Chapter 3

Banking Sector in the Digital Age: Balancing Innovation and Stability

Highlights

- The digitalization of banking services has picked up significantly in ASEAN+3 over the past decade amid strong policy support across the region. While customer demand for convenience and efficiency is probably the most important driver, technological developments and their innovative applications by new financial industry entrants have also contributed immensely to digitalization efforts. Furthermore, policymakers in ASEAN economies with low financial and high mobile-phone penetration have made an additional push for digitalization to promote financial inclusion.

- In the private sector, the digitalization efforts have been driven by fintechs, bigtechs, traditional banks, and digital banks. While fintechs have thrived in the payments, alternative lending, wealthtech, and insurtech domains, bigtechs have leveraged their ecosystems to provide financial services. Traditional banks have invested heavily in overhauling technology as they seek higher efficiency and strong customer retention.

- Digital banks are an emerging sector in ASEAN+3 economies. While the emphasis on digital channels reduces operational overheads, digital banks face pressures from heavy technological investments and customer acquisition costs in the first few years of doing business. Many digital banks in the region are either owned by or have partnerships with technology, e-commerce, and telecom companies to leverage their customer bases and reduce customer acquisition costs. Digital banks are still much smaller than incumbent banks but have expanded rapidly in recent years.

- Digitalization may affect market structure and could change the nature and distribution of financial stability risks. Operational risks, which include cybersecurity and fraud, are probably the most pronounced risks emanating from digitalization, followed by systemic risks, which can emerge from nonfinancial companies. The financial inclusion objectives and still developing financial systems in ASEAN economies could expose the new players to higher credit and business risks.

- A holistic approach to sound and prudent regulatory frameworks is key to facilitating further innovation while safeguarding financial stability. As there is no one-size-fits-all solution, authorities must use a mix of policy approaches to manage digitalization, depending on the nature of risks and maturity of industry segments. Policy should focus not only on preventing risk incidents but also on ensuring the quick recovery and resilience of the system, with frameworks for appropriating responsibilities (risk-sharing) across the banking value chain. Financial safety nets and effective communication can also play an important role during stress periods to help contain contagion and restore confidence.

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I. Overview

The past decade has brought an unprecedented rise in financial digitalization,[1] with technological progress and innovations transforming the financial industry. While there was always a demand for fast and efficient financial infrastructure and services, a combination of changing user preferences, progress in technology, and an appropriate policy push created the perfect environment for the changes to materialize. Indeed, while the COVID-19 pandemic acted as a catalyst, the change was well under way before the pandemic (Ong and others 2023). Digitalization has affected almost every sector of financial services—i.e., banking and payments, insurance and occupational pensions, and securities and markets.[2]

The changes have offered a wide range of benefits to consumers and the financial institutions but also pose some financial stability challenges. Technological progress has helped improve customer experience, achieve speed and cost efficiencies, increase financial inclusion, and strengthen risk management and compliance (World Bank 2022; BCBS 2024). However, these advances also have implications for financial stability. Financial digitalization could affect market structure (He and others 2017) and change the nature and distribution of financial stability risks. Risk monitoring systems and regulations need to adapt proactively to financial stability risks, while embracing technological advancement.

The spectrum of financial services undergoing tech-enabled transformation is wide. This chapter therefore focuses specifically on the transformation of banking and payment services and analyses potential financial stability risks.[3] It also provides a policy discussion about tackling the issues pre-emptively, without stifling innovation. Section II highlights drivers of the digitalization of banking services which include supply and demand-side factors as well as policy initiatives identified through a survey of ASEAN+3 authorities. Section III discusses the changing financial landscape resulting from digitalization and Section IV dives deeper into the emerging segment of digital banks in the region.[4] Section V analyzes the potential risk to financial stability from digitalization. Section VI assesses policies for containing and managing the risks emerging from digitalization of banking services while reaping their benefits.

[1] The use of new technologies and innovations to transform the delivery of traditional banking and financial services, covering a variety of applications, products, processes, and business models (Ong and others 2023).

[2] Financial services are classified as described in EBA, EIOPA, and ESMA (2024).

[3] The study is handicapped by extensive data not being available. Therefore, it relies on interviews and surveys with private sector enterprises and policymakers, while leveraging existing research.

[4] Digital banks include banks classified as virtual banks, internet banks, and banks which may have some branches but predominantly conduct business through mobile or internet channels.

II. Drivers of Digitalization in Banking Services

Financial digitalization has been picking up significantly across the world. Progress has been driven by a wide variety of factors—from both the demand and supply sides. On the demand side for financial services, customers have become more tech-savvy and increasingly prefer financial services delivered digitally and instantly. Supply side changes have been enabled by technology that allows fintechs and banks to provide banking services to customers through mobile phone applications and process transactions instantly without compromising on compliance and security. Innovations led by fintech and bigtech companies have pushed banks to upgrade their service delivery. Regulators have also had a significant role, and they view digitalization as an effective medium to achieve policy objectives such as financial inclusion and monitoring transactions.

AMRO staff conducted a survey of ASEAN+3 authorities to understand their perspectives on the digitalization of banking services.[5] According to the results, on average, Plus-3 financial systems are more digitalized than in the ASEAN economies (Figure 3.1), which also explains the different drivers of digitalization across these economic groups. Digitalization is mostly demand-driven across the ASEAN+3 region: in ASEAN economies demand for improved services was a stronger factor, whereas in Plus-3 consumers wanted higher efficiency (Figure 3.2). Technological developments that enabled fintechs and bigtechs to innovate and compete with traditional banks were more relevant in Plus-3 economies, whereas the need for financial inclusion drove policy in ASEAN. The results also show how the private sector (through fintechs, bigtechs, and traditional banks) has led the digitalization efforts, with authorities providing a conducive environment and incentives across most of the economies. Demographic and financial penetration data for ASEAN provides credence to the survey findings (Table 3.1):

- A young, mobile-native population and high rates of internet and smartphone penetration have created a large base of tech-savvy consumers who are drawn to seamless, digital-first financial services.

- A significant unbanked and underbanked population has made financial inclusion a priority, prompting targeted initiatives from governments and regulators. Lack of financial penetration itself is a complex issue and could reflect multiple problems including lack of financial literacy and infrastructure, and geographical inaccessibility (mountainous terrains, archipelagoes, and so on).

The example of Cambodia's Bakong system demonstrates the effectiveness of technology to expand financial inclusion in places where financial penetration is poor but mobile penetration is high (Box 3.1).

[5] Eleven of the fourteen authorities provided, at least partially, both qualitative and quantitative inputs to the survey questions.

Box 3.1:

Cambodia's Bakong and Financial Inclusion: Advancing the Benefits of Digitalization

Cambodia has made progress in financial digitalization during the pandemic, as an element of its national strategy, with financial inclusion being a significant objective. Key strategies and policy frameworks[1] emphasize financial digitalization as a tool to increase access to financial services, maintain financial stability, accelerate economic development, and improve social welfare. Though the share of individuals (aged 15 or above) using digital financial services[2] has increased, Cambodia lags its peer countries (Table 3.1.1). The proportion of adults with bank accounts has improved but progress is slow in rural areas (Figure 3.1.1).

Financial digitalization expands access to financial services beyond traditional channels (BCBS 2024). Secure and accessible retail payment systems are vital for inclusion, with transaction accounts acting as gateways to credit, insurance, and savings (BIS and World Bank 2016). Digital payment histories help individuals and small businesses to access credit despite having limited financial records.

To advance this agenda, Cambodia's NBC has upgraded its national payment system (Figure 3.1.2),[3] notably through the 2020 launch of the Bakong blockchain-based platform (NBC 2020). Bakong integrates bank and mobile money accounts,[4] enabling real-time, low-cost, peer-to-peer transactions. It supports both KHR and USD, is interoperable across banks and payment service institutions through KHQR, and features a simplified know-your-customer process to expand access—especially in rural areas, among small businesses, and in agriculture.

Table 3.1.1. Financial Digitalization and Access to Formal Financial Services

	2017	2021	2024				
	KH	KH	KH	VN	TH	PH	SG
1. Has a bank or similar financial institution account (% of 15+)	22	33	39	71	92	50	98
2. Owns a debit card (% of 15+)	7	15	12	65	57	20	95
3. Made or received a digital payment (% of 15+)	16	26	32	62	83	40	95
4. Sent/received domestic remittances through accounts (% of 15+ remittance senders/recipients)	12	10	46	53	80	52	82
5. Received wages in cash only (% of 15+ wage recipients)	88	72	58	21	31	63	2

Source: World Bank's Global Findex Database 2021, 2025.
Note: (1)-(3): Percent of people aged 15 or above (15+); (4): Percent among remittance senders/recipients aged 15+; (6): Percent among wage recipients aged 15+. KH = Cambodia, PH = Philippines, SG = Singapore, TH = Thailand, VN = Vietnam. Underlined numbers are from 2021.

The authors of this box are Kuchsa Dy and Andrew Tsang.

[1] Key strategic frameworks include the Financial Sector Development Strategy 2016–2025, National Financial Inclusion Strategy 2019–2025, Cambodia Digital Economy and Society Policy Framework 2021–2035, and Cambodia Financial Technology Development Policy 2023–2028.

[2] In this context, digital financial services refers to digital services including debit and credit cards, digital payments, money transfer services for remittances, and digital wage receipts.

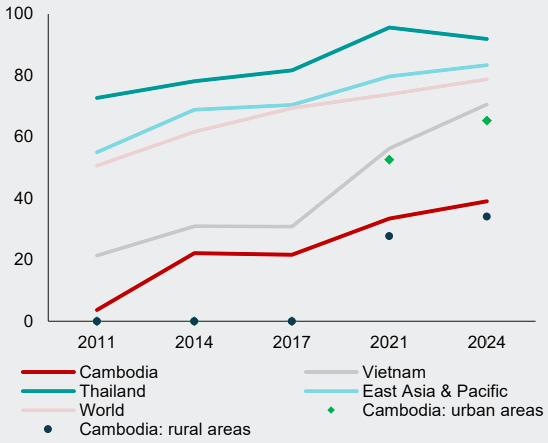
[3] The NBC has developed several payment systems: (1) National Clearing System (NCS), a deferred net settlement platform primarily facilitating banks' net settlements and fund transfers, (2) Online Banking System (OBS), providing online banking services for banking and financial institutions (BFIs) as well as government agencies, (3) FAST Payment System, enabling instant retail payments, with settlement occurring at the end of the day (KHR only), (4) Retail Pay System, supporting real-time fund transfers for both KHR and USD, with a QR payment component under development, (5) Cambodian Shared Switch (CSS), operating as a payment card scheme which allows ATM cards issued by one bank to be used at the ATMs of other banks, (6) Bakong Tourist App, streamlining transactions for travelers by linking their Bakong accounts to MasterCard or Visa cards, or by allowing funds to be added at participating banks.

[4] Popular payment service institutions such as Wing and TrueMoney have traditionally catered to unbanked and underbanked populations, particularly in rural and remote areas where formal banking infrastructure remains limited. These rely on low-cost and extensive physical agency networks and provide mobile accounts or e-wallets that are readily accessible because of KYC requirements have been simplified.

High mobile penetration has boosted the uptake of digital payments, while Bakong's cross-border functions[5] support remittances, trade, and tourism—further promoting account ownership and financial inclusion. By the end of 2024, Bakong reached 30 million users, and the number of KHQR-registered merchants grew to 4.5 million. Between 2022 and 2024, digital transaction value rose 67.7 percent to KHR 2,728.9 trillion (14.7 times GDP, up from 9.9 times GDP), with Bakong's share increasing from 7.0 percent to 22.2 percent (KHR 605.6 trillion), second only to mobile banking (31.8 percent) and ahead of e-wallets (17.2 percent of total digital transaction value) (Figure 3.1.3). Financial inclusion also improved: e-wallet accounts rose from 13.6 million to 20.7 million in number, and bank accounts from 12.7 million to 23.3 million (Figure 3.1.4).

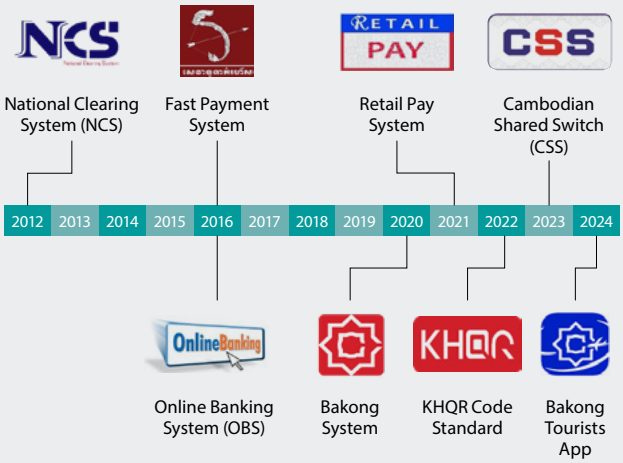
However, cash remains dominant, especially for paying wages (Table 3.1.1), resulting from the large informal sector. Expanding digital wage initiatives, such as IFC pilots in garments,[6] to sectors like hospitality could boost formal financial access. Persistent cash savings also point to trust and literacy gaps. Addressing these through financial education, consumer protection (e.g., deposit insurance), and stronger digital and cybersecurity frameworks will be key for sustainable, inclusive digital finance.

Figure 3.1.1. Percentage of Adults (15+) with Bank or Financial Institution Accounts
(Percent)



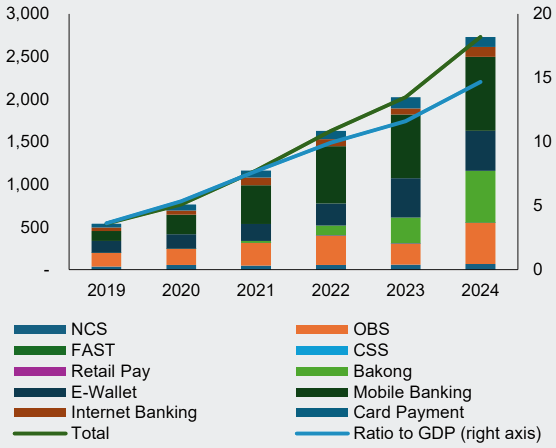
Source: World Bank's Global Findex Database 2021, 2025.

Figure 3.1.2. NBC's Payment System Infrastructure



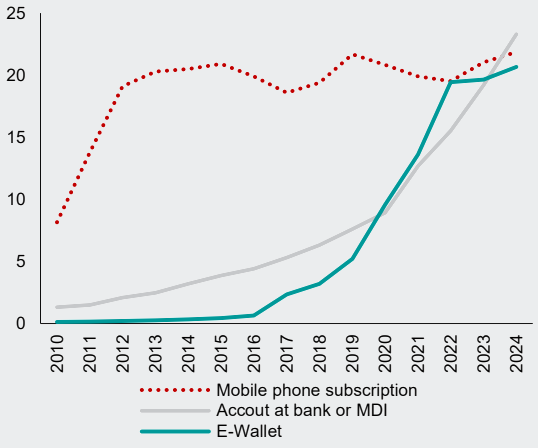
Source: National Bank of Cambodia; AMRO staff compilation.

