: HKIMR staff compilation based on the GBA survey.

²⁹ The lower expected increase in the participation rate in the Stock Connect in the next 2–3 years arises from the fact that the scheme has been launched 8 years and has become more mature, with various enhancements and widened coverage made since its launch.

³⁰ More information can be found at the following websites: <https://www.hkma.gov.hk/eng/news-and-media/press-releases/2022/07/20220704-4/>; https://www.ndrc.gov.cn/xxgk/zcfb/tz/202201/t20220126_1313250.html

³¹ For more details, please refer to the following website: <https://www.hkma.gov.hk/eng/news-and-media/press-releases/2022/07/20220704-4/>

³² In the survey, HKMA-regulated entities were considered as banks and SFC-regulated entities are considered as asset managers. Some of these entities may not require cross-boundary payment and settlement channels to conduct GBA outreach activities.

Table 4.1 elaborates on the specific cross-boundary payment and settlement channels used by the surveyed commercial banks or asset managers and insurers. Almost all of the commercial banks used the infrastructure (95%) established across the boundary rather than the corresponding banking network (65%) to settle payments within the GBA.³³ This high rate of usage may be attributable to the fact that the majority of commercial banks have direct access to the financial infrastructures in the GBA, which provides them with a more efficient and secure method for cross-boundary payments and settlements than the correspondent banking network. Furthermore, 55% of the commercial banks utilise closed-loop arrangements (that is through a service provider's internal network) for cross-boundary payments and settlements. The most frequently used closed-loop arrangements include intra-bank bank group settlement networks, card operator networks, and non-bank service provider networks.

Table 4.1: Usage of cross-boundary payment and settlement channels

	Commercial banks	Asset managers and insurers
Infrastructure	95%	Not applicable
Correspondent banking	65%	78%
Closed-loop	55%	52%

Sources: HKIMR staff compilation based on the GBA survey.

Unlike commercial banks, asset managers and insurers have no direct access to the cross-boundary infrastructure in the GBA, so their cross-boundary payments are settled through the correspondent

banking network (78%) and closed-loop arrangements (52%).³⁴ On the front end, the vast majority of asset managers and insurers use bank-related electronic payment methods, such as telegraphic transfer, to facilitate cross-boundary payments in the GBA.

4.2. CHALLENGES IN CROSS-BOUNDARY PAYMENTS AND SETTLEMENTS WITHIN THE GBA

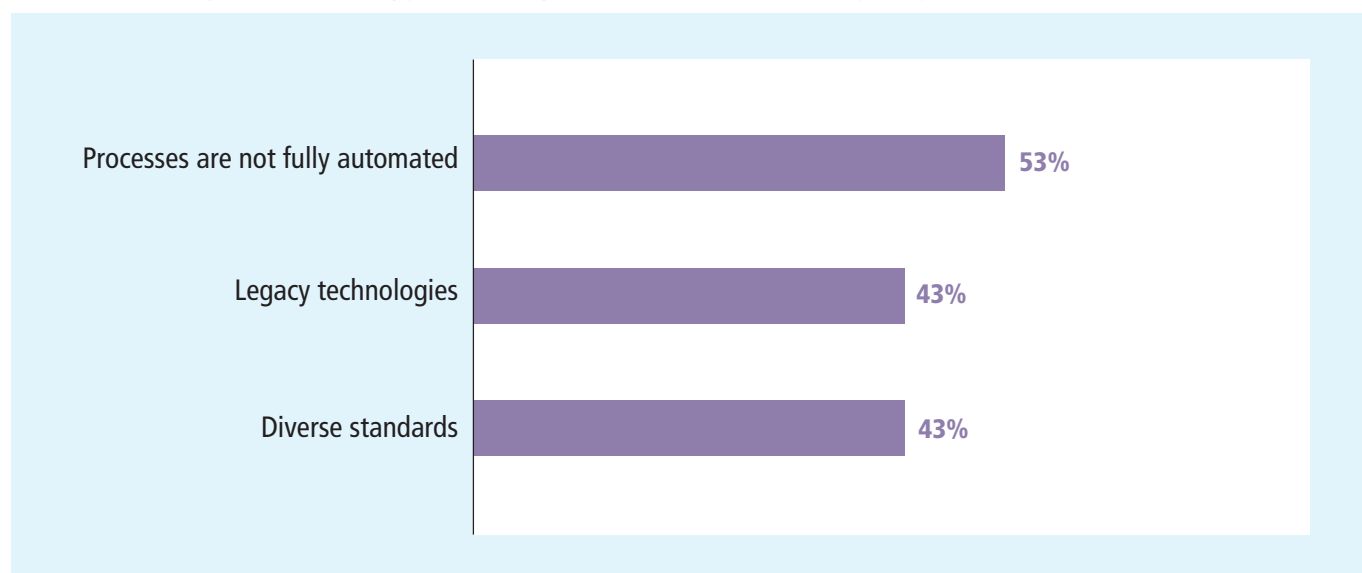
Against the backdrop of growing financial integration in the GBA, the survey respondents were asked about the challenges they encountered when providing cross-boundary financial services. They identified six main challenges associated with performing cross-boundary payment and settlement activities. Many of these challenges are also common to cross-border payments and settlements worldwide.³⁵ On the technological front, as shown in Chart 4.3, three major challenges are (i) cross-boundary payment and settlement procedures that are not fully automated, (ii) legacy technologies, and (iii) the use of diverse standards.

The lack of fully automated payment and settlement processes was identified by 53% of the survey respondents as a challenge. A few of them mentioned that a large proportion of financial transactions within Mainland China could be automatically processed on digitalised platforms. In contrast, some financial transactions in Hong Kong, including cross-boundary transactions, rely on a traditional and paper-based approach, which requires manual input and review of the information exchanged, thus creating an efficiency gap for cross-boundary transactions.

³³ The infrastructure mainly consists of the linkages between the settlement systems in Hong Kong and Mainland China, such as the CHATS–CNAPS link and the CHATS–CIPS link.

³⁴ For the full list of participants in the CHATS systems, please refer to the following website: https://www.hkicl.com.hk/eng/information_centre/clearing_members_participants_list.php

³⁵ See, for example, BoC–BoE–MAS (2018) and FSB (2020).

Chart 4.3: Major technology challenges for cross-boundary payments and settlements

Sources: HKIMR staff compilation based on the GBA survey.

43% of the survey respondents agreed that the use of legacy technologies in cross-boundary payments and settlements was a challenge. For instance, some traditional methods, such as letter- and fax-based methods, are still employed for processing information about cross-boundary payments and settlements. This adversely impacts cross-boundary financial services, as it may increase the difficulty of automating cross-boundary payments and settlements, increase the error rate, and decrease the security of the processes.

Another technology challenge considered by 43% of the survey respondents was diverse standards. They noted that across different jurisdictions in the GBA, there are differences in messaging formats, communication protocols, supporting technologies, and industrial standards for cross-boundary payments and settlements. These diverse standards increase the complexity of cross-boundary payments and settlements. For instance, some interviewees expressed concerns about the different asset valuation and pricing standards employed by different financial intermediaries performing cross-boundary payments and settlements in the GBA.

Interviewees noted differences in messaging formats, communication protocols, supporting technologies, and industrial standards for cross-boundary payments and settlements.

In addition to the technology challenges discussed above, survey respondents also identified three major non-technology challenges for cross-boundary payments and settlements: different regulatory requirements, risk management for AML/CFT checks, and limits on cross-boundary transactions (Chart 4.4).

Approximately 60% of the survey respondents indicated that different regulatory requirements added complexity to providing cross-boundary financial services. Interviewees highlighted the differences in the content, interpretation, and communication of cross-boundary payment and settlement regulations. Accordingly, cross-boundary

transactions may be subject to more complex requirements than domestic transactions, and financial institutions may need to dedicate additional resources to ensure compliance with multiple requirements. For instance, some of the interviewees observed that regulators in Hong Kong and Mainland China placed different levels of priority on customer notification and acknowledgement of payments made via electronic banking.

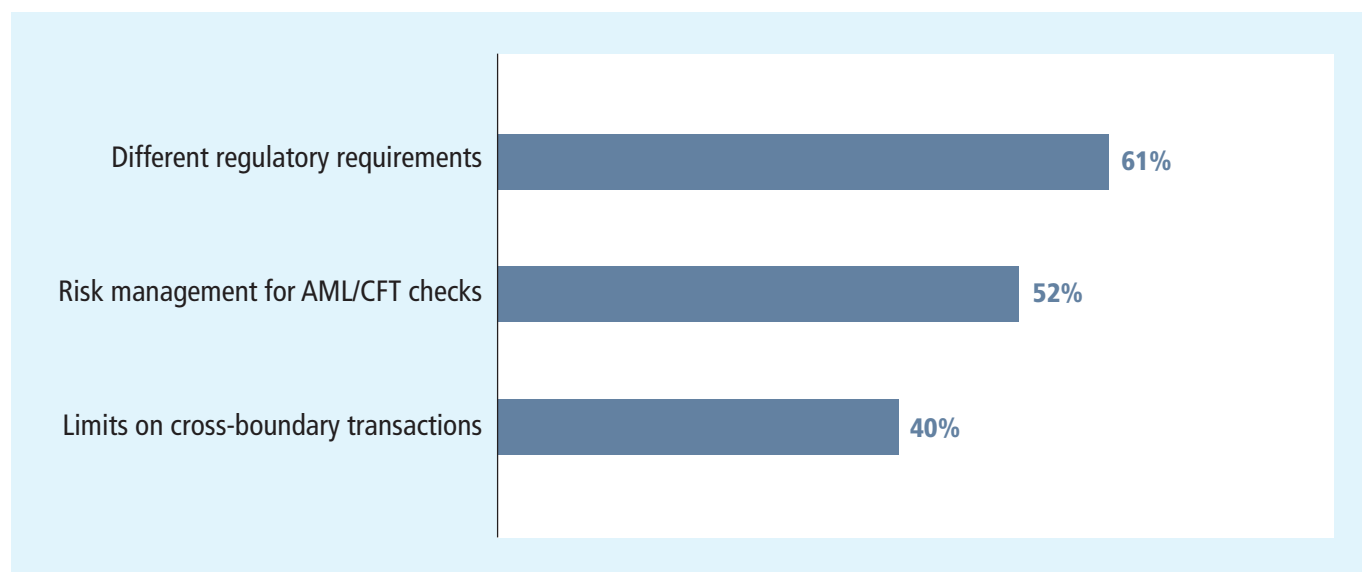
Approximately half of the survey respondents perceived risk management for AML/CFT checks as a challenge. Some of interviewees noted that, under the current procedures, each cross-boundary transaction needed to be reviewed manually and reported to Mainland regulators, which makes the process tedious and increases compliance costs. Several asset managers mentioned that these time-consuming procedures prevented fund subscriptions being performed on the same day that investors placed orders, causing a gap between the subscription price and the actual execution price, resulting in financial risks.

40% of the survey respondents reported having experienced a bottleneck related to limits on cross-boundary transactions, including investment quotas on various investment schemes and limits on remitting funds across the boundary. For instance, Hong Kong residents are subject to an HKD 80,000 daily limit for transferring funds to Mainland China.³⁶ Having said that, the interviewees were generally hopeful that, with the continual deepening of financial integration in the GBA, the existing limits on cross-boundary payments and settlements could be gradually relaxed over time.

4.3. OTHER PAIN-POINTS ASSOCIATED WITH GBA OUTREACH ACTIVITIES

In addition to the challenges associated with cross-boundary payments and settlements, the participants in the GBA survey highlighted three other pain-points they experience when providing financial services in the GBA (Chart 4.5).

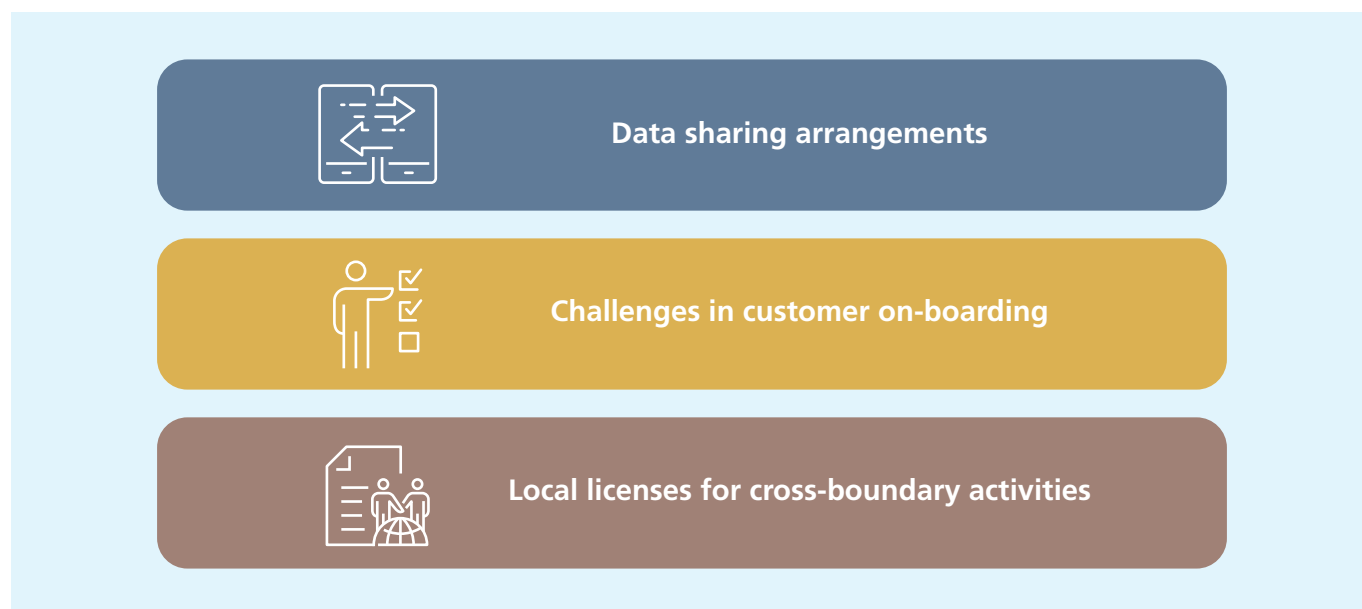
Chart 4.4: Major non-technology challenges for cross-boundary payments and settlements



Sources: HKIMR staff compilation based on the GBA survey.

³⁶ This limit is set out by PBC (2005). It applies to remittances from Hong Kong to Mainland China where (1) the payer is a person with Hong Kong Identity Card, (2) the payer and payee are the same person, and (3) the remittance currency is HKD.

Chart 4.5: Other pain-points associated with GBA outreach activities



Sources: HKIMR staff compilation based on the GBA survey.

According to the survey respondents, there is room for improvement in the data-sharing arrangements within the GBA. Current challenges mainly result from differences in data-sharing technologies, standards, protocols, and regulations. For instance, the interviewees noted that they utilise distinct platforms to store and process data in Mainland China and Hong Kong, which complicates the process of exchanging data. They also discussed the difficulties in accessing, exchanging, and verifying customers' personal information and medical records between different jurisdictions in the GBA. Some of their customers are hesitant to share their personal data across the boundary, probably due to privacy concerns.

The survey respondents also reported facing the challenge of effectively on-boarding customers across the boundary. The interviewees commented that the travel restrictions enforced during the COVID-19 pandemic limited their customers' ability to cross the boundary to open accounts. The difficulty of on-boarding customers remotely may arise from legacy technology, diverse standards, and

the need for identity checks. The process may also involve back-and-forth communication with customers to obtain relevant KYC documents. Essential technologies underpinning identity verification for remote customer on-boarding, such as facial recognition and biometric authentication, are not yet extensively utilised in the GBA.