Figure 3.1.3. Value of Digital Payment Transactions by Payment Systems
(Trillions of Cambodian riel; percentage of GDP)



Source: National Bank of Cambodia; AMRO staff calculation.
Note: Mobile banking transactions refer to digital transactions in mobile bank accounts through bank payment systems. E-Wallet transactions refer to digital transactions in e-wallet accounts through bank and financial institutions (BFIs) and the systems of payment service institutions. Refer to Figure 3.1.2 for payment systems abbreviations.

Figure 3.1.4. Number of Bank Accounts, E-Wallet Accounts, and Registered Mobile Subscriptions
(Number of accounts/subscriptions in millions)



Source: National Bank of Cambodia; CEIC.
Note: MDI = microfinance deposit-taking institution

[5] This includes interoperability with Union Pay, Alipay, and payment systems in Thailand, Lao PDR, Vietnam, Malaysia, and Korea, and the launch of the Bakong Tourist App.

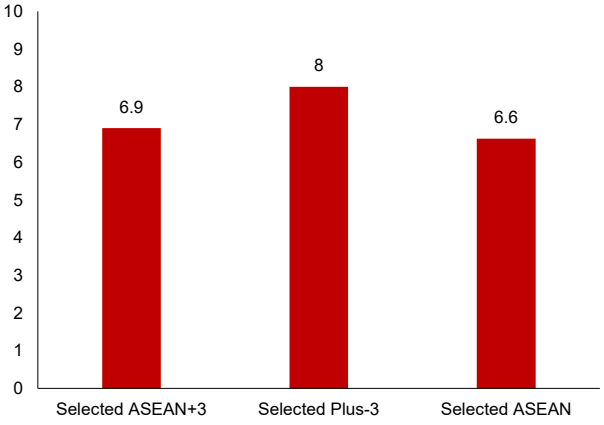
[6] Research by the International Finance Corporation and BSR's HERproject™(2022), "The Potential Gains of Digitizing Garment Sector Wages in Cambodia" found that digitizing wage payments in the garment sector could enhance supply chain efficiency while bringing large numbers of unbanked workers—especially women—into the formal financial system.

The COVID-19 pandemic accelerated digital adoption (Ong and others 2023), pushing both consumers and institutions to embrace online channels. Supportive regulatory frameworks, public investment in digital infrastructure, and rising financial and digital literacy have built trust and enabled rapid digital transformation across ASEAN+3.

Demand and supply factors, along with the policy objectives, are crucial for driving the digitalization efforts, yet progress is highly dependent on the enabling technologies. Table 3.2 provides a list of important technological innovations and their role in improving banking services. Our survey of ASEAN+3 authorities shows that most technologies listed in the table are used across the region, but authorities are especially intrigued by the immense potential of artificial intelligence and machine learning (AI/ML) and data analytics. They also highlight the increasing adoption of cloud-based solutions by financial institutions.

Figure 3.1. Selected ASEAN+3: Extent of Digitalization of Banking Services
(Scale of 1 to 10)

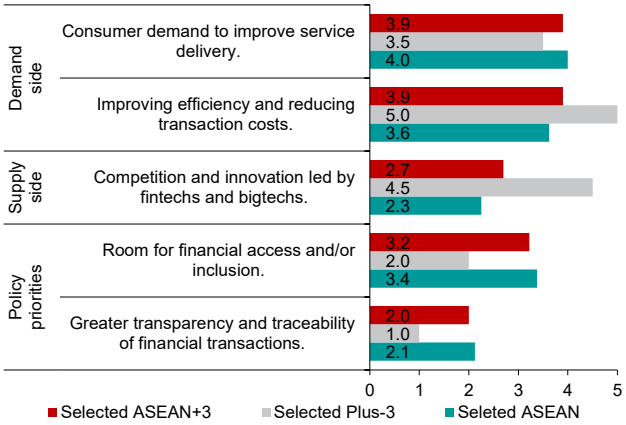
On average, the Plus-3 are more digitized than ASEAN economies.



Source: Authority Survey; AMRO staff compilation.
Note: Survey results for the question "On a scale of 1 (least) to 10 (most), how would you rate the extent of digitalization of banking services in your economy? Why?" *[Enter 10 if all the banking services listed in the context have been digitalized and 1 if none are digitalized].* Figures shown are the averages for the selected economy groups.

Figure 3.2. Selected ASEAN+3: Key Drivers of Financial Digitalization
(Ranked from 1 to 5 in significance)

Demand-side factors drive digitization across the region.



Source: Authority Survey; AMRO staff compilation.
Note: Survey results for the question "What are the drivers of digitalization of banking services in your economy?" *[Rank from 5 for most significant and 1 for least; enter NA for drivers that are not applicable].* Demand, supply and policy drivers are included in the survey, with respondents also able to input any other driver with its corresponding significance. The Figures shown are averages for the selected economy groups.

Table 3.1. ASEAN+3: Demographics and Penetration of Banking, Internet, and Mobile Services

Large tech-savvy consumers and unbanked populations drive financial digitalization in the region.

Economy	Unbanked Population (Percent)	Cash Transactions (Percent)	Card Transactions (Percent)	Number of ATMs per 100,000 adults	Internet Penetration (Percent)	Mobile Penetration	Median Age
Brunei	-	-	-	73.1	99	127	31.8
Cambodia	60.97	-	-	52.2	61	121	25.8
China	10.62	4.2	17.7	82.2	78	128	39.1
Hong Kong	2.69	7.6	52.4	46.7	96	319	46.2
Indonesia	43.67	36.4	20.5	50.5	69	125	29.8
Japan	1.48	36.3	38.9	109.6	87	178	49
Korea	3.11	6	66.3	245.2	97	162	44.5
Lao PDR	62.35	-	-	28.7	64	65	24.3
Malaysia	11.31	22	33.5	57.9	98	143	30.1
Myanmar	52.21	-	-	6.9	59	121	29.5
Philippines	49.82	39	24.3	30.1	84	117	25.3
Singapore	2.03	11.4	50.7	55.6	94	173	35.1
Thailand	8.18	28.4	14.3	113.5	90	169	39.7
Vietnam	29.45	32.8	18.1	30.9	78	131	32.4

Source: World Bank, Worldpay's Global Payments Report 2025; IMF Financial Access Survey (FAS); United Nations (UN); AMRO staff compilations.
Note:
1. Statistics on unbanked population are drawn from the World Bank's Global Findex Database 2025, which compiles surveys in countries and economies worldwide. The measure is based on the proxy "Account (%, 15+)", which measures the percentage of respondents who report having an account (by themselves or together with someone else) at a bank or similar financial institution or report personally using a mobile money service in the past year. All data refer to 2024, except for Myanmar, which is as of 2021.
2. Statistics on cash and card transactions are drawn from the Worldpay's Global Payments Report 2025. All data refer to 2024.
3. Statistics on the number of ATMs per 100,000 adults are drawn from the IMF's FAS. All data refer to 2024, except for Brunei (2021), Hong Kong (2023), Korea (2023), Lao PDR (2023), Japan (2023) and Myanmar (2019).
4. Statistics on internet penetration are drawn from the World Bank and refer to individuals using the Internet in 2023.
5. Statistics on mobile penetration are drawn from the World Bank and refer to mobile cellular subscription per 100 people in 2023.
6. Statistics on median age are drawn from the UN. All data are as of 1 July 2023.
7. Cells with "–" denote no data. The darker red shades indicate a stronger case for the use of financial digitalization.

Table 3.2. Technologies that Enable the Modernization of Banking Services

Technology	Description	Selected Examples of Use Cases
Cloud Computing	Cloud computing facilitates the on-demand delivery of IT services and resources through the internet through various deployment models, such as public, private or hybrid clouds. It helps banks with cost efficiency, operational flexibility, and scalability, and it offers robust security tools. Cloud adoption also reduces reliance on capital-intensive infrastructure, allowing banks to innovate and scale more rapidly.	• Migration and hosting of core banking system and IT infrastructure (Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS)). • Data analytics and applications (e.g., fraud detection, personalized customer insights, real time collaboration, GenAI tools), either through Software-as-a-Service (SaaS) or bank-developed models deployed through PaaS.
Application Programming Interfaces (API)	APIs are sets of rules and protocols that enable different software applications to communicate and interact. APIs generally provide stronger security than other data-sharing methods by shielding the internal architecture of systems and disclosing only selected information. APIs support the integration and interoperability of independent software applications, enabling digital resources to be unlocked from silos and made reusable across a range of contexts, while offering institutions greater control over the accessibility of data.	• Enables open banking third-party integration with fintechs (such as e-wallets and ride-hailing apps) to support account information sharing, payment initiation, and other embedded financial services. • Digital onboarding and Electronic Know Your Customer (e-KYC) by connecting to external databases such as national identification registries. • Bank integration with national payment systems for real-time transfers (e.g., PromptPay Thailand).
Mobile Technology	Mobile technology refers to the set of electronic devices, software, and wireless communication systems that enable users to access information, communicate, and perform services in real-time regardless of physical location.	• Smartphones and mobile networks allow on-the-go access to digital banking applications. • Built-in mobile cameras and biometrics technology (e.g., facial, fingerprint) support e-KYC functions.
Artificial Intelligence (AI)	AI refers to technologies that can perform tasks traditionally requiring human cognition such as prediction, classification, and decision-making. It is a broad umbrella encompassing machine learning, large language models (LLMs) and Generative AI (GenAI). AI enables banks to enhance efficiency, improve risk management, and deliver more personalized customer experiences at scale.	• Support administrative and operational processes (e.g., summarize reports, knowledge management). • Customer engagement and servicing (e.g., chatbots, personalized content, AI bank teller). • Compliance (e.g., transaction and fraud monitoring). • Core business activities (e.g., analyze factors for loan approval, portfolio construction and selection).
Digital Ledger Technology (DLT)	DLT refers to infrastructure and protocols that allow multiple participants across locations to propose, validate, and record transactions in a synchronized manner without relying on a central authority. Depending on their design, DLTs can offer strong security, high data integrity, with varying degrees of transparency. They often support programmability through smart contracts, which execute automatically when predefined conditions are met.	• Real-time cross-border payments and foreign exchange transactions (e.g., Project mBridge). • Cross-border clearing and settlement of local currency bonds (e.g., Project Tridecagon). • Trade finance and supply chain tracking.

Source: AMRO staff compilation from articles, reports and websites.

Benefits of digitalization in safeguarding financial stability

Digitalization not only addresses consumer demand and direct policy objectives, but it can also significantly improve financial sector resilience and help safeguard financial stability. Technology, with appropriate policy frameworks, strengthens compliance and risk management, makes reporting efficient, and helps identify real-time vulnerabilities.

Compliance and risk identification: Technology has helped automate and streamline compliance procedures such as Know Your Customer (KYC) and Anti-Money Laundering/Combating the Financing of Terrorism (AML/CFT), making them faster and more efficient. Biometric and advanced document verifications help establish customer identity, which may be verified using Application Programming Interfaces (APIs) to centralized databases, while Robotic Process Automation (RPA) collects customer information from various sources to automate compliance. Financial institutions are also leveraging technologies such as real-time analytics and automated monitoring systems that scan transactions for suspicious patterns using AI and machine learning algorithms. These algorithms can process large volumes of data, learn from historical trends, adapt to evolving threats, and improve their detection of suspicious activities, to improve both the accuracy and speed of risk identification (FATF 2021).

Cyber protection and business continuity: Robust cybersecurity practices protect financial institutions and their customers while enhancing the overall stability and resilience of the system. This reduces the risk of disruption from cyberattacks and maintains trust in digital financial services. Implementing multilayered detection controls—spanning people, processes, and technology—ensures that each layer is a safeguard for the others (BIS 2016). Technology also enables rapid response to potential breaches, minimizing the effect of cyber incidents. In addition, a well-designed business continuity plan can further reinforce the financial resilience of individual firms and the broader system.

Faster response and recovery: Beyond real-time monitoring and automation, advanced technologies can facilitate faster responses and recovery following a crisis. Cloud services, in particular, offer strong disaster recovery and business continuity capabilities for financial institutions. Features like redundancy, automatic backups, and data distribution help institutions recover from service disruptions and cyberattacks more effectively and efficiently (Uppaluri 2025). Technology-enabled innovations—regtech, when adopted by financial institutions for regulatory reporting and compliance purposes; suptech, when used by supervisory authorities to support supervision—can help financial regulators monitor the increasingly digitalized financial system and respond to incidents in real time. These technologies support early detection of regulatory breaches, enable the integration of broader data into stress testing, and enhance responsiveness to emerging risks such as liquidity imbalances—allowing authorities to act swiftly and decisively.

Functional resilience: One of the key policy objectives behind financial digitalization, especially in the emerging and developing economies, is to increase financial inclusion.[6] Beyond strengthening the financial resilience of consumers, financial inclusion also contributes to the overall resilience of the financial system. Integrating the unbanked and underserved into the formal financial system diversifies customer bases and reduces the concentration risks faced by financial institutions. For example, deposit inclusion can strengthen banks' resilience by attracting more stable retail deposits from individuals and small businesses (Ahamed and Mallick 2019). Similarly, credit inclusion supports loan diversification by spreading credit exposure across a larger number of small borrowers, thereby lowering banking risks, particularly in emerging markets (Naceur and others 2024). Furthermore, expanding access to financial services requires stronger safeguards—such as effective consumer protection and robust regulatory frameworks—which help build trust and promote greater financial system stability (Lin and Ashwin 2024).

III. The Evolving Ecosystem of Banking Services in ASEAN+3

Banking is undergoing a structural transformation as technology is reshaping the delivery of products and services and altering the market structure. Technology has disaggregated and reconfigured the traditional banking value chain, enabling new entrants, including nonbanks, to participate in the provisioning of banking services. The financial landscape in ASEAN+3 has four major types of private firms, which are key participants in the digitalization of banking services.

1. **Fintech firms (fintechs)** provide innovative financial products and services with their differentiated and customer-centric value propositions, collaborative business models, and cross-skilled and agile teams (McKinsey & Company 2023).

2. **Bigtechs**, or large technology companies, use their competitive advantage of tech expertise, access to large amounts of user data, and network effects within their ecosystem to provide an array of innovative financial services.

3. **Traditional banks** embrace digital transformation to adapt to changing customer preferences and competition, while staying up to speed with technological developments.

4. **Digital banks** have emerged in ASEAN+3 due to either a regulatory push or attempts by nonfinancial firms to diversify into banking services. They aim to bring together the advantages offered by fintechs and traditional banks.

While the private sector has innovated and invested significantly in digitalization, the public sector has also encouraged these efforts to foster innovation and achieve varied policy goals.

[6] Financial digitalization improves digital financial inclusion and can also increase the digital divide between countries that is due to demographics, digital and financial literacy, and access to technology. Within a country, the divide may exist between urban and rural populations, larger and small institutions, and so on.