The interviewees noted that essential technologies for remote customer on-boarding, such as facial recognition and biometric authentication, were not yet extensively utilised in the GBA.

The survey respondents were also challenged by the need to obtain local licenses for their GBA outreach activities. They noted that they were required to obtain local licenses to solicit, advertise, distribute, or

sell products and services across the boundary.³⁷ Many of them relied on local distributors instead. This operational model is associated with high administrative costs and makes it less possible for financial institutions in Hong Kong to form direct connections with their Mainland customers, preventing those customers from receiving quality investment advice.

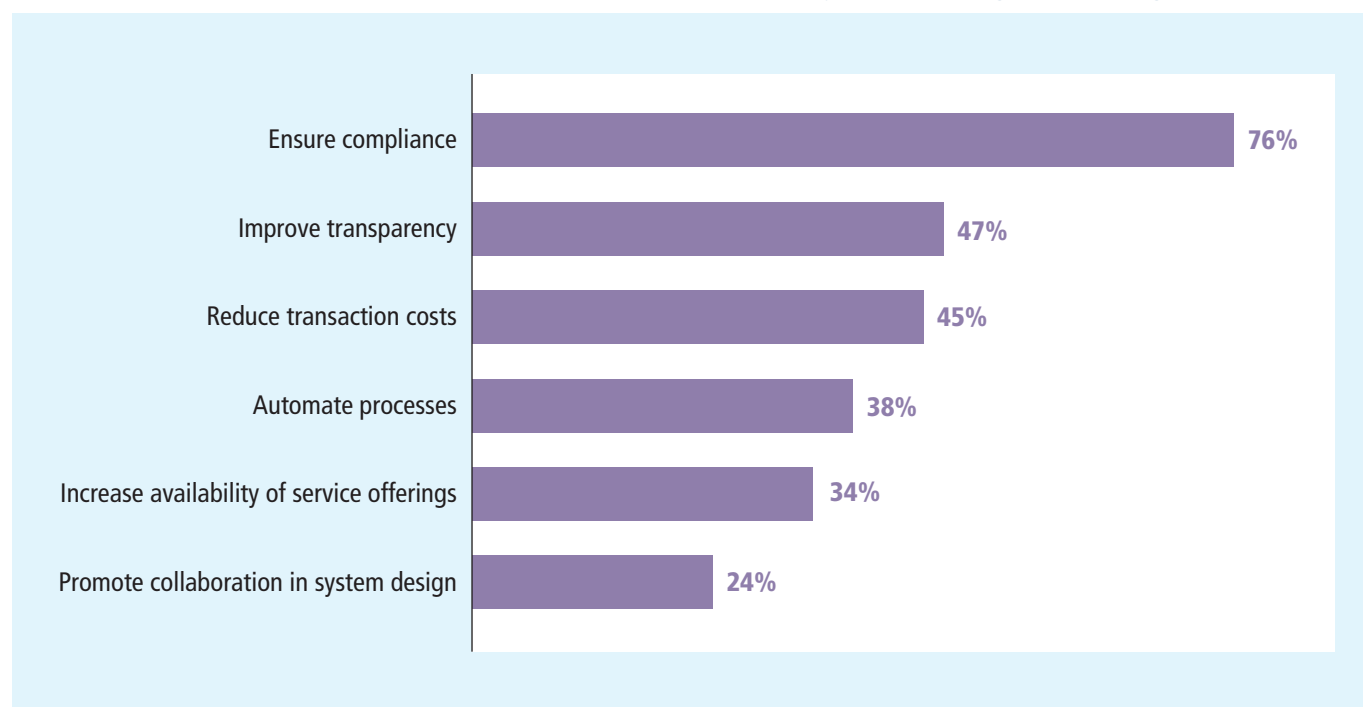
4.4. SUPPORTING TECHNOLOGIES FOR IMPROVING CROSS-BOUNDARY PAYMENTS AND SETTLEMENTS

The survey also examined the role of emerging technologies in addressing the challenges explored above. The survey respondents were asked which important aspects they expected technology to achieve for supporting cross-boundary payments and settlements (Chart 4.6).

According to the survey results, most of the respondents (76%) considered the ability to ensure compliance as a desirable attribute of supporting technologies. This result is consistent with the fact that the survey respondents perceived different regulatory requirements as a challenge to their GBA business activities. Other important aspects include improving the transparency of cross-boundary payment and settlement processes (47%) and reducing transaction costs (45%).

Some existing or emerging technologies have the potential to alleviate challenges in cross-boundary payments and settlements. The survey asked the financial market participants which technologies they found useful for enhancing financial integration in the GBA (Chart 4.7).

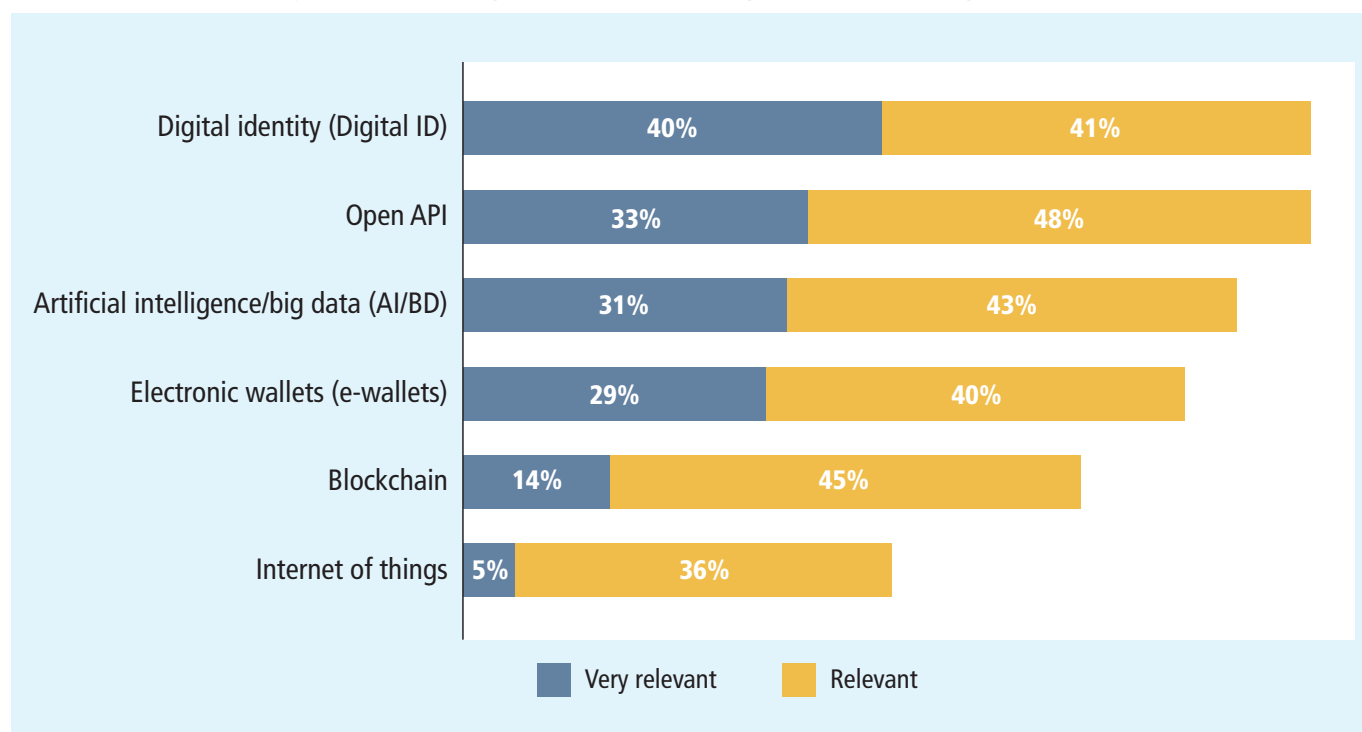
Chart 4.6: Important aspects expected to be achieved by supporting technologies



Sources: HKIMR staff compilation based on the GBA survey.