Fintechs: Specialized Technology Solutions

Fintechs typically use an asset-light, technology-driven, and targeted strategy that allows them to address specific market inefficiencies in the banking value chain and deliver more accessible, efficient, and cost-effective solutions (BIS 2021; BCBS 2024). ASEAN+3 is at the forefront of financial digitalization and has made great progress in the past decade (ADB 2023; Ong and others 2023). The region has a thriving fintech landscape with ASEAN+3 cities steadily appearing among the top global startup ecosystems (Startup Genome 2025). Fintech investments in ASEAN-6[7] have been resilient (UOB, PWC, and SFA 2024) and the revenue projections for Asia are also stronger than the rest of the world, expected to grow 36 percent annually from 2024 to 2030 (Figure 3.3).

Payment solutions constitute the largest share of fintechs in ASEAN+3 operating in the banking and payments domain.[8] Besides payments, ASEAN fintechs (ex-Singapore) are focused on alternative lending, whereas Plus-3 and Singapore have more firms in wealthtech and insurtech solutions (Mittal and others 2016; Choi 2024; UOB, PWC, and SFA 2024; HKUST and others 2025; Singlife 2025). Alternative lending platforms cater to financially underserved segments, which aligns with the greater need for financial inclusion in ASEAN (ex-Singapore). In contrast, fintechs in most Plus-3 economies and Singapore focus on providing more sophisticated financial services.

The dominance of payment fintechs in ASEAN+3 is a result of high transaction volumes, relatively lighter regulatory requirements, and, in some cases, a strong push by the authorities (Pande and others 2025). Payment regulations focus largely on consumer protection and anti-money laundering and have lower guardrails (compared to banking) on prudential and capital requirements, thus reducing entry barriers. ASEAN+3 authorities undertook initiatives such as QR code standardization (e.g., SGQR, QRIS, KHQR) and developing digital payment infrastructures (e.g., PromptPay, PayNow, DuitNow), while providing targeted policy and regulatory support and engaging in public education to encourage cashless payments. These efforts have led to a significant rise in the share of cashless payments (Figure 3.4).

Fintech lenders in ASEAN play an important role in improving financial inclusion by broadening access to credit for underserved individuals and small businesses. Peer-to-peer (P2P) lending platforms connect borrowers with investors and use alternative credit evaluations for borrowers lacking credit or financial history.[9] Providers of Buy Now, Pay Later (BNPL) services offer short-term consumer credit at point of sale, often without requiring conventional credit checks. Some fintechs have also embedded their financial products and services within specialized nonfinancial services.[10] Separately, wealthtech and insurtech aim to reduce friction in the provision of wealth management and insurance products to an expanding number of consumers.

Most fintechs in banking and payments either directly compete with banks or provide services to banks,[11] but many can operate as "adjacent competitors"—i.e., providing services that banks have chosen not to offer. These fintechs add value to traditional bank products by helping improve customer engagement and tap new customer segments quickly (BCG and QED Investors 2022). For example, banks in Indonesia invest in P2P platforms to lend to customers who may have limited access to financial services. The P2P platform helps with customer onboarding, due diligence, credit evaluation, and loan disbursements and recovery, which allows the bank to expand its borrower base without taking up much operational overhead.

Bigtechs: Platform Integration

Large technology companies (or bigtechs) that specialize in nonfinancial products or services may use their ecosystems to seamlessly integrate financial services. They often leverage a large customer base, brand recognition, a strong financial position, access to a rich user data network effect (data-network-activities loop),[12] and ecosystem integration to generate synergies between the core product and the financial services to improve customer experience (Box 3.2). They deliver personalized services, reduce marginal costs, and reinforce user engagement to acquire, service, and retain customers and reduce frictions by offering a wide range of interlinked services in "super apps." The ecosystem integration also helps them serve underbanked segments, such as gig workers and small businesses.

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7 Includes Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam.

8 These include fintechs that provide services directly competing with those provided by traditional banks—i.e., those providing services similar to banks to customers who are current or prospective banking sector clients. Therefore, it excludes banking tech, blockchain, digital asset and cryptocurrency platforms, and cybersecurity firms.

9 These can include a wide range of information, which can facilitate credit profiling. These may include demographics (age, gender, employment), geographical location (place of residence, place of work), transaction data (bill payment history, type, volume, and nature of financial transactions), and social media profiling (user preferences, potential income through social media, and so on).

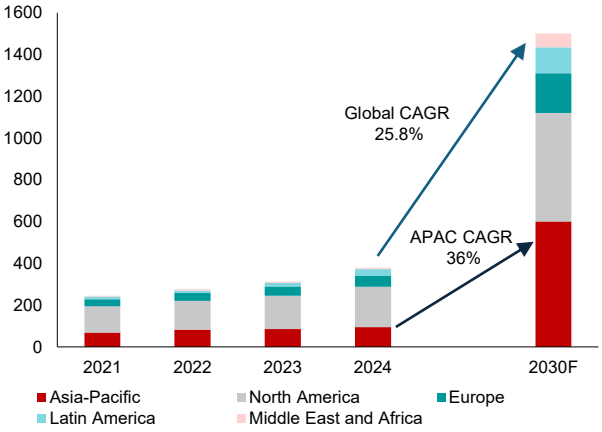
10 For example, a supply chain management solution may also provide working capital and purchase order financing.

11 These include, but are not limited to, marketing support, data and analytics, risk management, and other technological solutions.

12 Data analytics enhances user experience and attracts more users to participate in the platform of a big tech. The expanding user base amplifies cross-side network externalities, further enhancing the platform's value. When the number of users reaches a critical mass, the bigtech can roll out more service activities on the platform. This will generate more data and fuel the next round of the data-network-activities loop.

Figure 3.3. Selected Regions: Fintech Revenues
(Billions of US dollars)

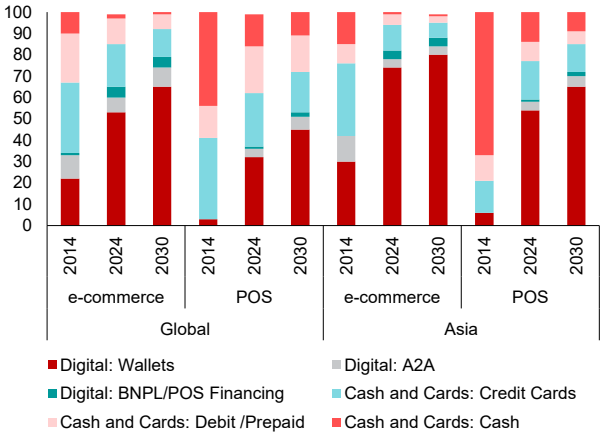
Asia fintech revenue projections remain stronger than the rest of the world and are expected to grow rapidly.



Source: Boston Consulting Group (BCG); AMRO staff calculations.
Note: 2021 values were back calculated from the 2030 forecast using the Compounded Annual Growth Rate (CAGR); 2023 values were obtained by linear interpolation.

Figure 3.4. Global and Selected Asia: Share of Payment Modes in E-commerce and Point of Sale Transactions
(Percent of total)

There has been a significant rise in the share of cashless payments, both globally and in Asia.



Source: WorldPay's Global Payment Report 2025; AMRO staff calculations.
Note: The data for 2030 are forecasts. Selected Asia includes Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, Korea, Taiwan Province of China, Thailand, and Vietnam. BNPL =Buy Now, Pay Later, POS = point of sale, A2A = Account to Account transfer.

Box 3.2:

Mobile Payment Solutions by Bigtechs in China

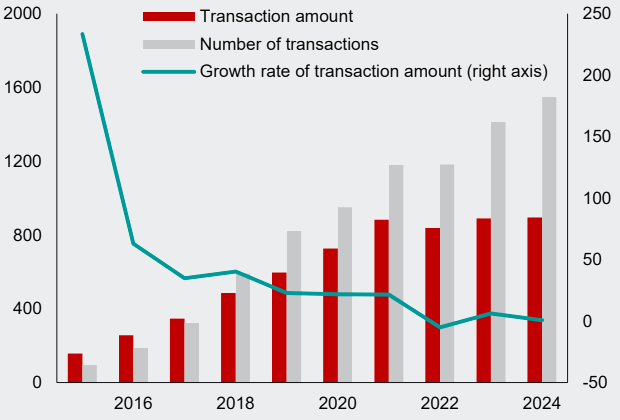
China has become a global leader in mobile payment adoption as digital transactions are now deeply embedded in everyday life. As of 2024, mobile payment transactions reached RMB 895 trillion—equivalent to 6.6 times the country's GDP—with a total of 1.55 trillion transactions recorded.[1]

Mobile payments started before 2010 but relied primarily on SMS and WAP protocols. In 2010, regulatory frameworks—most notably introduction of the "Nonfinancial Institution Payment Services Regulation" by the People's Bank of China—formally legitimized nonbank payment service providers (PSPs). This regulatory shift and increased smartphone penetration, drove exponential growth in the sector over the following decade (Figure 3.2.1). PSPs now account for about 80 percent of total digital payment transaction volumes in recent years (Figure 3.2.2).

Infrastructural inadequacies and device compatibility constraints made it a struggle for early bank-led initiatives to scale up.[2] In contrast, third-party platforms achieved rapid and widespread adoption by strategically integrating payment functionalities into existing digital ecosystems. Alipay leveraged the e-commerce infrastructure of Taobao, while WeChat Pay capitalized on Tencent's extensive social media network—making them the dominant players in the mobile payment landscape.[3] Mobile payments have since integrated into the financial ecosystems and transformed the operations of nonbank financial institutions in China. Alipay and WeChat Pay have evolved into multifunctional financial service platforms, offering a diverse portfolio of services including micro-lending, wealth management, and insurance products. Huabei, Alibaba's consumer credit product, caters to about 20 percent of China's consumer credit market. Its user base is largely young and has expanded credit access across urban and rural demographics.[4] Alipay and WeChat Pay's micro-lending products are linked to the People's Bank of China's credit registry, helping build formal credit histories.

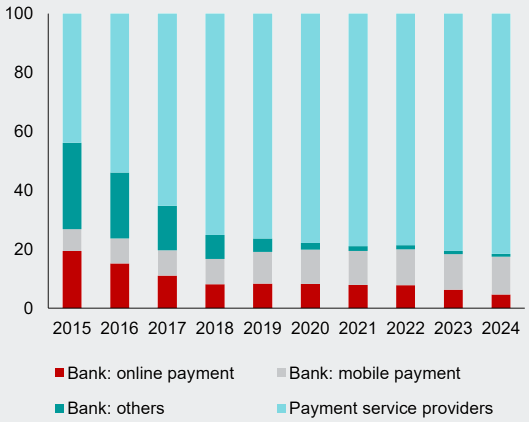
Yu'e Bao, launched by Alipay and Tianhong, saw its user base grow tenfold in five years, with AUM peaking at RMB 1.58 trillion in 2017. Regulatory tightening later reduced its market share from 67 percent to 38.2 percent, but it played a key role in improving financial literacy and lowering entry barriers to financial participation.[5] Alipay and WeChat Pay have also expanded into cross-border payments, supporting Chinese users abroad and foreign visitors to China. WeChat Pay now supports 31 currencies across 74 economies, and Alipay operates in over 70 economies through 36 PSP partners—enhancing accessibility for retail and small business transactions.

Figure 3.2.1. Mobile Payment Development
(Trillions of RMB/ number in 100 million; Percent)



Source: People's Bank of China; AMRO staff calculations.

Figure 3.2.2. Share of Digital Payment by Institution Types (by number of transactions)
(Percent)



Source: People's Bank of China; AMRO staff calculations.
Note: Other forms of banks' digital payment include telephone payments, ATM, and POS-based payments.

The authors of this box are Yang Jiao and Chenxu Fu.

[1] Digital payments, the broadest category under People's Bank of China definitions, include both bank and nonbank payment service providers (PSPs). For banks, this covers online, mobile, telephone, ATM, and point of sale payments; for nonbank PSPs, payments are predominantly mobile based. Mobile payment here refers to the sum of bank transactions conducted through mobile and total payments facilitated by nonbank PSPs.

[2] In 1999, China Mobile, the Industrial and Commercial Bank of China, and China Merchants Bank piloted SMS-based services in Guangdong.

[3] In 2024, Alipay and WeChat Pay accounted for 55 percent and 39 percent of total mobile payments.

[4] Notably, 60 percent of these users are geographically distributed across third-tier and lower-tier cities.

[5] The proportion of urban residents utilizing internet financial services increased from 8.5 percent in 2013 to 72.3 percent in 2024 (People's Bank of China 2025).

Shaping Consumer and Business Behavior

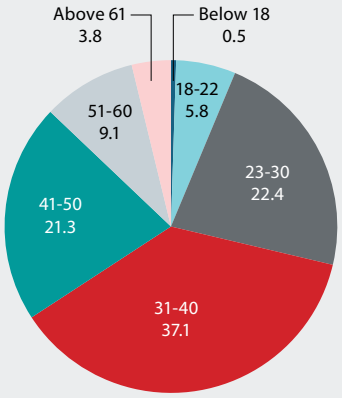
Mobile payments in China have been widely adopted, led by users aged 18–40 but with uptake rising among people aged over 40 (Figure 3.2.3). Use spans various contexts, with high penetration rates in food services, transportation, and public services (Figure 3.2.4). In urban areas, mobile payments, integrated with platforms, have accelerated the shift toward a cashless economy. In rural areas, they have boosted financial inclusion, with 77.5 percent of rural internet users adopting the technology (Payment and Clearing Association of China 2023). Mobile payments support rural revitalization. For micro, small and medium-sized entrepreneurs, PSPs have reduced operational barriers and improved market and credit access.[6]

Regulation for Emerging Risks

Mobile payment platforms in China advanced financial inclusion and grew into multifunctional ecosystems. In recent years, China has tightened regulation on mobile payment giants to manage the systemic and consumer risks associated with their rapid expansion. In response to growing financial risks, regulators designated large fintech firms as financial holding companies, subjecting them to capital and governance requirements comparable to those for banks. To address credit opacity and data monopolies, authorities also mandated that platform-generated consumer credit data be submitted to the central credit registry.

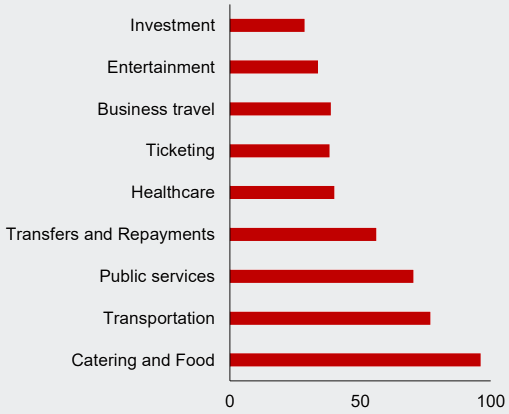
Regulations also address anti-competitive practices by prohibiting exclusive partnerships and mandating QR code interoperability, promoting a level playing field among PSPs. Oversight of money market funds has been tightened to mitigate liquidity and shadow banking risks. Cross-border payment services are now subject to enhanced know-your-customer and compliance standards. Key regulatory priorities include credit data integration, interoperability, and oversight of embedded financial products.

Figure 3.2.3. Distribution of Mobile Payment Usage by Age, 2023
(Percent)



Source: China Payment and Clearing Association.