³⁷ Interviewees also mentioned that they could not train their distributors and intermediaries on product specifications and information, due to licensing restrictions.

Chart 4.7: Relevancy of technologies for enhancing financial integration in the GBA



Sources: HKIMR staff compilation based on the GBA survey.

As highlighted by some of the interviewees, the adoption of digital IDs for individuals could improve the process of remote customer on-boarding and account opening, such as document authentication and liveness checks. It could also help reduce the risks associated with AML/CFT and KYC checks, as the information contained in a digital ID is officially verified. Some interviewees also pointed out that it would be useful to have a unified corporate identification system in Hong Kong.

Open API shared the top spot with digital IDs as the most relevant technology for enhancing financial integration in the GBA, as identified by 81% of the survey respondents. According to those respondents, Open API would be an ideal technology for collecting cross-boundary transaction data directly from

government departments, such as customs, thus enhancing efficiency and minimising manual processing errors. Furthermore, some of the interviewees in Hong Kong indicated that they had explored the possibility of using Open API to access customer information from institutions in Mainland China for KYC checks and credit reviews.

More than 70% of the respondents identified AI/BD technologies as relevant or very relevant. Some of them explained that they had used BD-supported AI techniques for customer on-boarding and KYC checks both locally and across the boundary. They used optical character recognition for extracting information from identity cards and used machine learning algorithms for detecting fraudulent transactions and improving operational efficiency.³⁸

³⁸ HKMA (2019c) provides an in-depth study on the application of artificial intelligence in the banking sector, which covers various AI use cases for customer on-boarding, including applying machine learning-enhanced optical character recognition, facial recognition, and voice authentication in the scanning and checking process.

The interviewees reported using AI techniques for customer onboarding and KYC checks, including applying optical character recognition to extract information from identity cards and using machine learning algorithms to detect fraudulent transactions.

69% of the respondents agreed that e-wallets play an important role in facilitating cross-boundary activities. Some of the interviewees indicated that customers could use the cross-boundary e-wallet services previously launched to conveniently settle cross-boundary payments. For example, when a customer makes an RMB payment in Mainland China through an e-wallet, the payment is automatically charged to the credit bank linked to the wallet in HKD. From a regulatory standpoint, the possibility of tracking payment records through e-wallets is also beneficial for adhering to AML/CFT compliance.

59% of the respondents perceived blockchain as a relevant or very relevant technology. The interviewees considered blockchain useful for multiple operations within cross-boundary transactions, including ensuring the accuracy and security of the information for settling cross-boundary payments, customer

identity verification, and AML/CFT scrutiny. Furthermore, blockchain serves as the technology underlying digital currency. The interviewees listed various advantages of using digital currency for cross-boundary payments and settlements, including lower transaction costs, increased transaction speed, and decreased risks of money laundering and terrorist financing.

Finally, the Internet of Things (IoT) was considered by 41% of the respondents as an important emerging technology. The term IoT refers to devices that are connected to the Internet for collecting and sharing data, which range from everyday objects, such as kitchen appliances and consumer electronics, to sophisticated industry tools, such as smart robotics. Wearable devices are an application of the IoT that can track wearers' status, which may be used by financial institutions to provide personalised services.

In light of the preceding discussion of emerging technologies, the next chapter examines the adoption of technology-related and non-technology-related initiatives supported by regulatory authorities in the GBA. In addition, by taking stock of the current landscape of cross-boundary payments and settlements and referencing the international recommendations, it offers several considerations for improving cross-boundary payments and settlements to deepen financial integration in the GBA going forward.

Chapter 5

Reaping the Benefits of Financial Integration in the GBA

Considerations towards a closer financial integration

HIGHLIGHTS:

- Based on our survey results, expanding FPS to the GBA, promoting the adoption of Open API, and developing standardised data-sharing arrangements or protocols are the top three most useful technology-related regulatory initiatives for enhancing financial integration within the GBA.
- Technology-related considerations related to facilitating cross-boundary payments and settlements include measures to improve the functionality of existing infrastructure, promote the adoption of emerging technologies, and encourage data-sharing arrangements while safeguarding individual privacy and data security.
- Non-technology-related considerations include measures to expand the accessibility of financial services and foster communication between regulators and the industry.

5.1. MARKET VIEWS ON HOW TO ADDRESS CHALLENGES

In light of the challenges the financial services industry faces in their GBA outreach activities, particularly in the area of cross-boundary payments and settlements, the GBA survey asked market participants to rank their top three technology-related and non-technology-related regulatory initiatives.

The top three technology-related regulatory initiatives were identified as follows: expanding FPS to the GBA, promoting the adoption of Open APIs, and developing standardised data-sharing arrangements or protocols. These were considered the most relevant initiatives to address challenges in cross-boundary payments and settlements and support GBA business activities by over 75 per cent of the survey respondents. More than half of the insurers and asset managers surveyed suggested that regulatory sandbox or Regtech and Suptech initiatives were as useful as technical assistance on cross-boundary payment and settlement services. Those technology initiatives have been adopted in applications such as CDI in the banking system, Open APIs for banks in Hong Kong, blockchain technology,

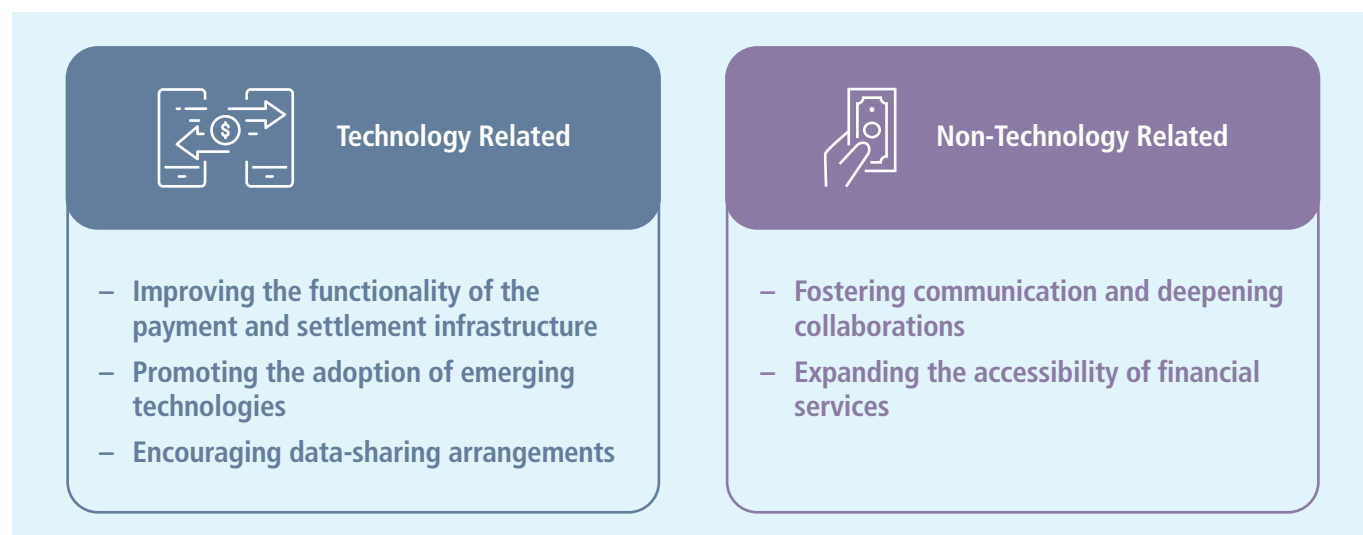
the FSS, and the mBridge for cross-boundary payments and settlements.

Non-technology-related initiatives supported by regulators were regarded as another important component to facilitate financial integration in the GBA. Based on the survey, the top three non-technology initiatives are policy support on cross-boundary remote on-boarding, mutual recognition of professional qualifications and standards, and grants and incentives for innovation.