Figure 3.2.4. Distribution of Mobile Payment Usage by Scenario, 2023
(Number of accounts/subscriptions in millions)



Source: China Payment and Clearing Association.

[6] Research indicates that more than 80 percent of small-scale merchants have adopted digital payment and credit instruments, with many leveraging platform-generated analytics to improve operational efficiency and strategic decision-making (Webank and Postal Savings Bank 2022).

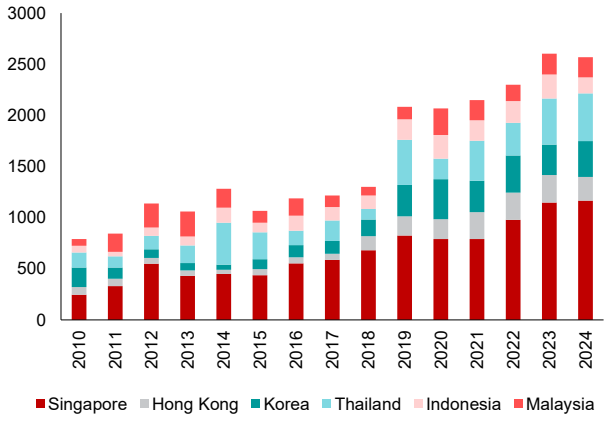
Traditional banks: Digital Metamorphosis

Traditional banks in ASEAN+3 have also increased their investment (Figure 3.5) in technology upgrades as they seek higher efficiencies, improved customer acquisition and retention, faster time to market, and higher balances in current and savings accounts (McKinsey & Company 2023).[13] They are adding more digital channels for customer engagement and are actively upgrading their core banking functions to fit their transformation goals. The use of omnichannel banking has led to a reduced number of ATMs and branches needed to serve their customers (Figure 3.6). Meanwhile, many ASEAN+3 authorities are encouraging digital-only and digital banks.

Some of the important changes being made to legacy IT systems include using cloud technologies to improve cost efficiency and roll out of new offerings faster, RPA to automate tasks and streamline processes, biometric technologies to improve security, and APIs for sharing data. Banks are also exploring the potential of AI/ML for use cases such as chatbots for 24/7 customer support, robo-advisors for investment advice, transaction screening for fraud detection, credit scoring, and offering personalized services to their customers. A few banks are looking into the use of distributed ledger technology (DLT) for tokenization of assets and deposits and other purposes such as payment, though DLT activities remain a small fraction of the market (BCBS 2024). Traditional banks also seamlessly partner with external firms using open banking to securely share data and services. These partnerships allow each party to leverage unique strengths and help banks reduce costs, accelerate innovation, and better meet evolving customer expectations.

Figure 3.5. Selected ASEAN+3: Investments by Banks in Technology
(Billions of US dollars)

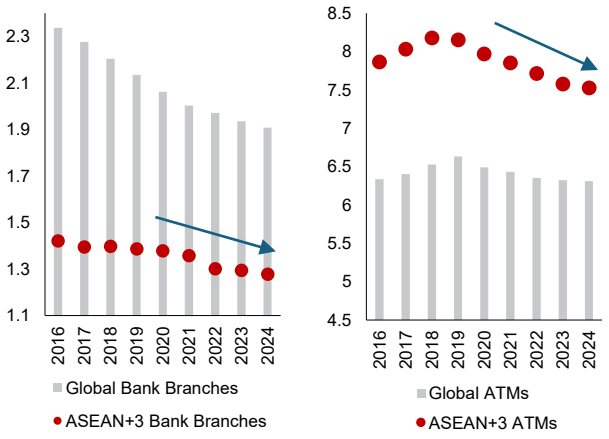
Banks in most economies have increased their technology expenses.



Source: Company balance sheets; AMRO staff calculations.
Note: Includes software additions (or the closest approximation) under intangible assets available in the three largest banks (by assets) of each of the markets.

Figure 3.6. Global and Selected ASEAN+3: Bank Branches and ATM Penetration
(Number per million adults)

Banks have reduced the number of branches and ATMs in recent years.



Source: IMF Financial Access Survey (FAS); AMRO staff compilation.
Note: The number of bank branches in ASEAN+3 excludes Brunei, Lao PDR, and Myanmar due to data unavailability. For Hong Kong, Japan and Korea, 2023 figures are used as proxies as 2024 data are not yet available. The number of ATMs in ASEAN+3 excludes Brunei and Myanmar due to data unavailability. For Hong Kong, Japan, Korea, and Laos, 2023 figures are used as proxies as 2024 data are not yet available.

Public Sector: Promoting Innovation to Pursue Policy Objectives

The public sector, including ASEAN+3 authorities and international organizations, have also led various initiatives to enable financial digitalization and promote innovation.

- The major contribution of the authorities has been in providing a conducive environment for financial digitalization. Steps have included modernization of compliance and regulatory processes (e-KYC, online AML/CFT), providing centralized, shared infrastructure (such as credit databases, identity verification, payment systems), providing safe testing grounds for new products and services (sandboxes, pilots), and encouraging the establishment of digital banks.

[13] Balances held in current and savings accounts are the least expensive for banks as they pay interest rates much lower than term deposits. Banks enjoy higher balances in current and savings accounts if they can embed various daily transaction services in their application. Depositors will maintain higher balances to seamlessly conduct daily transactions without worrying about the availability of funds.

- Many jurisdictions are establishing open banking and API infrastructures to give customers greater control over their own data while encouraging digital and data-driven innovation. In Malaysia, the development of a proposed regulatory framework and infrastructure to enable Open Finance is underway. However, this shift toward increased data sharing among financial institutions, services providers, and customers requires new regulatory considerations around data privacy, consent management, and cybersecurity (Kijang 2025). In Thailand, Project "Your Data" aims to let consumers share their financial and nonfinancial data with third-party service providers, based on consent.[14]

- Many ASEAN+3 economies have developed domestic FAST payment systems and cross-border links. ASEAN launched the Regional Payment Connectivity initiative to enable cooperation in cross-border payments. Various regional authorities, with support from the Bank for International Settlements (BIS), set up Nexus Global Payments, a system to provide multilateral payment connectivity to member economies (Pande and others 2025).

- Central banks have continued exploring the use of central bank digital currencies (CBDCs), along with their implications for financial stability and cross-border payments, and uses for wholesale and retail applications. Notably, the Philippines launched a wholesale CBDC pilot (BSP 2023) and China expanded its e-CNY pilot to test cross-border interoperability (HKMA 2024). Thailand concluded its retail CBDC pilot program (BOT 2024). Multiple ASEAN+3 central banks have also participated in many cross-border CBDC (or DLT) projects such as Dunbar (MAS 2022), mBridge (BISIH 2022), Stella (BOJ 2020), and Ubin (MAS 2020).

- Regulators acknowledge the potential of AI, including Generative AI (GenAI) and large language models (LLMs) in financial services but remain cautious about the risks. They have permitted low-risk AI use cases to improve customer experience, risk management, and operational efficiency. These applications include chatbots, real-time fraud and abnormal transaction detection, remote account opening, and automating administrative tasks such as proofreading and internal analysis (FSC 2024; HKIMR 2025).

IV. The Emergence of Digital Banks in ASEAN+3

Digital banks have emerged globally in response to technological innovation, regulatory reform, and consumer interest in more accessible and user-friendly banking services. Unlike traditional bricks-and-mortar banks, fully digital banks operate without physical branches[15] and deliver services entirely through digital channels such as mobile apps and internet platforms. This results in lower operating costs than traditional banks, which allows digital banks to charge lower fees and usually offer higher deposit rates.

Digital banks in ASEAN+3 generally serve dual objectives—financial inclusion and fintech innovation. The push for digital banking is linked closely to improving access for the unbanked and underserved small businesses and individuals, as well as increasing competition by modernizing banking services and fostering fintech innovation. While these are the overarching objectives for all ASEAN+3 authorities, China, Hong Kong, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam have emphasized more on financial inclusion while Japan, Korea, and Singapore are relatively more focused on increasing competition by modernizing banking services and fostering fintech innovation.

ASEAN+3 regulators have adopted pragmatic and adaptive licensing frameworks for digital banks. Korea, and the Philippines treat digital banks and traditional banks differently and issue dedicated digital bank licenses, while Hong Kong issues the same license as traditional bank with some tailored supervisory requirements and conditions. These digital banks can start offering the full suite of banking services as soon as they obtain the license. Malaysia, Singapore, and Thailand implement structured licensing frameworks, beginning with restricted operational phases with simplified regulatory framework to ensure stability and regulatory compliance, and for the banks to test-and-learn as they scale up their businesses, before allowing full-scale operations. Indonesia, Japan, and Vietnam do not issue digital banking licenses. While digital banks in Indonesia operate under the existing tiered banking licensing framework, they provide more digitalized services than the traditional banks. In Vietnam, incumbent digital banks do not have separate licenses and need to partner with traditional banks to offer financial products and services. Table 3.3 compares the licensing frameworks across ASEAN+3 digital banks.

[14] "Your Data" Project aims to develop mechanisms that enable individuals and businesses to exercise their rights to digitally transfer their data, both in the financial and non-financial sector, to financial service providers in order to receive better, more personalized services, thereby becoming a key infrastructure for the digital financial system and enhancing financial services. (BOT 2025)

[15] In some jurisdictions, such as Hong Kong, digital banks are permitted to have physical branches to serve customers where in-person interactions are still preferred or required. In contrast, Indonesia does not differentiate between traditional and digitalized banks, due to which many of them have physical branches for legacy or business reasons. Japan does not prohibit digital banks from establishing branches, but these banks have chosen not to maintain any physical branches.

Table 3.3. Digital Banks in ASEAN+3

Country	Licensing Framework	Key Players	Primary Objective
China	Full bank licenses for digital banks	WeBank (Tencent), MYbank (Ant), XWBank	Serve SMEs and underbanked using tech-driven models
Hong Kong, China	Full bank licenses for digital banks	ZA Bank, Mox, WeLab, Fusion, Livi Bank, PAO Bank, Ant Bank (Hong Kong), Airstar.	Promote fintech and innovation, offer new customer experience and promote financial inclusion
Japan	No separate digital bank licenses; digital banks operate under traditional model	Rakuten Bank, Minna Bank, au Jibun Bank, Sony Bank, Paypay Bank	Modernize retail banking, enhance user experience
Korea	Internet-only bank licenses issued (2017)	KakaoBank, K Bank, Toss Bank	Promote competition and innovation
Indonesia	No separate digital bank licenses	Bank Jago, Blu by BCA Digital, SeaBank, Bank Neo Commerce	Serve unbanked/ underbanked, MSMEs' financing
Malaysia	Digital bank licenses (2022)	GXBank, AEON Bank, Boost Bank, KAF Digital Bank, Ryt Bank	Expand financial inclusion, especially underserved groups
Philippines	Digital bank licenses (2020)	Maya Bank, OFBank, Tonik Digital Bank, GoTyme Bank, UNObank, UnionDigital Bank	Improve financial inclusion, digitalize payments
Singapore	Full bank or wholesale bank licenses for digital banks (2020)	Trust Bank, GXS Bank, MariBank, GLDB, ANEXT Bank	Promote competition and innovation
Thailand	Virtual bank licenses (2025)	Three major consortiums led by Krungthai Bank, SCB X, and Ascend Money to launch virtual banks in 2026	Enhance financial inclusion, competition and innovation
Vietnam	No separate digital bank license, digital-only banks operate under the license of their sponsoring commercial banks	Timo, TNEX, Cake	Drive digital financial inclusion

Source: Bank's websites; central bank websites; news articles; reports; AMRO staff compilation.
Note: MSME = micro, small, and medium-sized enterprises; SME = small and medium-sized enterprises.

In ASEAN+3, digital banks are primarily established (Figure 3.7) by:

- **Bigtechs:** Ownership of digital banks enables seamless integration of payments and credit services within their apps, making transactions highly convenient and driving efficient customer acquisition.

- **Fintechs:** Acquiring digital bank licenses allows fintechs to expand beyond niche services like payments or lending, using their initial customer base to offer a broader range of financial products and capture more value along the financial services chain.

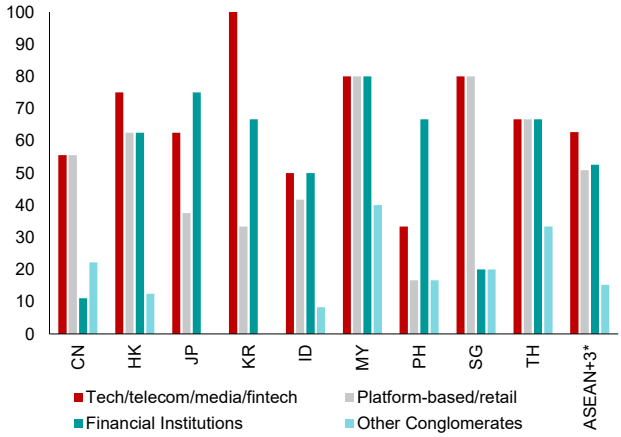
- **Incumbent banks:** A digital subsidiary allows incumbent banks to focus on high-value clients through physical channels, while serving the mass market more cost-effectively through technology. It helps onboard underserved segments and acts as a low-risk pilot for broader digital transformation.

ASEAN+3 is at the frontier of technology and financial services convergence, which is enabling ecosystem-based digital banking. This is where digital banks are embedded within a broader digital environment—typically built by bigtechs, platform companies, or super apps—that integrates financial services with nonfinancial offerings such as e-commerce, ride-hailing, food delivery, social media, and lifestyle service and uses the collection of high frequency transaction data to provide personalized services to customers. Examples of ecosystem-based digital banking include WeBank (the Tencent ecosystem) and MYbank (Ant/Alibaba) in China, KakaoBank (Kakao ecosystem) and K Bank (KT telecom ecosystem) in Korea, GXS (Grab-Singtel) in Singapore, SeaBank (Shopee) in Indonesia, and Maya in the Philippines.

Digital banks remain a small but growing segment of the ASEAN+3 banking system. With the exception of Korea, the market share of digital banks remains below 1 percent of total assets, loans, and deposits across the region (Figure 3.8), reflecting the position of incumbent banks, later market entry, and caution by regulatory authorities. That Korean digital banks are early movers can be attributed to the country's earlier start in licensing internet-only banks and platform integrations. Rapid growth is evident in continued expansion of digital banks' deposits and loans across the region, especially in the earlier years of operation (Figures 3.9 and 3.10). For markets where digital banks are more mature, such as China and Korea, growth has become less aggressive but still remains firm.

Figure 3.7. Ownership Patterns of ASEAN+3 Digital Banks
(Percent)

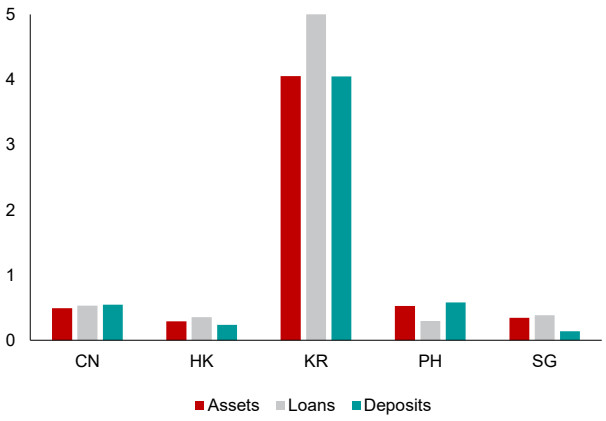
Digital banks in the region are primarily established by bigtechs, fintechs, and traditional banks.