5.2. CONSIDERATIONS FOR FACILITATING CROSS-BOUNDARY PAYMENTS AND SETTLEMENTS

Taking stock of the market views of the survey respondents and the recommendations of international organisations, we make the following suggestions for facilitating cross-boundary payments and settlements within the GBA from technology-related and non-technology-related perspectives (Chart 5.1). These suggestions may help facilitate cross-boundary payments and settlements and could contribute to the deepening of financial integration within the GBA.

Chart 5.1: Considerations for facilitating cross-boundary payments and settlements



Sources: HKIMR staff compilation based on the GBA survey.

5.2.1. Improve the functionality of the payment and settlement infrastructure

As highlighted by the G20 roadmap for enhancing cross-border payments, improving the functionality of the existing infrastructure would help to increase the speed, decrease the costs, and enhance the accessibility and transparency of cross-border payments internationally.³⁹ One approach would be to improve upon existing system linkages. For example, a mechanism recently explored by the BIS is the establishment of liquidity bridges across central banks in different jurisdictions.⁴⁰ The adoption of liquidity bridges and other liquidity-saving mechanisms in the payment and settlement channels within the GBA is worth exploring. These mechanisms may relieve the liquidity constraints faced by the financial services industry across the boundary while helping reduce credit and settlement risks and supporting financial stability.

Another possibility would be to extend existing local payment infrastructures across the boundary. For example, because the application of FPS has become increasingly mature in Hong Kong, it could be useful to explore adopting FPS for cross-boundary payments. This would enable Hong Kong residents to transfer funds to Mainland accounts, and vice versa, more efficiently and at a lower cost than before. The PBC and the HKMA have been working together to explore the use of e-CNY in cross-boundary payments, including using the FPS to top up the e-CNY wallet.⁴¹ The adoption of the FPS in cross-boundary e-CNY transactions has the potential to increase the efficiency and accessibility of cash payment services in the GBA.

5.2.2. Promote the adoption of emerging technologies

There are clear benefits to leveraging emerging technologies to facilitate cross-boundary payments and settlement, as they are key to addressing some of the technology and non-technology challenges described in the preceding chapter. The interviewees suggested three main use cases of emerging technologies. First, AI/BD technologies may help streamline and automate compliance checks for cross-boundary transactions and customer onboarding, while protecting privacy and mitigating the risk of data security breaches. Typical use cases include monitoring financial transactions, detecting financial crimes, and verifying personal identities.⁴² Second, adopting iAM Smart and other digital identities may have the potential to deliver benefits for cross-boundary business activities. Because digital identities are already verified via official channels, using them for cross-boundary financial services can save the time and money that is currently spent on authenticating and matching the identities of individuals or corporations. Third, applying blockchain could enhance the efficiency and security of cross-boundary settlements. Because the information stored in blockchain is unalterable and traceable, applying this technology to document checking may enhance the speed, accuracy, and security of the procedures. Blockchain also serves as the underlying technology for digital currency, and as some of the interviewees remarked, using digital currency in cross-boundary transactions may accelerate the payment and settlement processes while reducing AML/CFT risks.⁴³

³⁹ BIS (2020a).

⁴⁰ BIS (2022a).

⁴¹ For more details, please refer to the following website: <https://www.hkma.gov.hk/eng/news-and-media/insight/2022/09/20220909/>

⁴² 'Federated Learning' is one example of AI technology adoption for credit assessment and compliance check that is separate from data privacy protection. It is applied by the Hong Kong Applied Science and Technology Research Institute (ASTRI), the HKMA, and participating banks. Please refer to the following website for more details: <https://www.astri.org/news-detail/astri-leverages-privacy-preserving-federated-learning-technology-to-facilitate-credit-scoring-for-msme-financing-in-collaboration-with-standard-chartered-paob-openrice-and-freightal>. In addition, the IA is engaging ASTRI in a pilot project to promote the adoption of Federated Learning in the insurance industry, with the target of a mid-2024 launch.

⁴³ For more details, please refer to the following website: <https://www.hkma.gov.hk/eng/news-and-media/press-releases/2022/07/20220721-3/>

The survey respondents also noted that some new applications and their underlying technologies may not be mature enough for mass adoption in the GBA. As a result, they suggested evaluating the applicability of these applications through pilot programmes before broadening their usage in the GBA. This approach has the benefit of avoiding spreading the financial risks associated with the new applications to the whole industry, and it is conducive to observing the industry's acceptance of the new technologies. The approach is exemplified by the launch of the GBA Fintech Pilot Trial Facility by the PBC and the HKMA, which provides financial institutions operating in the GBA with a 'one-stop platform' to pilot test their cross-boundary fintech initiatives concurrently in Hong Kong and other GBA cities, in order to obtain early supervisory feedback and user opinions.

The survey respondents recommended evaluating the applicability of new applications through pilot programmes, prior to their wider usage in the GBA.

5.2.3. Encourage data-sharing arrangements

Encouraging cross-boundary data-sharing is helpful for cross-boundary payments and settlements and the provision of other financial services in the GBA, while safeguarding individual privacy and cyber and data security.⁴⁴ The survey respondents expressed the need to establish and connect data-sharing facilities in the GBA to assist the financial services industry in retrieving information to support their business activities. These facilities may enhance financial intermediation in the GBA and offer better infrastructure for financial

institutions operating in the area. For example, some interviewees foresaw the benefits of integrating the CDI and similar systems in other GBA cities to support the sharing of commercial data in the area. Some interviewees also emphasised that a secure data-sharing agreement would help the financial services industry to comply with data security and privacy regulations when delivering financial services across the boundary.

As a prerequisite for sharing data across the boundary, it is necessary to standardise the format and content of the messages being exchanged for cross-boundary transactions. This approach could provide efficiency gains by eliminating the need to translate messages from one standard to another, thus reducing the complexity and costs associated with the transactions. For example, many international organisations have advocated the consistent adoption of the ISO 20022 messaging standard to exchange information about the clearance of cross-border payments and settlements worldwide,⁴⁵ which the HKMA has implemented for its FPS.⁴⁶

It would also be helpful to develop harmonised API protocol standards. The survey respondents rated Open API as one of the most relevant technologies to cross-boundary financial integration. Supported by the HKMA, the implementation of the Open API Framework in Hong Kong has enabled local banks and third-party service providers to efficiently share data under a set of consistent protocol standards.⁴⁷ Some of the interviewees foresaw the possibility of developing and adopting standardised Open API protocols for cross-boundary payments and settlements, a point also proposed by other international organisations. This would increase the connectivity of financial institutions from different GBA cities, thereby facilitating the transparency and interoperability of the cross-boundary payment and settlement infrastructures.

⁴⁴ As a supplement to the considerations listed here, interested readers may also refer to FSDC (2022) on data-governance measures to facilitate the further integration and connectivity of the financial services industry within the GBA.

⁴⁵ See, for example, BIS (2020a), World Bank (2021), and the following IMF website: <https://www.imf.org/en/News/Articles/2019/05/09/sp050919-paving-the-way-for-fintech>

⁴⁶ HKMA (2018).

⁴⁷ HKMA (2021f).

Some of the interviewees also noted the importance of promoting the cross-boundary and cross-institutional exchange of information for identity verification. This exchange is essential for maintaining the security and compliance of cross-boundary transactions. To minimise the risks associated with compliance checks and reduce the efficiency losses attributable to duplication of identity verification, it would be advisable to share information about customers' identities across the boundary with different financial institutions while complying with data security and privacy regulations, probably through a centralised identity verification system, as some interviewees suggested.

5.2.4. Foster communication and deepen collaboration

As discussed in the preceding chapter, the survey respondents considered diverse standards and different regulatory requirements as the main challenges to cross-boundary payments and settlements. To address these issues, it may be beneficial to enhance policy communication and coordination among regulators across different jurisdictions in the GBA. This would involve identifying the similarities and differences in the supporting technologies, industrial standards, policies and regulations, and compliance costs to local financial institutions, along with working towards a mutually agreed roadmap for narrowing the gaps in these areas.