Source: Digital bank websites; AMRO staff compilation.
Note: Bars show the percentage of digital banks in each economy/region that have at least one shareholder in each of four categories: 1. Tech/Telecom/Media/Fintech firms; 2. Platform-based or retail groups; 3.Financial institutions (banks, insurers, investment firms); 4. Other conglomerates, which are diversified groups excluding those whose primary businesses are in tech, telecom, media, fintech, retail, or financial services. Because many digital banks have multiple shareholders spanning more than one category, the category shares for an economy/region can sum to more than 100 percent. CN = China; HK = Hong Kong; JP = Japan; KR = Korea; ID = Indonesia; PH = Philippines; SG = Singapore; TH = Thailand. ASEAN+3* include China, Hong Kong, Japan, Korea, Indonesia, Philippines, Singapore and Thailand.

Figure 3.8. Market Share of Digital Banks
(Percent of banking system)

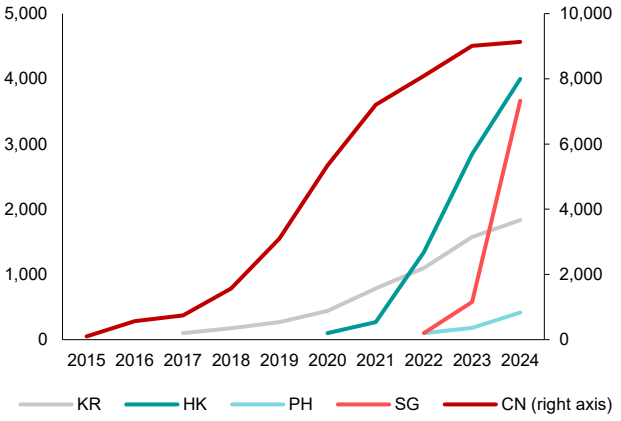
The size of digital banks' assets, loans, and deposits remain small compared to traditional banks.



Source: National authorities, Moody's BankFocus; CEIC.
Note: For cross-country comparability, total banking system size refers to the total assets, loans, and deposits of commercial banks only. Specialized government credit institutions, savings banks, cooperative banks, microfinancing institutions, and foreign branches are excluded. For PH, banking system refers to universal and commercial banking groups. CN = China; HK = Hong Kong; KR = Korea; PH = Philippines; SG = Singapore.

Figure 3.9. Selected ASEAN+3: Growth of Digital Bank Customer Deposits
(Index, first operating year = 100)

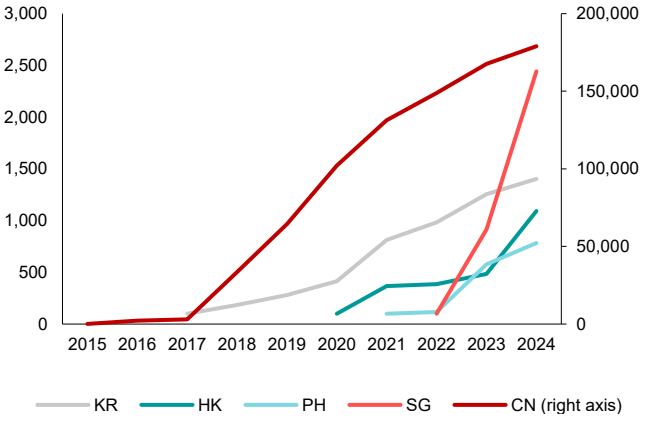
Digital banks have rapidly scaled customer deposits…



Source: Moody's BankFocus, AMRO staff calculations.
Note: Outliers from first year full-year growth are omitted. CN = China; HK = Hong Kong; KR = Korea; PH = Philippines; SG = Singapore.

Figure 3.10. Selected ASEAN+3: Growth of Digital Bank Loans
(Index, first operating year = 100)

…accompanied by a corresponding growth in loans.

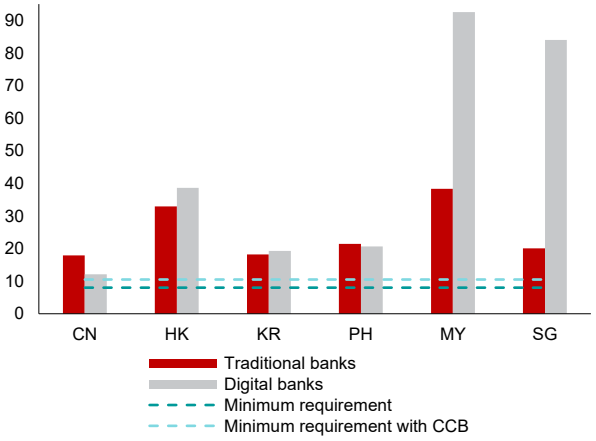


Source: Moody's BankFocus, AMRO staff calculations.
Note: Outliers from first year full-year growth are omitted. CN = China; HK = Hong Kong; KR = Korea; PH = Philippines; SG = Singapore.

Digital bank capital and liquidity buffers generally remain strong. Digital banks report significantly higher capital adequacy ratios (CARs), exceeding 80 percent in Malaysia and Singapore, where digital banks are more recently established (Figure 3.11). High CARs reflect early-stage development with limited lending activity and large initial capital injections. Strong capital positions provide an important safeguard as digital banks scale up and take on more credit and operational risks. Similarly, newer digital banks, particularly in Malaysia and Singapore, maintain high liquidity ratios (Figure 3.12), which provide a buffer against sudden deposit outflows. However, high capital and liquidity buffers will likely gradually normalize as digital bank balance sheets grow, and lending activities continue to expand. As these banks move into riskier lending segments and scale up operations, their capital positions may come under pressure, particularly given their currently weak profitability and reliance on subsidized offerings to gain market share.

Figure 3.11. Selected ASEAN+3: Capital Adequacy Ratio (CAR) by Bank Type
(Percent of risk-weighted assets)

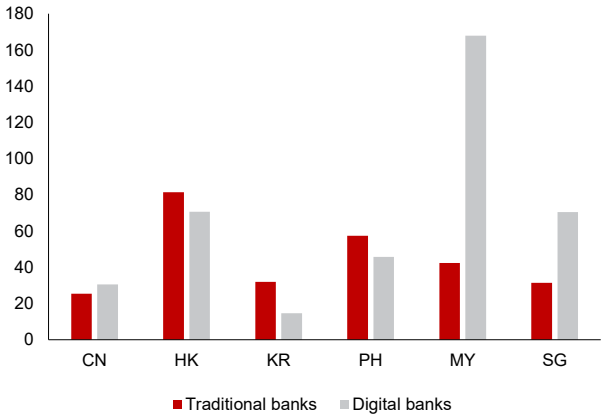
Digital banks' strong capital buffers enable them to scale up operations and absorb early-stage risks.



Source: Moody's BankFocus; AMRO staff calculations.
Note: As of the end of 2024. CN = China; HK = Hong Kong; KR = Korea; PH = Philippines; MY = Malaysia; SG = Singapore; CCB = capital conservation buffer

Figure 3.12. Selected ASEAN+3: Liquid Assets by Bank Type
(Percent of total deposits)

Newer banks maintain higher liquidity buffers to guard against rapid deposit outflows.



Source: Moody's BankFocus; AMRO staff calculations.
Note: As of the end of 2024. Recently established digital banks omitted from compilation. CN = China; HK = Hong Kong; KR = Korea; PH = Philippines; MY = Malaysia; SG = Singapore.

V. Key Risks to Financial Stability from Digitalization of Banking Services

Digitalization could increase some financial stability risks or change their nature and distribution. Our survey of country authorities showed that operational risks, such as cybersecurity and fraud, are the most pronounced, followed by systemic risks. Plus-3 policymakers are more concerned about liquidity risks whereas ASEAN policymakers focus more on credit and business risks (Figure 3.13). Most respondents ranked procyclicality risks as lowest.

Operational risks

Operational risk is the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events (including legal risk but excluding strategic and reputational risks). Technology improves the efficiency and speed of operations and reduces the overall operational risks. However, it also introduces or increases other operational risks such as higher incidence of cyber risks, elevated risks of digital fraud, and model risk, and may function as a channel to amplify other nonoperational risks.

Cyber risk

Digitalization improves cybersecurity but also increases the number of digital touchpoints, potentially increasing cyber risks.[16] Cyber incidents with a malicious intent (i.e., cyberattacks) to steal, cause damage, or to disrupt have increased in the past decade across the world (Figure 3.14). Reported cyberattacks in ASEAN+3 have also been on an upward trend since 2014, with the financial industry increasingly targeted (Figure 3.15).

[16] Cyber incidents are defined as a cyber event that adversely affects the cybersecurity of an information system or information the system processes, stores, or transmits whether resulting from malicious activity or not. Cyber risk is the combination of the probability of cyber incidents occurring and their impact (FSB 2023).

Cyberattacks against the financial sector are predominately exploitative; that is, to access and steal sensitive information such as personal identification information or financial assets. However, mixed motives, where cyberattacks have sought both to steal and disrupt financial firms' operations, appear increasingly frequent since 2020 (Figure 3.16).

Cyber incidents causing data breaches or disruption of services can cause direct operational losses from legal costs and additional investments in IT. Financial institution can also suffer reputational loss which leads to decreased franchise values (Kamiya and others 2021). A fall in franchise value because of a cyberattack can be nontrivial (Figures 3.17 and 3.18).[17] ASEAN+3 bank's average stock market losses, estimated using a market model, ranged from approximately -0.4 percent to -1.2 percent (depending on the estimation window) following cyberattacks during 2014–2023. Unadjusted market losses are larger and range from approximately -0.7 percent to -2.4 percent. Cyber incidents unrelated to cyberattacks, such as human coding errors during maintenance or software bugs, can also result in reputational, market, and regulatory risk (Box 3.3). Cyber incidents may also increase liquidity risks as they can lead to deposit outflows from a loss of confidence in the safety of deposits (Gogolin and others 2025).

While ASEAN+3 has yet to face systemic risks from cyber incidents, it is important to understand the channels through which cyber risks can also amplify systemic risk. These are erosion of confidence, lack of substitutes, and interconnectedness (Adelmann and others 2020). Cyber incidents can erode confidence in the banking sector's ability to safeguard against cyber threats, leading to systemwide "cyber runs" (Duffie and Younger 2019). Second, cyber incidences at institutions or services that are not easily substitutable can amplify systemic risks. For instance, the failure of key cloud services or payment systems can have cascading effects and increase liquidity risks in the system (Kotidis and Schreft 2024).[18] Lastly, interconnectedness of the banking systems through technological or financial linkages could also lead to systemic failures in the event of severe cyberattacks.

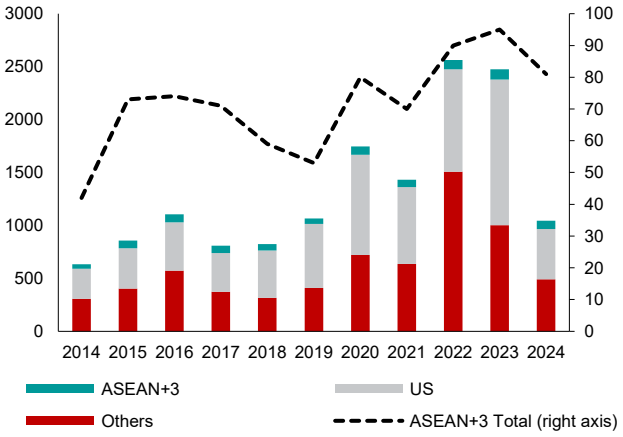
Figure 3.13. Selected ASEAN+3: Risks Posed by Digitalization
(Risk ranking)

Operational risk is seen as the most significant risk.

Source: Authority Survey; AMRO staff compilation.
Note: Survey results for the question "Based on your qualitative assessment, please rank the following risks posed by the digitalization of banking services." The spiderweb shows the average risk rankings for the various economy groups for each specific risk, with 5 carrying the most risk and 1 the least.

Figure 3.14. Worldwide: Total Number of Cyberattacks
(Worldwide; in ASEAN+3)

Cyberattacks have increased significantly in the past decade.



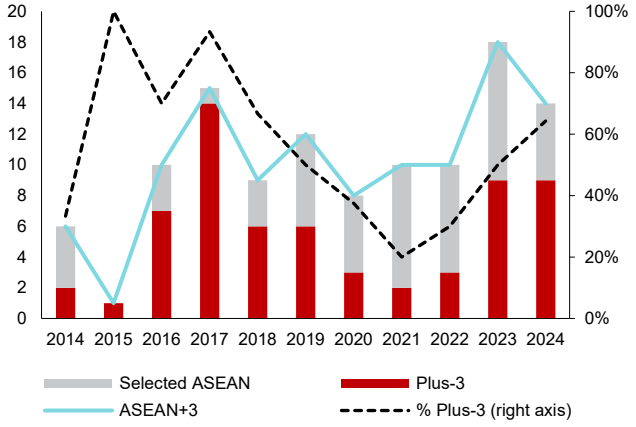
Source: Center for International and Securities Studies at Maryland (CISSM) Cyber events database; AMRO staff calculations.
Note: The data collected by CISSM relies on scraping publicly available data, the data could be biased toward large, developed economies. In addition, count data might also be underreported for recent years (e.g., 2024) as cyberattacks that occurred might only be revealed or reported in future. ASEAN+3 = Cambodia, China, Hong Kong, Indonesia, Japan, Korea, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.
Others = all economies less ASEAN+3 and US.

[17] Figure 3.17 contains eight cyberattacks in selected ASEAN+3 economies (Malaysia, Thailand, and Indonesia) from 2014–2023. Bank abnormal returns are calculated using the market model. The model's parameters are estimated using 220 trading days of return data beginning 280 days before and ending 61 days before the cyberattack, with the market index being the stock market index of the economy in which the cyberattack occurred. Daily abnormal returns are then cumulated to obtain cumulative abnormal returns for various windows (0, -2), (0, -3), (0, -4), (0, -5). Normal returns are cumulative unadjusted stock market returns. Solid bars represent significance at the 10 percent level. Figure 3.18 presents the data again, excluding an outlier.

[18] Kotidis and Schreft (2022) study the effects of a multiday cyberattack on a technology service provider that led to banks being unable to send payments over Fedwire. This caused counterparty banks to receive fewer payments, increasing their liquidity risk. Unaffected banks thus had to increase their borrowing from either the discount window or the federal funds market. Eisenbach and others (2022) also show that if one of the top five banks in the US were hacked and unable to make payments, 38 percent of network would be impaired, leading to liquidity shortages at counterparties. In turn, these counterparties hoard liquidity, further amplifying liquidity shortages in the financial system.

Figure 3.15. ASEAN+3: Cyberattacks in Finance and Insurance Industry
(Number; Percent of Plus-3 as a share of ASEAN+3)

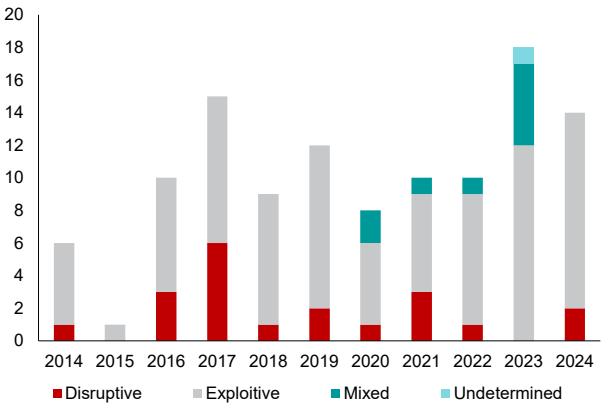
Cyber risks in the financial sector have increased over time for the region.



Source: Center for International and Securities Studies at Maryland (CISSM) Cyber events database; AMRO staff calculations.
Note: Plus-3 = China, Hong Kong, Japan, Korea. Selected ASEAN = Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam.

Figure 3.16. ASEAN+3: Cyberattacks in Finance and Insurance Industry by Type
(Number)

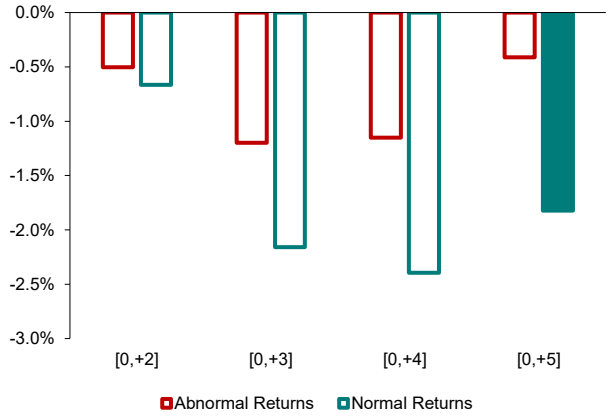
Cyberattacks targeting the financial sector are predominantly exploitative in nature.



Source: Center for International and Securities Studies at Maryland (CISSM) Cyber events database; AMRO staff calculations.
Note: Sample includes ASEAN+3 economies; Cambodia, China, Hong Kong, Indonesia, Japan, Korea, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Disruptive cyberattacks impede the firm's normal operations. Exploitative cyberattacks illicitly access or exfiltrate sensitive information such as personal identifiable information, classified information, or financial data. Mixed cyberattacks incorporate both disruptive and exploitative elements, such as ransomware attacks.

Figure 3.17. ASEAN+3: Stock Market Losses from Cyberattacks on Banks (Full Sample)
(Percent)

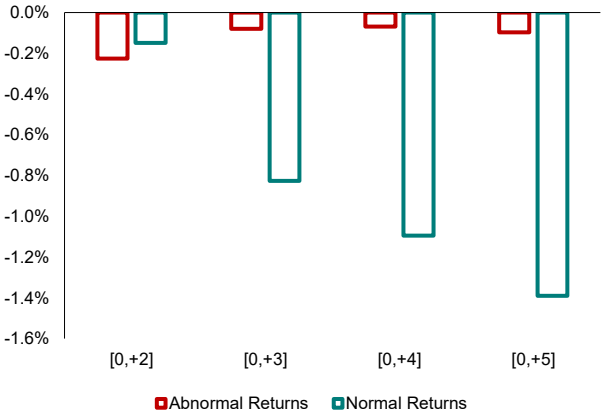
Market losses from cyberattacks range from -0.4 to -2.4 percent.



Source: Bloomberg Finance L.P.; AMRO staff calculations.
Note: Figure contains eight cyberattacks in selected ASEAN+3 (Malaysia, Thailand and Indonesia) economies from 2014–2023. Bank abnormal returns are calculated using the market model. The market model parameters are estimated using 220 trading days of return data beginning 280 days before and ending 61 days before the cyberattack, with the market index being the stock market index of the economy in which the cyberattack occurred. Daily abnormal returns are then cumulated to obtain the cumulative abnormal returns (CAR) for various windows (0, -2), (0, -3), (0, -4), (0, -5). Normal returns are unadjusted cumulative daily stock market returns. Solid bars represent significance at the 10 percent level.

Figure 3.18. ASEAN+3: Stock Market Losses from Cyberattacks on Banks (Excluding Outliers)
(Percent)

Market losses from cyberattacks range from -0.1 to -1.4 percent.



Source: Bloomberg Finance L.P.; AMRO staff calculations.
Note: Figure contains seven cyberattacks (excluding an outlier) in selected ASEAN+3 (Malaysia and Thailand) economies from 2014–2023. Bank abnormal returns are calculated using the market model. The market model parameters are estimated using 220 trading days of return data beginning 280 days before and ending 61 days before the cyberattack, with the market index being the stock market index of the economy in which the cyberattack occurred. Daily abnormal returns are then cumulated to obtain the cumulative abnormal returns (CAR) for various windows (0, -2), (0, -3), (0, -4), (0, -5). Normal returns are unadjusted cumulative daily stock market returns. Solid bars represent significance at the 10 percent level.

Box 3.3:

Operational Disruptions at Singapore's DBS Bank in 2023

DBS Bank Ltd, a leader in digital banking services, endured multiple major disruptions to its digital banking services in 2023, with key incidents occurring on 29 March, 5 May, 26 September, and 14 and 20 October. During these disruptions, customers were unable to access online and mobile banking platforms as well as PayLah! Mobile Wallets (Table 3.3.1). In some outages, ATMs, mobile contactless payments on DBS cards, and mobile trading apps were also affected, with severe disruptions lasting up to a full day. As a result, customers were unable to complete payment transactions or access their accounts, balances, and other essential banking functions.[1]

The technical causes varied, with four of the bank's five major disruptions related to bugs or software incidents. For instance, the disruption on 5 May 2023 was due to human error in coding the program used for system maintenance.[2] That led to a significant reduction in system capacity, which in turn affected the system's ability to process transactions. The incident on 14 October 2023 involved a cooling failure at a third-party data center hosting the DBS IT system that supported delivery of its retail and corporate banking services. The data center's temperature exceeded the optimal operating range, leading to a shutdown of the bank's IT systems. Efforts to recover affected systems at back-up data centers also failed because of network misconfigurations. In addition, the 14 October incident also affected Citibank, which relied on the same third-party data center.

The outages created significant problems for DBS customers and negatively impacted its stock price. For instance, the widespread disruption on the 14 October 2023 incident prevented completion of about 2.5 million payment and ATM transactions.[3] As a result, DBS reopened its branches from 5.30 pm to 9.30 pm on 14 October (a Saturday) to assist affected customers. In another serious day-long outage on 29 March of the same year, branch opening hours were extended by two hours to help customers complete transactions. Market reactions to the operational outages were negative. DBS's average five-day cumulative normal returns following severe operational outages were -2.63 percent, more than double that of UOB and OCBC (Figure 3.3.1). Cumulative five-day abnormal returns using a market model on severe outages were also negative at -0.9 percent (Figure 3.3.2).

Table 3.3.1. Description of Major Digital Outages in 2023

Date	Disruption	Cause	Details
29 Mar, (Wed)	Day long outage of internet and mobile banking platform, mobile wallet, and mobile trading app	Software bug	Independent review reported weak system resilience, incident management, change management, technology risk governance and oversight
5 May, (Fri)	Intermittent disruptions to internet and mobile banking, mobile wallet, mobile trading, ATM, and contactless payment on DBS cards	Human error in coding used for system maintenance	Error led to a significant reduction in system capacity, affecting system's ability to process transactions
26 Sep, (Tue)	Delays in FAST and instant interbank transfers (PayNow) payment services in the afternoon	Unspecified system issue	Services were restored in a day; reconciliation and remediation of affected transactions/customers were completed only three days later
14 Oct, (Sat)	Severe nationwide disruption of DBS's suite of digital banking services, mobile wallets and ATM banking from afternoon till morning	Cooling failure at third-party Equinix data center	Temperature in the data center hosting banking services rose above the optimal operating range during a planned system upgrade. Network misconfiguration errors prevented recovery of affected systems at back-up data centers
20 Oct, (Fri)	Intermittent access issues affecting Mobile Wallet Payment service	Unspecified system issue	Other payment services such as DBS's digital banking Scan & Pay remained operational

Source: AMRO staff compilation from articles, reports and websites.

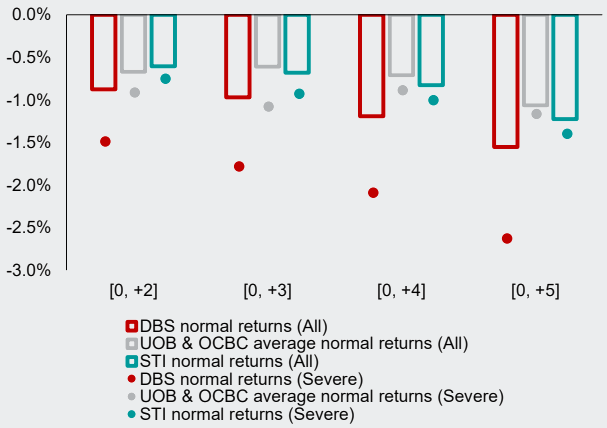
The author of this box is Wen Yan Ivan Lim.

1 Oi, Rebecca. 2023. "How Will DBS Bank Reclaim Trust After Service Interruptions?" *Fintechnews*, 3 November.

2 MAS. 2023. "Written reply to Parliamentary Question on the disruption of DBS' digital banking services".

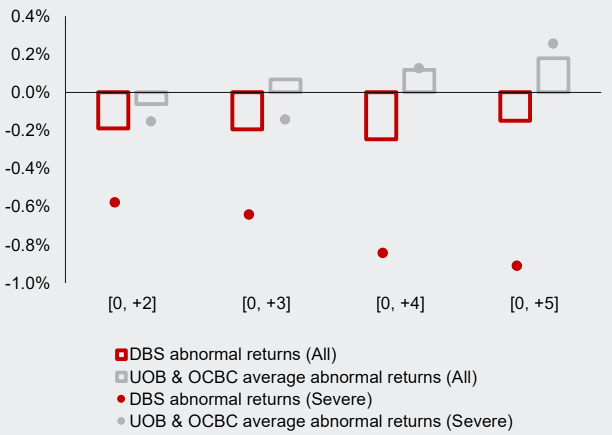
3 MAS. 2023. "Oral reply to Parliamentary Questions on banking services disruption of DBS and Citibank on 14 October 2023." MAS, 6 November.

Figure 3.3.1. Stock Reaction: Normal Returns following DBS Operational Disruptions
(Percent)



Source: Bloomberg Finance L.P.; AMRO staff calculations.
Note: The bars show cumulative daily normal unadjusted returns for DBS Bank, the average cumulative daily normal unadjusted returns for UOB and OCBC Bank, as well as the cumulative daily normal unadjusted returns for Singapore STI Index following the five DBS operational disruptions (29 Mar, 5 May, 26 Sep, 14 Oct, 20 Oct). The dots display cumulative daily normal unadjusted returns for only the three severe DBS operational disruptions (29 Mar, 5 May, and 14 Oct).

Figure 3.3.2. Stock Reaction: Abnormal Returns following DBS Operational Disruptions
(Percent)



Source: Bloomberg Finance L.P.; AMRO staff calculations.
Note: The bars show cumulative abnormal returns for DBS Bank and the average cumulative abnormal returns for UOB and OCBC Bank following the five DBS operational disruptions (on 29 Mar, 5 May, 26 Sep, 14 Oct, 20 Oct). Abnormal returns are calculated using the market model. The market model parameters are estimated using 120 trading days of return data beginning 125 days before the and ending six days before DBS's operational disruption occurred. The dots display cumulative abnormal returns for only the three severe DBS operational disruptions (on 29 Mar, 5 May, and 14 Oct).

The Monetary Authority of Singapore (MAS) viewed the repeated outages as unacceptable and took strong supervisory actions. An independent review mandated by MAS after the March incident uncovered structural deficiencies in DBS's IT governance and processes, including weaknesses in system resilience, incident and change management, and technology risk oversight.[4] Following the May disruption, MAS imposed additional capital requirements on DBS and raised the multiplier for the bank's risk-weighted assets for operational risk to 1.8 times, reducing the bank's Common Equity Tier-1 capital ratio by 0.3 percentage point, from 14.4 percent to 14.1 percent.[5,6] The October 2023 disruptions drew further enforcement against DBS: MAS imposed a six-month moratorium on all non-essential IT changes, barred the bank from acquiring new business, and prohibited any reduction in its branch and ATM networks. This was to ensure resources were focused on addressing weaknesses in IT systems as well as providing alternate offline avenues for customers in the event of digital outages.

The DBS board and management acknowledged the severity of these failures. In response to the disruptions, the bank imposed a 30 percent reduction (SGD 4.14 million) in CEO Piyush Gupta's 2023 variable compensation, and a collective 21 percent pay cut for its management committee, holding them accountable for the repeated operational outages.[7] Following the independent review, DBS committed a SGD 80 million special budget to strengthen system resilience as part of a phased, 24-month technology road map designed to address structural shortcomings and improve the robustness of its digital banking infrastructure.

The 2023 DBS operational disruptions are a cautionary case study for the banking industry's digital journey. These incidents demonstrate how accelerated digitization can rapidly escalate into operational crises through IT outages, potentially undermining public confidence and trust. The disruptions also highlight the risks associated with third-party service providers, which banks increasingly rely on to support critical IT operations. Such providers often fall outside direct regulatory purview and can become single points of failure if not properly managed. In turn, this could pose a systemic risk if multiple institutions are affected simultaneously. Thus, strong oversight, resilient system design, and rigorous contingency planning are crucial to ensure that the pursuit of digital efficiency does not compromise financial stability.

4 MAS. 2023. "MAS Imposes Six-Month Pause on DBS Bank's Non-Essential Activities as Bank Restores System Resilience." 1 November.
5 DBS Bank. 2023. "DBS' response to MAS' actions on digital disruption." DBS, 5 May.
6 This is up from the 1.5 times multiplier and SGD 980 million in additional regulatory capital imposed by MAS in 2022, following a major disruption that lasted two days.
7 Tan, Angela. 2024 "DBS CEO Piyush Gupta gets 30 percent cut in 2023 variable pay over bank's digital disruptions." The Straits Times, 7 February.

Fraud

Digital fraud is the act of stealing customers or financial institution's assets through digital mediums by external perpetuators through fraudulent or illicit means. The issue is especially relevant for ASEAN+3 economies as the region may have suffered financial losses between USD 18 billion to USD 37 billion from scams in 2023, and the losses may have risen in subsequent years. The scams are committed by organized crime groups in Southeast Asia who use technologies such as malware, generative AI, and deepfakes (UNODC 2024). Though law enforcement agencies and regulators have stepped up their efforts to curb the crimes (Nikkei Asia 2025), incidents continue to rise at an alarming pace. Apart from the fraudsters becoming more sophisticated, the sharp rise in fraud is due to the widespread adoption of mobile banking applications and instant payment systems, increased e-commerce-based transactions, and the ease of accessing personal information through social media (Raman and others 2024). Some common means of digital fraud perpetuation are through unauthorized payment transactions from theft of customer payment details, the manipulation of customers into making payments, and exploiting weaknesses in cybersecurity and compliance systems.[19]

Digital fraud can also pose risks to financial institutions and the broader financial system. It can inflict direct (liability sharing) or indirect costs (compliance costs and fines) and reputational loss to financial institutions (IMF 2023). More broadly, a widespread erosion of confidence in the digital financial ecosystem could dampen payment activity and digital consumer spending, amplifying liquidity and systemic risks.