The survey respondents also highlighted the value of fostering communication between regulators and the financial services industry. Mutual understanding not only helps financial institutions to better align their cross-boundary businesses with regulatory requirements but also enables regulators to better formulate policies and launch initiatives to support cross-boundary financial service offerings while containing the associated financial risks. As some interviewees suggested, this could be achieved by creating a single point of contact to coordinate the communication of local and cross-boundary regulations. Furthermore, more education and promotion could be useful to help deepen financial institutions' understanding of financial regulations in the GBA.

In addition, it may be useful to establish new official communication channels and extend the existing channels between industrial practitioners and regulators to provide opinions and receive feedback. For example, the HKMA has issued a series of consultation papers to solicit views about its planned policy actions and to communicate the orientation of its regulations to the industry. Some of these papers are related to technology initiatives, such as Open API, that may play a fundamental role in enhancing payments and settlements in GBA. The HKMA also has a fintech supervisory chatroom, which provides supervisory feedback to financial institutions on new technology applications.⁴⁸ Going forward, it may be helpful to explore the feasibility of expanding the chatroom's function to include communications about the regulations and initiatives linked to cross-boundary payments and settlements.

⁴⁸ For more details, please refer to the following website: <https://www.hkma.gov.hk/eng/news-and-media/press-releases/2017/11/20171128-4/>

The survey respondents suggested enhancing communication between regulators and the financial services industry by creating a single point of contact to coordinate the communication of local and cross-boundary regulations.

5.2.5. Expand the accessibility of financial services

The survey respondents highlighted the importance of expanding the accessibility and variety of financial services across the boundary. They considered lowering the entry barriers for financial institutions, especially small and medium-sized ones, to participate in cross-boundary payment and settlement systems as an important step in deepening financial integration in the GBA. This may shorten the payment and settlement chain for cross-boundary transactions, which could increase the speed, transparency, and accessibility of those transactions. Additionally, with more players in the market, financial institutions may increase their efficiency and decrease the costs of providing cross-boundary financial services.

In addition, some interviewees suggested introducing provisional local licenses and promoting the mutual recognition of licenses, thus enabling local industry practitioners to provide financial services across the boundary. This approach may deepen the public's

understanding of the available cross-boundary financial services and help the distribution and sale of products and services in the GBA. As noted by some interviewees, legal practitioners in Hong Kong can become qualified to practise law in the GBA upon passing the GBA Legal Professional Examination. Similar arrangements may be implemented in the financial services industry.

The survey respondents also suggested gradually relaxing the limits on cross-boundary financial transactions. Currently, daily limits apply to fund remittances from Mainland China to Hong Kong and vice versa, and there are investment quotas for various cross-boundary investment schemes. With the increasing flow of people and goods and closer regional cooperation within the GBA, there will be a greater need for cross-boundary transactions in future. As some interviewees suggested, a pilot approach could be adopted to gradually relax the transfer limits and investment quotas for financial transactions in the GBA. Additionally, measures to contain financial risks during the relaxation period, such as limiting participants to those domiciled in the GBA, could be implemented.

Conclusions

The development of the GBA presents the financial services industry in Hong Kong with a unique opportunity. Through various cross-boundary investment schemes, including the WMC and the Bond Connect schemes, the financial services industry in Hong Kong gains access to Mainland financial markets and benefits from the economic growth in the GBA and the rest of China, while Mainland China receives alternative sources of funding from other jurisdictions. **To consolidate these advantages, a set of efficient and robust cross-boundary payment and settlement systems has been developing gradually,** such as the mBridge project to facilitate financial transactions in a real-time and digital manner. Based on a survey commissioned by the HKIMR, more than 90% of the surveyed financial institutions highlighted the essentiality of cross-boundary payment and settlement channels in supporting their GBA outreach activities. Many also showed a strong and growing interest in participating in the WMC and other cross-boundary investment schemes over the next 2-3 years, which would be reinforced by well-functioning cross-boundary payment and settlement systems.

Despite current developments in cross-boundary payment and settlement systems, some challenges remain. Based on the survey commissioned by the HKIMR, the market participants highlighted challenges in both technology-related and non-technology-related areas. Legacy technologies and manual procedures are challenges that suggest the need for technology improvements to avoid high costs and low speed in transactions. Different regulatory requirements and standards,

limits on cross-boundary business, and risks from diverse AML/CFT procedures are non-technology-related challenges that prevent investors from having enough market access and transparent services. Indeed, these challenges, identified by local financial market participants, are in line with the ones experienced in other international markets.

In light of these challenges, emerging technologies have been adopted in Hong Kong with practical applications to improve the efficiency and quality of cross-boundary payments and settlements. According to the survey respondents, Open API, digital ID, and AI/BD technologies are three key technologies to upgrade cross-boundary payment and settlement systems. The adoption of these technologies is already taking place. For instance, using Open API technology, the CDI platform developed by the HKMA shares data in an accessible and secured manner and is set to explore the digitalisation of the cross-boundary trade process with connections to diverse data providers. Digital ID technology is another example adopted in Hong Kong for expediting identity authentication and reducing transaction costs. The “iAM Smart” application promoted by the HKMA has adopted this technology to enhance the effectiveness of remote on-boarding in cross-boundary financial services. Since 2016, the HKMA has applied AI/BD technologies to automate compliance checks and increase transaction speed.

Some technology-related and non-technology-related considerations could further contribute to improving cross-boundary payment and settlement systems. Suggestions include technology-related strategies, such as improving the functionality of payment and settlement infrastructures, promoting the adoption of emerging technologies, and encouraging the implementation of data-sharing arrangements. The non-technology-related strategies include fostering communication between regulators and the financial services industry and expanding the accessibility of financial services across the boundary. These considerations might further deepen financial integration in the GBA.

Appendix A:

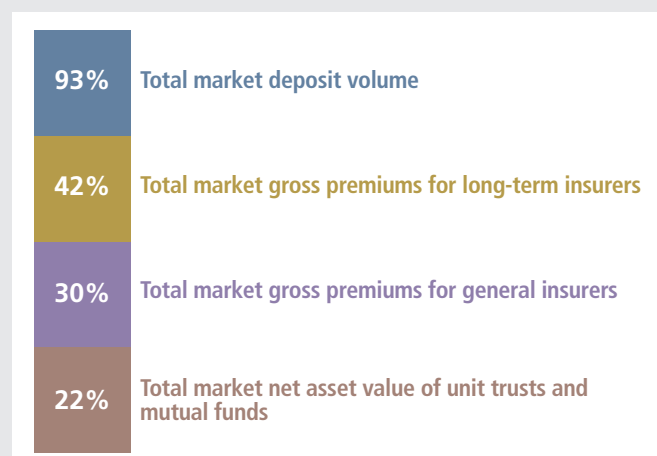
Background of the GBA Survey

The GBA Survey was designed to collect information about the role of technology in enhancing cross-boundary payments and settlements within the GBA. It also investigated the challenges faced by Hong Kong's financial institutions to provide financial services in the GBA, and potential strategies to mitigate these challenges. The survey was conducted in collaboration with PricewaterhouseCoopers Limited during July and October 2022.

In total, 58 institutions participated in the survey: 31 companies from the banking sector, 14 companies from the insurance sector, and 13 from the asset management sector. The sampled retail and corporate banks together account for 93% of the total market deposit volume. The sampled long-term insurers and general insurers account for 42% and 30% of the total market gross premiums, respectively. The sampled asset managers together account for 22% of the total market net asset value of unit trusts and mutual funds authorised by the SFC (Chart B.1).

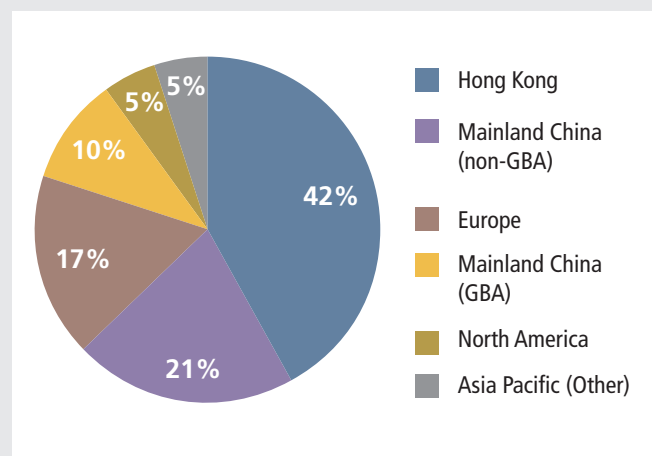
The respondents are diverse in the locations of their global headquarters, with 42% located in Hong Kong, 31% in Mainland China (21% in non-GBA areas, 10% in the GBA area), 17% in Europe, and 5% in North America (Chart B.2).