Model risk

Model risk refers to the potential for financial losses arising from the flawed or inappropriate use of models. Broad adoption of AI/ML into various facets of bank's core business significantly amplifies model risks as they exhibit limited explainability, the use of unstructured data, and the approach of overfitting historical data in the model. In the Philippines, about 60 percent of surveyed financial institutions assessed their AI model to be explainable, and about half considered them to be auditable (BSP 2024a). In Hong Kong, nearly all financial institutions (95 percent) have identified model performance and accuracy as the foremost risk-management consideration when adopting GenAI, while 65 percent also cite model transparency and explainability (HKIMR 2025).

The models may have poor predictive accuracy, particularly during black swan events or when structural changes have altered market conditions. The quality of training data can influence model outcomes and lead to biases or structural shortcomings. For instance, AI/ML models may perpetuate bias in credit underwriting decisions and discriminate against certain groups of borrowers, exposing the financial institution to litigation and reputational risks (MindForge 2024). The prevalence of AI/ML models in credit scoring by fintechs and digital banks in ASEAN could be an avenue where model risks manifest. Model risks can amplify credit risks if the credit-scoring models incorrectly assess credit worthiness.

Systemic risk

Systemic risks have evolved from being an outcome of interconnectedness between financial institutions alone to now being dependent on nonfinancial entities such as technology service provides. In this way, digitalization has transformed the nature of systemic risks as the source of risk can extend beyond the financial sector.

Many banks are increasingly reliant on fintechs and technology companies for functions such as collection and storage of data, advanced analytics, and servicing customers. But these collaborations have also produced vulnerabilities in data and transaction security, privacy concerns, and inconsistent cybersecurity standards (Liu and others 2025). Such added layers of complexity and opacity make it more challenging for regulators to identify, assess, and respond to emerging risks.

The dominance of a limited number of technology providers, such as Cloud Service Providers (CSPs) or AI ecosystems, also increases concentration and systemic risks (IDC 2024). The business continuity of many financial firms may be affected by cyberattacks, outages, or other operational issues at any of these technology providers (Koh and Prenio 2023; BCBS 2024). Inadequate oversight of third-party service providers could lead to cybersecurity breaches or system failures, disrupting banks' operations. For example, an October 2022 fire at a data center shared by Kakao Corp. and Naver Corp. resulted in temporary operational disruptions for both tech companies (Judge 2022).[20]

[19] Social engineering is a general term for trying to deceive people into revealing information or performing certain actions (FSB 2023). See BCBS (2023) for a classification of these fraud types.

[20] KakaoTalk suffered a record-breaking outage that lasted over 11 hours, with service disruptions extending for several days. By contrast, Naver experienced a much shorter interruption, as it was able to restore services more quickly thanks to established backup systems, including servers at a separate site. In the aftermath, former President Yoon ordered an investigation into the causes and measures to prevent a recurrence. Subsequently, in December 2022, the Ministry of Science and ICT announced plans to diversify the core functions of major Korean online platforms across multiple data centers, given their critical importance.

Credit risk

Financial digitalization in lending activities has been characterized by three important and interrelated changes: (1) catering to the unserved or underserved population, (2) alternative credit-scoring mechanisms, and (3) innovative lending structures such as BNPL, platform lending and P2P lending. The resultant risks are largely concentrated with fintechs and digital banks because incumbent banks continue to lend to "financially included" customers with strong credit history and use traditional credit-scoring measures and lending structures, while only tweaking their procedures to suit a digital delivery.

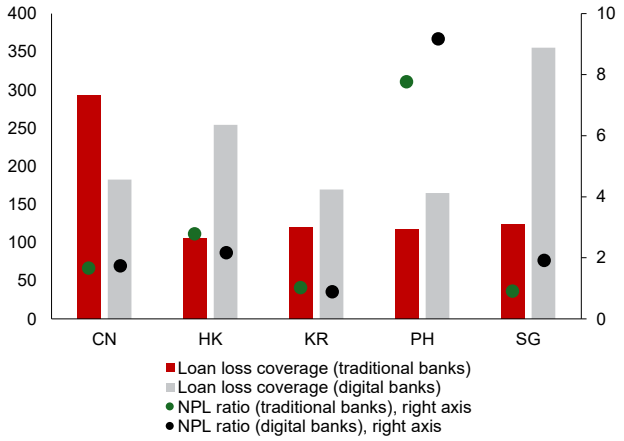
Using alternative credit assessment methods allows fintechs and digital banks in ASEAN to target unbanked or underbanked populations and avoid direct competition from incumbent banks. However, it also increases the risk of adverse selection and loan defaults. As already noted, alternative credit-scoring strategies are susceptible to model risks and may prompt firms to extend loans to unworthy customers, potentially raising nonperforming loan (NPL) ratios as the models adapt to incoming data. The new age financial institutions also lack physical infrastructure and work with limited staffing, which can also pose challenges in loan collection. Credit risk is not yet a major concern for most digital banks across the region, but close monitoring is warranted where the loss buffers are thin.

Digital banks' NPL ratios, on average, are generally comparable to those of traditional banks with ample provisioning among those who have started to report such data (Figure 3.19). Average NPLs for digital banks in Korea and Hong Kong are even lower than those of their traditional counterparts. However, credit risk warrants continued monitoring, as seen in the Philippines, where the initial higher NPLs reported by digital banks were due to nascent underwriting standards and the challenges of lending to underserved borrowers. While the NPLs level have since declined, these banks will likely require more time to mature and strengthen their internal credit risk management frameworks (Box 3.4).

The focus on less-served borrower segments leads to higher interest margins among digital banks. Reported net interest margins (NIM) are higher for digital banks than for traditional banks across most ASEAN+3 economies (Figure 3.20). This reflects their focus on higher-yielding segments such as unsecured consumer credit and loans to micro, medium and small-sized enterprises (MSMEs), which are often priced with wider spreads to compensate for higher perceived risk.

Figure 3.19. Selected ASEAN+3: NPL and Loan Loss Coverage Ratio by Bank Type
(Percent)

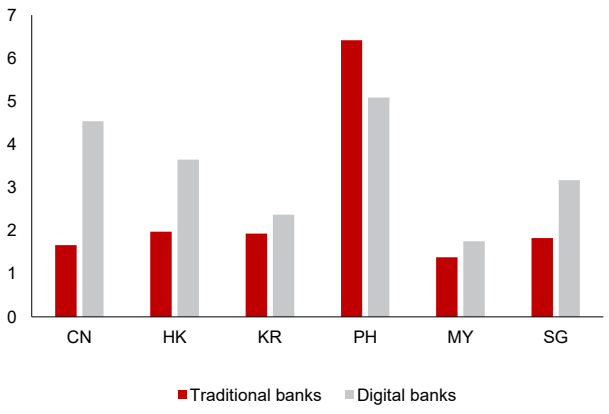
On average, NPL levels remain manageable and well covered by loan loss reserves.



Source: Moody's BankFocus; AMRO staff calculations.
Note: Latest available quarterly data for each bank. NPL ratio = nonperforming loans/total loans. Loan Loss Coverage Ratio = loan loss reserves/nonperforming loans. Digital bank figures refer those of digital banks that reported NPL data out of the total with available data as of end 2024: CN (8/8), HK (7/8) Korea (3/3), PH (5/6), Singapore (1/5). For banks with no reported NPL ratios, stage 3 loans under IFRS 9 is used for calculation. CN = China; HK = Hong Kong; KR = Korea; PH = Philippines; SG = Singapore.

Figure 3.20. Selected ASEAN+3: Net Interest Margin Ratio by Bank Type
(Percent)

Digital banks generally show higher NIM, reflecting their focus on higher-yielding segments.



Source: Moody's BankFocus; AMRO staff calculations.
Note: NIM (net interest margin) = (interest income – interest expense)/average interest-earning assets. CN = China; HK = Hong Kong; KR = Korea; PH = Philippines; MY = Malaysia; SG = Singapore.

Box 3.4:

Evolving Digital Banks in the Philippines: Unlocking Financial Inclusion While Managing Credit Risks in the Startup Phase

Since formulating its first National Strategy for Financial Inclusion in 2015, the government has promoted financial inclusion as a national agenda.[1] Inclusive digital finance, as a priority initiative, has emerged as a key contributor to advancing financial inclusion, particularly by serving unbanked individuals and micro, small, and medium-sized enterprises (MSMEs). In this context, this box examines the evolving role of digital banks as startups in financial inclusion and credit risk management.

Digital banks in the Philippines show strong potential for advancing financial inclusion, especially among the estimated 34.3 million unbanked as of 2021 (BSP 2021).[2] The country's archipelagic geography makes digital delivery particularly effective, aligning with broader goals of Bangko Sentral ng Pilipinas, the central bank, to expand financial access. Since May 2024, digital bank deposits have grown rapidly—averaging 34 percent year-on-year and far outpacing the less than 10 percent growth in traditional banks (Figure 3.4.1). However, they still represent just PHP 114 billion, or 0.56 percent of the PHP 20 trillion in total system deposits as of July 2025. Similarly, digital bank loans surged 89 percent year-on-year in the first seven months of 2025, driven by credit card, personal, and MSME lending (Figure 3.4.2), yet their PHP 58 billion loan book accounts for just 0.37 percent of the PHP 16 trillion in total loans. Notably, account ownership rose from 3 percent in March 2023 to 18 percent by June 2025, reflecting growing demand[3] and supporting financial inclusion through digital channels.

Amid the rapid expansion of lending, the nonperforming loans (NPL) of the six digital banks were volatile over a short period. The NPL ratio peaked at 25.3 percent in March 2024 and declined to 7.0 percent by July 2025 (Figure 3.4.3). Consistent with these trends, the digital banks recorded losses, partly because credit costs increased, including those for provisioning in response to rising credit risks and write-offs on nonperforming loans (Figure 3.4.4).[4, 5]

Volatility in NPL ratios and related losses suggests that digital banks in the Philippines are still building credit risk management capabilities, especially as they target underserved borrowers with limited credit histories. High NPLs may reflect early-stage trial-and-error, structural challenges like limited debt collection infrastructure, and nascent underwriting standards. The recent improvement in NPL ratios suggests digital banks are refining strategies and credit risk controls by enhancing expertise, reassessing customer segments, and strengthening data-driven underwriting.

To sustain progress and achieve long-term profitability, digital banks must continue refining credit risk practices. Their resilience will be tested across credit cycles, especially during downturns, requiring robust, risk-based underwriting and adaptive risk management frameworks.

The authors of this box are Shunsuke Endo and Chiang Yong (Edmond) Choo.

1 The Financial Inclusion Steering Committee (FISC) in 2022 launched the National Strategy for Financial Inclusion 2022–2028, focusing on reducing inequalities in financial access and improving financial health and resilience by empowering consumers.

2 The share of Filippino adults with bank accounts rose from 29 percent in 2019 to 56 percent in 2021, according to the Bangko Sentral ng Pilipinas 2021 Consumer Finance Survey. The central bank aims to further increase this figure to 70 percent.

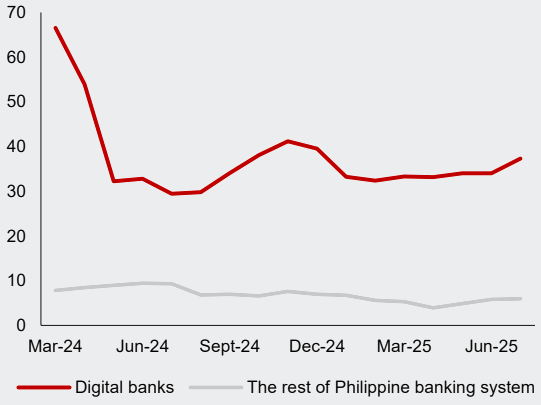
3 On the supply side, the expansion of digital banking services can also be attributed to their appeal. Most digital banks offer accounts with no minimum balance requirements, which attracts individuals with limited funds. Seamless remote onboarding—often completed within minutes—eliminates the need to visit physical branches, benefiting those in hard-to-reach areas. Furthermore, each digital bank offers a unique value proposition to help integrate more Filipinos into the formal financial system. Some focus on secure remittance and financial services for overseas Filipino workers, while others partner with e-commerce platforms to reward consumers, offer easy access to credit lines, or expand investment opportunities.

4 These losses were also influenced by elevated noninterest expenses. Such costs were likely driven by initial investments in IT infrastructure, risk management model development, regulatory compliance, and marketing expenditures aimed at improving business visibility. While in aggregate the six digital banks remained in deficit, a few banks recently recorded profits.

5 Startups may take several years to achieve a net gain, as they require time not only to establish their organizational structures but also to comply with regulatory requirements, conduct business-related R&D, and build customer trust.

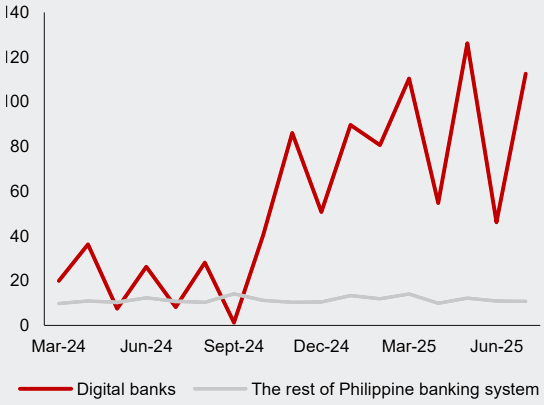
Bangko Sentral ng Pilipinas adopted a phased licensing framework to assess the impact of digital banks before expanding the sector. After licensing six digital banks from 2020,[7,8] a moratorium was imposed in August 2021 to evaluate their contributions to financial inclusion and digital transformation. It was lifted in January 2025 following a positive assessment, allowing up to 10 digital banks to operate, with emphasis on innovation and targeting underserved segments (BSP 2024b). This test-and-learn approach balances inclusion and risk management. Digital banks are monitored for both financial inclusion and stability, and are subject to the same prudential standards as traditional banks, including credit risk regulation (BSP 2020, BSP 2022). As the central bank gains further experience, it may refine regulations in consultation with the industry[9]—offering valuable lessons for other jurisdictions.