Chart B.1: Sectoral coverage of survey respondents



Sources: HKIMR staff compilation based on the GBA Survey.

Chart B.2: Distribution of the global headquarters of survey participants



Source: HKIMR staff calculations based on the GBA Survey.

In addition to the survey, 13 interviews were conducted to obtain more detailed insights from the participants. The participants were from 6 banks and securities firms, 4 asset management companies and 3 insurance companies.

Appendix B:

List of Abbreviations

24/7	24-hours per day, 7 days per week
AI	Artificial Intelligence
AML	Anti-Money Laundering
API	Application Programming Interface
BD	Big Data
CBDC	Central Bank Digital Currency
CCASS	Central Clearing and Settlement System
CCP	Central Counterparty
CDI	Commercial Data Interchange
CFT	Counter-Financing of Terrorism
CHATS	Clearing House Automated Transfer System
CIPS	Cross-Border Interbank Payment System
CMU	Central Moneymarkets Unit
CNAPS	China National Advanced Payment System
CSD	Central Securities Depository
Digital ID	Digital Identity
DNS	Deferred Net Settlement
DvP	Delivery-versus-Payment
e-Bills	Electronic Bills
EBPP	Electronic Bill Payment & Presentment
e-Cheques	Electronic Cheques
EUR	Euro
e-wallets	Electronic Wallets
FPS	Faster Payment System
FSB	Financial Stability Board
FSS	Fintech Supervisory Sandbox
FX	Foreign Exchange
GBA	Greater Bay Area

GDP	Gross Domestic Product
HKD	Hong Kong Dollar
HKICL	Hong Kong Interbank Clearing Limited
HKIMR	Hong Kong Institute for Monetary and Financial Research
HKMA	Hong Kong Monetary Authority
HKTDC	Hong Kong Trade Development Council
IA	Insurance Authority
IoT	Internet of Things
KYC	Know Your Customer
mBridge	Multiple CBDC Bridge
MPFA	Mandatory Provident Fund Schemes Authority
MRF	Mainland-Hong Kong Mutual Recognition of Funds
OCASS	OTC Clearing and Settlement System
OGCIO	Office of the Government Chief Information Officer
PBC	People's Bank of China
RMB	Renminbi
RTGS	Real-Time Gross Settlement
SFC	Securities and Futures Commission
SSS	Securities Settlement System
SVF	Stored Value Facility
USD	US Dollar
WMC	Wealth Management Connect

Appendix C:

Glossary of Technical Terms

Term	Meaning
Application programming interface (API)	A set of programming tools that allow the exchange of information and execution of instructions across different computer systems
Blockchain	A distributed ledger system that allows records to be stored in a traceable, unalterable, and accessible manner
Cash payment systems	A variety of systems that generate the transfer of funds through transactions originated by cash, cheques, or similar instruments, such as credit and debit cards
Cash settlement systems	A variety of systems that facilitate the transfer of large-value payments among financial intermediaries.
Central counterparties (CCP)	An securities settlement system that interposes itself between counterparties of financial transactions, becoming the buyer to every seller and seller to every buyer
Central securities depositories (CSD)	An securities settlement system where securities are centrally safekept and the issuance, ownership, and transference of securities are recorded.
Clearing house automated transfer system (CHATS)	A set of RTGS systems in Hong Kong that handle large-value interbank transfers denominated in HKD, USD, EUR, and RMB
Closed-loop arrangement	An arrangement in which the payer and payee in different jurisdictions employ the same service provider, and cross-border payments are settled within this service provider's internal network
Correspondent banking	An arrangement between banks to provide each other with payment services, usually in different jurisdictions
Cross-border activities	Any financial activity done across country borders
Cross-boundary activities	Any financial activity done across the boundaries of jurisdictions within the GBA
Deferred net settlement (DNS)	A form of cash settlement arrangement where payments are accumulated and netted off throughout a business day or other settlement period
Delivery-versus-payment (DVP)	A securities settlement mechanism in which the delivery of a security occurs if and only if the corresponding payment is completed

Term	Meaning
Electronic clearing service (ECG)	A service for clearing and settling various types of small-value electronic payments
Federated learning	An application of artificial intelligence technology in the financial services industry for credit assessments, compliance checks, and data privacy protection
Internet of things (IoT)	A system of devices that are connected to the Internet for collecting and sharing data
Know your customer (KYC)	A process in the financial services industry of identifying and verifying a client's identity for protection against fraud, money laundering, or terrorist financing.
Multi-purpose stored value facility (SVF)	A means of payment for goods and services provided by participating merchants, akin to an electronic surrogate for coins and banknotes
Peer to peer (P2P) model	An arrangement in which one individual payer sends a payment to one individual payee without any involvement from financial intermediaries
Real-time gross settlement (RTGS)	A form of cash settlement arrangement where payments are continuously settled in real-time and transferred on the gross-value without being netted off
Securities settlement systems (SSS)	A variety of financial market infrastructures that enable the transfer and settlement of financial securities, such as equity, debt, and derivatives

Appendix D:

References

Applied Science and Technology Research Institute/ASTRI. (2016). "Whitepaper on distributed ledger technology." November.

Armour, John, Dan Awrey, Paul Davies, Luca Enriques, Jeffery Gordon, Colin Mayer, and Jennifer Payne. (2016). "Principles of financial regulation." Oxford University Press, July.

Asian Development Bank. (2020). An ASEAN+3 bond market guide: the inter-bank bond market in the People's Republic of China.

Bank for International Settlements/BIS. (1995). "Cross-border securities settlements." March.

Bank for International Settlements/BIS. (2012). "Payment, clearing and settlement systems in Hong Kong SAR." November.

Bank for International Settlements/BIS. (2016a). "Correspondent banking." July.

Bank for International Settlements/BIS. (2016b). "Fast payments-Enhancing the speed and availability of retail payments." November.

Bank for International Settlements/BIS. (2018). "Cross-border retail payments." February.

Bank for International Settlements/BIS. (2020a). "Enhancing cross-border payments: building blocks of a global roadmap." July.

Bank for International Settlements/BIS. (2020b). "Enhancing cross-border payments: building blocks of a global roadmap: Stage 2 report to the G20 – technical background report." July.

Bank for International Settlements/BIS. (2020c). "Payment aspects of financial inclusion in the fintech era." April.

Bank for International Settlements/BIS. (2021a). "Central bank digital currencies for cross-border payments." July.

Bank for International Settlements/BIS. (2021b). "Developments in retail fast payments and implications for RTGS systems." December.

Bank for International Settlements/BIS. (2022a). "Central bank liquidity bridges for cross-border payments." July.

Bank for International Settlements/BIS. (2022b). "Interlinking payment systems and the role of application programming interfaces: A framework for cross-border payments." July.

Bank for International Settlements Innovation Hub Hong Kong Centre, Hong Kong Monetary Authority, Bank of Thailand, Digital Currency Institute of People's Bank of China & Central Bank of the United Arab Emirates. (2021a). Inthanon-LionRock to mBridge: building a multi CBDC platform for international payments.

Bank for International Settlements Innovation Hub Hong Kong Centre, Hong Kong Monetary Authority, Bank of Thailand, Digital Currency Institute of People's Bank of China & Central Bank of the United Arab Emirates. (2021b). mBridge - building a multi CBDC platform for international payments.

- Bank for International Settlements-International Organization of Securities Commissions/BIS-IOSCO. (2012).** "Principles for financial market infrastructures." April.
- Bank for International Settlements-International Organization of Securities Commissions/BIS-IOSCO. (2017).** "Implementation monitoring of PFMI: Level 2 assessment report for Hong Kong SAR." May.
- Bank of Canada/BoC-Bank of England/BoE-Monetary Authority of Singapore/MAS. (2018).** "Cross-border interbank payments and settlements: Emerging opportunities for digital transformation." November.
- Bank of China (Hong Kong)/BOCHK-Hong Kong Interbank Clearing Limited/HKICL. (2022).** "Principles for financial market infrastructures: Disclosure for RMB CHATS." July.
- Bech, Morten, Umar Faruqi, and Takeshi Shirakami. (2020).** "Payments without borders." BIS Quarterly Review, March.
- Bech, Morten and Jenny Hancock. (2020).** "Innovation in payments." BIS Quarterly Review, March.
- Bech, Morten, Jenny Hancock, Tara Rice, and Amber Wadsworth. (2020).** "On the future of securities settlement." BIS Quarterly Review, March.
- Bindseil, Ulrich and George Pantelopoulos. (2022).** "Towards the holy grail of cross-border payments." ECB Working Paper, August.
- Central Committee of the Communist Party of China & State Council of the People's Republic of China. (2019).** Outline Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area.
- Deloitte. (2017).** How blockchain can reshape trade finance.
- Financial Services Development Council/FSDC. (2020).** "Hong Kong's unique role in enhancing financial connectivity in the Greater Bay Area." June.
- Financial Stability Board/FSB. (2020).** "Enhancing cross-border payments - Stage 1 report to the G20: Technical background report." April.
- Financial Services Development Council/FSDC. (2022).** "Connecting data: Establishing Hong Kong as a cross-boundary financial data hub." December.
- Fintech Association of Hong Kong. (2019).** The GBA Fintech Report 2019.
- Hong Kong Exchanges and Clearing Limited/HKEX. (2020)** "An overview of OCASS." July.
- Hong Kong Exchanges and Clearing Limited/HKEX. (2022).** "Stock connect: Another Milestone. FAQ." September.
- Hong Kong Institute for Monetary and Financial Research. (2021).** Artificial Intelligence and Big Data in the Financial Services Industry: A Regional Perspective and Strategies for Talent Development.
- Hong Kong Monetary Authority/HKMA. (2018).** "Implementation of a Faster Payment System in Hong Kong." September.
- Hong Kong Monetary Authority/HKMA. (2019a).** "Consumer protection in respect of use of big data analytics and artificial intelligence by authorized institutions." November.
- Hong Kong Monetary Authority/HKMA. (2019b).** "High-level principles on artificial intelligence." November.
- Hong Kong Monetary Authority/HKMA. (2019c).** "Reshaping banking with artificial intelligence." December.
- Hong Kong Monetary Authority/HKMA. (2019d).** "Remote on-boarding of individual customers." September.

- Hong Kong Monetary Authority/HKMA. (2020a).** "Alternative credit scoring of micro-, small and medium-sized enterprises." October.
- Hong Kong Monetary Authority/HKMA. (2020b).** "Launch of iAM Smart." December.
- Hong Kong Monetary Authority/HKMA. (2020c).** "Transforming risk management and compliance: Harnessing the power of regtech." November.
- Hong Kong Monetary Authority/HKMA. (2021a).** "Keynote speech at Wealth Management Connect and Southbound Bond Connect Conference." November.
- Hong Kong Monetary Authority/HKMA. (2021b).** "Principles for financial market infrastructures: Disclosure for Central Moneymarkets Unit." November.
- Hong Kong Monetary Authority/HKMA. (2021c).** "Regulatory requirements on the Northbound Scheme." September.
- Hong Kong Monetary Authority/HKMA. (2021d).** "Regulatory requirements on the Southbound Scheme." September.
- Hong Kong Monetary Authority/HKMA. (2021e).** "Remote on-boarding and iAM Smart." May.
- Hong Kong Monetary Authority/HKMA. (2021f).** "The Next Phase of the Banking Open API Journey" June.
- Hong Kong Monetary Authority/HKMA. (2022a).** "Joint announcement of the People's Bank of China, the Hong Kong Securities and Futures Commission and the Hong Kong Monetary Authority." July.
- Hong Kong Monetary Authority/HKMA. (2022b).** "Launch of Greater Bay Area Fintech Pilot Trial Facility." February.
- Insurance Authority/IA. (2018).** "Speech by Dr Moses Cheng, Chairman, at the Guangdong-Hong Kong-Macao Greater Bay Area Summit on Insurance Connect." September.
- Insurance Authority/IA. (2020).** "Launch of iAM Smart." December.
- International Monetary Fund/IMF. (2014).** "People's Republic of China - Hong Kong Special Administrative Region – Financial sector assessment program - Oversight and supervision of financial market infrastructures." July.
- Kuhn, B. (2021).** China's Greater Bay Area. Wirtschaftsdienst.
- Lai, E. L.-C. (2021).** One Currency, Two Markets: China's Attempt to Internationalize the Renminbi. Cambridge University Press.
- Mandatory Provident Fund Schemes Authority/MPFA. (2020).** "Launch of iAM Smart." December.
- McKinsey Global Institute/MGI. (2019).** "Digital identification: A key to inclusive growth." April.
- National Development and Reform Commission, People's Government of Guangdong Province, Government of the Hong Kong Special Administrative Region & Government of the Macao Special Administrative Region. (2017).** Framework Agreement on Deepening Guangdong-Hong Kong-Macao Cooperation in the Development of the Greater Bay Area
- Our Hong Kong Foundation. (2021).** Central Bank Digital Currency: the cornerstone of digital financial infrastructure.
- People's Bank of China/PBC. (2005).** 中国人民银行关于内地银行与香港银行办理人民币业务有关问题的补充通知. December.

People's Bank of China & State Administration of Foreign Exchange. (2011). Regulations on Funds of Securities and Futures Investment by Foreign Institutional Investors.

People's Bank of China, China Securities Regulatory Commission & State Administration of Foreign Exchange. (2020). Measures for the Administration of Domestic Securities and Futures Investment by Qualified Foreign Institutional Investors and RMB Qualified Foreign Institutional Investors.

Ruan, Liyao and Yanming Yan. (2022). "Comparative analysis on and implications from models and arrangements of cross-border CSD links." Chinabond, January.

Securities and Futures Commission/SFC (2020). "Launch of iAM Smart." December.

Statista. (2021). "Most used digital payment smartphone applications among respondents from nine mainland cities in Greater Bay Area of China compared to Hong Kong in the past 12 months as of October 2019." March.

World Bank. (2020). "Summary outcomes of the fifth global payment systems survey." June.

World Bank (2021). "Implementation considerations for fast payment systems." June.

World Bank (2022). "Remittance Prices Worldwide Quarterly." September.

ABOUT THE HONG KONG ACADEMY OF FINANCE (AOF)

The AoF is set up with full collaboration amongst the Hong Kong Monetary Authority, the Securities and Futures Commission, the Insurance Authority and the Mandatory Provident Fund Schemes Authority. By bringing together the strengths of the industry, the regulatory community, professional bodies and the academia, it aims to serve as (i) a centre of excellence for developing financial leadership; and (ii) a repository of knowledge in monetary and financial research, including applied research.

ABOUT THE HONG KONG INSTITUTE FOR MONETARY AND FINANCIAL RESEARCH (HKIMR)

The HKIMR is the research arm of the AoF. Its main remit is to conduct research in the fields of monetary policy, banking and finance that are of strategic importance to Hong Kong and the Asia region. The Applied Research studies undertaken by the HKIMR are on topics that are highly relevant to the financial industry and regulators in Hong Kong, and they aim to provide insights on the long-term development strategy and direction of Hong Kong's financial industry.

CONTACT US

Email: hkimr@hkma.gov.hk

Tel: +852 2878 1706

Website: <https://www.aof.org.hk/research/HKIMR>



This is printed on environmentally friendly paper