Figure 3.4.1. Growth in Deposits
(Percent, year-on-year)



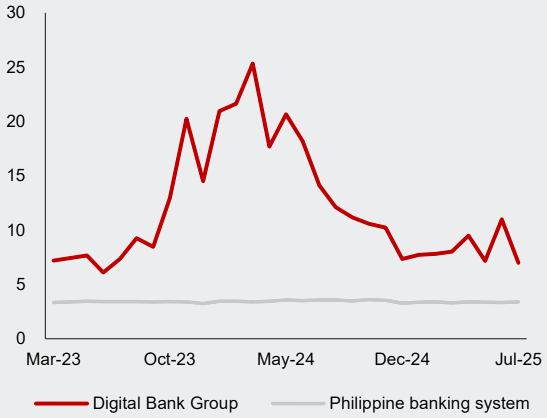
Source: Digital banks' balance sheets; Bangko Sentral ng Pilipinas; AMRO staff calculations.

Figure 3.4.2. Growth in Loans
(Percent, year-on-year)



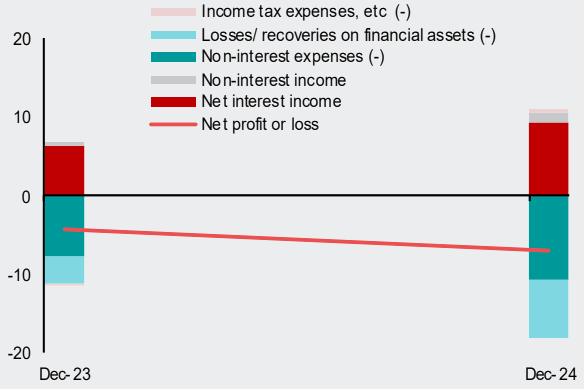
Source: Digital banks' balance sheets: Bangko Sentral ng Pilipinas; AMRO staff calculations.

Figure 3.4.3. Digital Bank Gross NPL Ratios
(Percent)



Source: Bangko Sentral ng Pilipinas.
NPL = nonperforming loan.

Figure 3.4.4. Digital Bank Earnings Breakdown[6]
(Billions of Philippine pesos)



Source: Bangko Sentral ng Pilipinas; AMRO staff calculations.

[6] Net Profit or Loss = "Net Interest Income" + "Non-Interest Income" - "Non-Interest Expenses" – "Losses/Recoveries on Financial Assets" - "Income Tax Expense etc". "Losses/Recoveries on Financial Assets" comprise "provision for credit losses on loans and other financial assets", "bad debts written off", and "recovery on charged-off assets", encompassing not only expenses related to loans but also those associated with other financial assets. Those related to NPLs refer to simply as credit costs in the main text.

[7] In December 2020, Bangko Sentral ng Pilipinas issued Circular No. 1105 (Guidelines on the Establishment of Digital Banks), which established the formal guidelines for digital banks as a distinct classification within the banking system. The guidelines define digital banks as institutions that offer financial products and services exclusively through digital platforms, without physical branches, and are required to maintain a principal office in the country.

[8] Under this framework, Bangko Sentral ng Pilipinas granted licenses to six digital banks: GoTyme Bank, Overseas Filipino Bank, Maya Bank, Tonik Digital Bank, UnionDigital Bank, and UNObank. They primarily served overseas Filipino workers, the underserved, unbanked, mass market consumers, and MSMEs.

[9] Provided that risks to financial stability remain limited and further acceleration of financial inclusion is needed, there could be room to fine-tune regulation based on the proportionality principle as necessary, for example, in a manner suited to the Philippines. The proportionality approach is taking regulatory and supervisory requirements that are tailored to the size, complexity of activities, risk profile and systemic importance of a financial institution. That said, implementing a sound proportionality regime is not an easy task, and appropriate international guidance can help authorities avoid being perceived as having a less rigorous regulatory framework (Restoy 2022).

Liquidity risk

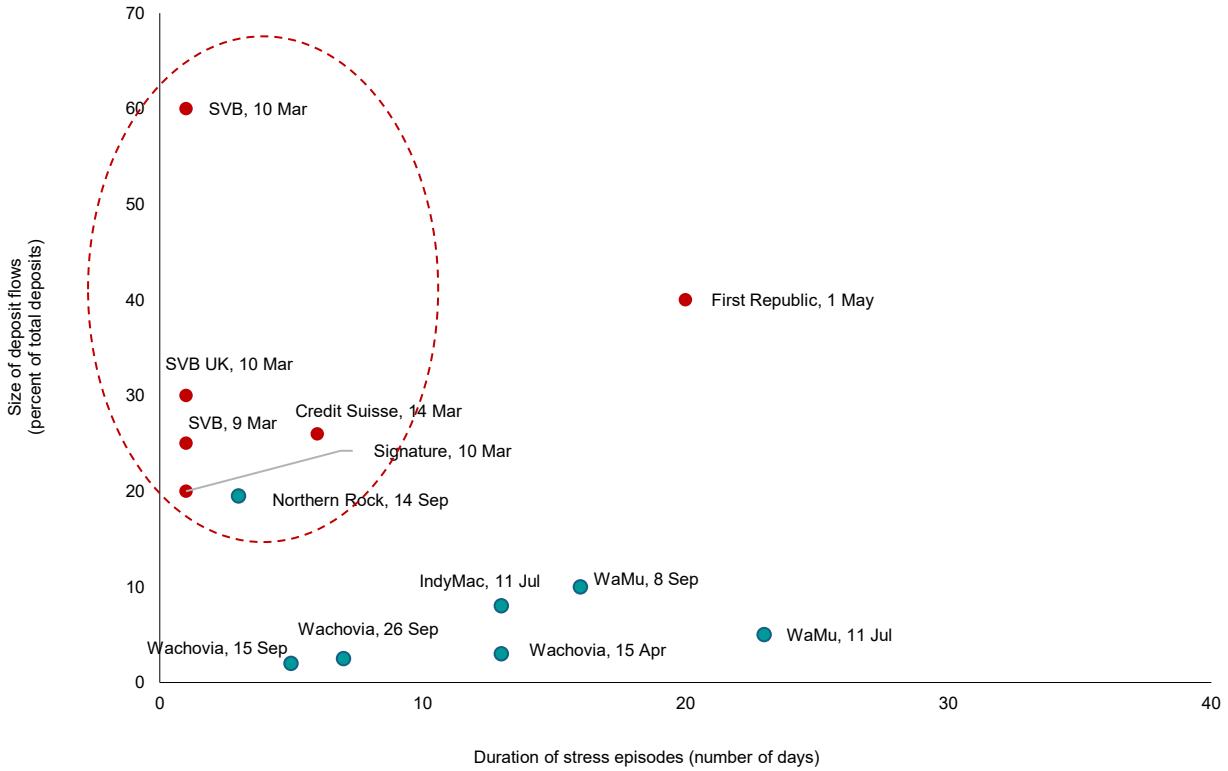
Financial digitalization can heighten liquidity risks in the banking system through several channels. First, while e-wallets and alternative lending platforms—often linked to nonbank ecosystems and offering attractive returns—are not yet able to compete with traditional banks, their rise could draw deposits away once they reach strategic scale. In an extreme scenario, this shift could weaken banks' core deposit bases, compelling them to rely more heavily on volatile wholesale funding, which is both more expensive and less stable during times of financial stress. The ASEAN+3 traditional banks are aware of these risks and are transforming their mobile apps into super-apps which provide financial services and seamless integrations with other nonfinancial products and services. More usage of bank wallets for daily transactions helps banks attract low-cost current and savings account deposits, which reduces liquidity risks. That said, and as discussed in relation to business risks, the technological investments for the super apps and integrations are very high and not all banks can afford to invest. The small and mid-sized banks will likely remain more vulnerable to liquidity risks.

Second, the always-on nature of digital banking allows customers to move funds instantaneously, heightening the risk of sudden liquidity outflows and amplifying market volatility during times of stress (Ong and others 2023). On 9 March 2023, Silicon Valley Bank (SVB) experienced a classic bank run, as depositors rapidly withdrew funds following rumors and concerns about the bank's financial health. While the concerns were well founded, the speed at which they spread across social media platforms, and the pace of deposit withdrawals was unprecedented. The collapse of SVB and of Signature Bank, which shut down just days later, demonstrate that liquidity outflows enabled by technology were too fast for the banks or the authorities to take corrective actions (Figure 3.21).

Finally, the expansion of cross-border banking activities may present a greater challenge for supervision and crisis management. It may limit central banks' ability to act as lenders of last resort—providers of liquidity to financial systems or banks that are temporarily illiquid. Poor liquidity management could trigger the failure of a banking group across the region. Although a home supervisor can provide liquidity support for settlement of its own currency, it may not be able to prevent a chain reaction of failures in other markets (ADB 2023). Stronger economic and financial integration among regional economies has increased the use of local currencies in cross-border transactions, necessitating closer cooperation among regulators to effectively manage emerging risks.

Figure 3.21. US and Europe: Magnitude and Speed of Bank Deposit Runs

Recent bank runs have been larger and faster compared to past episodes.



Source: Adrian and others (2024); AMRO stylization.
Note: Red dots denote incidents in 2023. Teal dots denote incidents in 2008, except for Northern Rock which occurred in 2007. SVB = Silicon Valley Bank; WaMu = Washington Mutual Inc.

Business or strategic risk

The digitalization of banking services needs large investments. Global fintech investments rose consistently leading into and during the pandemic as demand for digital services rose. Investment has eased since then (Figure 3.22) because of higher interest rates, rising geopolitical uncertainties, valuations concerns, and an environment with limited exit opportunities for venture capitals (Jawhar and Troiano 2022; KPMG 2024, 2025). Investment in ASEAN+3 fintechs was notably weaker as they did not pick up during the pandemic and have continued to weaken. The decline in funding, despite the growth in fintech revenues and a positive outlook, shows that potential investors in fintech were probably seeking higher premiums.

ASEAN+3's digital banks also face business sustainability concerns as many are yet to turn profitable. Digital banks have very limited fee-based income and profitability indicators point to strategic vulnerabilities in some economies (Figure 3.23). In economies such as Hong Kong and Singapore, digital banks report much higher costs driven by elevated operating costs and still-nascent revenue streams. Cost pressures for digital banks come from the need for significant initial investments in technology and high (and often unsustainable) customer acquisition costs through marketing campaigns and attractive service terms. Digital banks also face business concentration risks in the absence of meaningful fee-based income and diversified funding sources, and by catering to specific customer segments. Fintechs and digital banks also face talent retention challenges as they often compete with large tech firms and traditional banks for a limited pool of skilled tech and data talent.

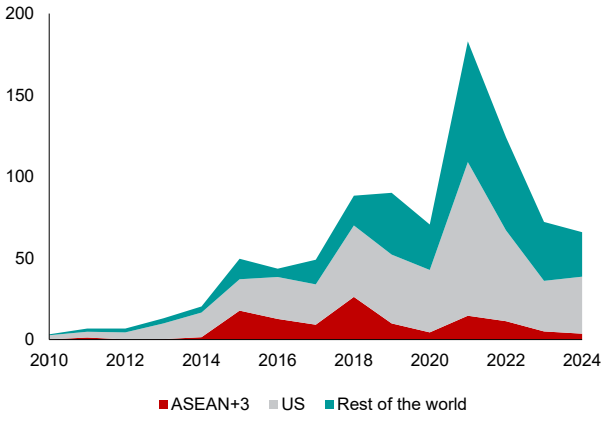
On the other hand, large traditional banks face minimal sustainability risks. They have invested heavily in upgrading (and even overhauling) their technology and systems to improve customer experience and engagement and to keep up with competition from fintechs and digital banks, rather than return-on-investment considerations. That said, they run the risk of investing in technologies with much lower marginal returns and at the same time dealing with the dilemma of either partnering with external vendors or building technological solutions in-house. Partnering with external service and product providers is generally cheaper, but in-house development provides more flexibility and control over product development. Many large banks in ASEAN+3 have typically resorted to in-house development teams for core functions while small and mid-sized banks have relied more on service providers.

Sustainability pressures are greater for mid-sized firms as they compete with both large institutions and nimble niche providers. Financial digitalization may lead to a "barbell" market structure where few very large, multiproduct institutions can dominate on one end thanks to economies of scale, scope, and access to extensive data, while at the other end, many focused niche providers thrive by using technology to reach targeted customer bases (BIS 2021). This dynamic leaves little room in the middle for mid-sized firms, who are caught in a double bind.

We find early signs in some ASEAN+3 advanced economies that the "barbell" structure could be further disrupted. This is largely because many traditional banks have upgraded their service offerings enough to nullify any competitive advantage that niche fintechs may have. This is pushing fintechs and mid-sized banks to either of two paths for survival: (1) form a consortium of similar financial institutions to upgrade technology and compete with the large banks, or (2) integrate into defensive ecosystems where financial and nonfinancial services can be seamlessly integrated. The recent trend of Japanese telecom providers acquiring digital banks is a step in this direction as it eases customer acquisition and servicing costs for both the telecom provider and bank (Business Times 2025).

Figure 3.22. World and ASEAN+3: Funding to Fintech Companies
(Billions of US dollars)

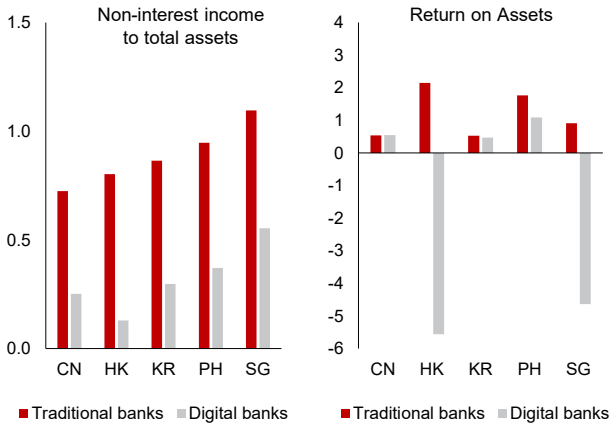
Global funding to fintech companies has slowed after more than a decade of rapid growth.



Source: Tracxn; AMRO staff calculation.

Figure 3.23. Selected ASEAN+3: Non-Interest Income to Total Assets, and ROA (2024)
(Percent)

Digital banks have lower non-interest incomes and return on assets.



Source: Moody's BankFocus; national authorities; AMRO staff calculations.
Note: Data as of end 2024. ROA = return on assets. CN = China; HK = Hong Kong; KR = Korea; PH = Philippines; SG = Singapore.

Procyclicality risks

Digitization of banking services can heighten procyclicality by amplifying credit cycles. Digital banks, fintechs, and bigtechs often concentrate lending in underserved retail and MSME segments with weaker credit profiles. When conditions deteriorate, asset quality can deteriorate quickly, prompting tighter lending to conserve capital. For instance, during COVID-19, fintech companies in Indonesia scaled down on P2P lending (IMF 2021). This can exacerbate procyclicality by restricting access to credit to already distressed customers. Furthermore, the growing adoption of AI models in banking could increase market correlations adding to procyclicality risks as financial institutions increasingly rely on similar pretrained models or models that are trained using similar data sources (MAS 2024).

VI. Policy Discussion

Key regulatory approaches and developments in ASEAN+3

Regulatory developments across the region vary depending on the maturity of the financial ecosystem, national objectives for digitalizing in finance, and specific idiosyncratic risks. Authorities have adopted diverse approaches to address these differentiated risks. The approaches, however, are not mutually exclusive; regulators often blend elements from multiple frameworks to design customized regulatory systems.

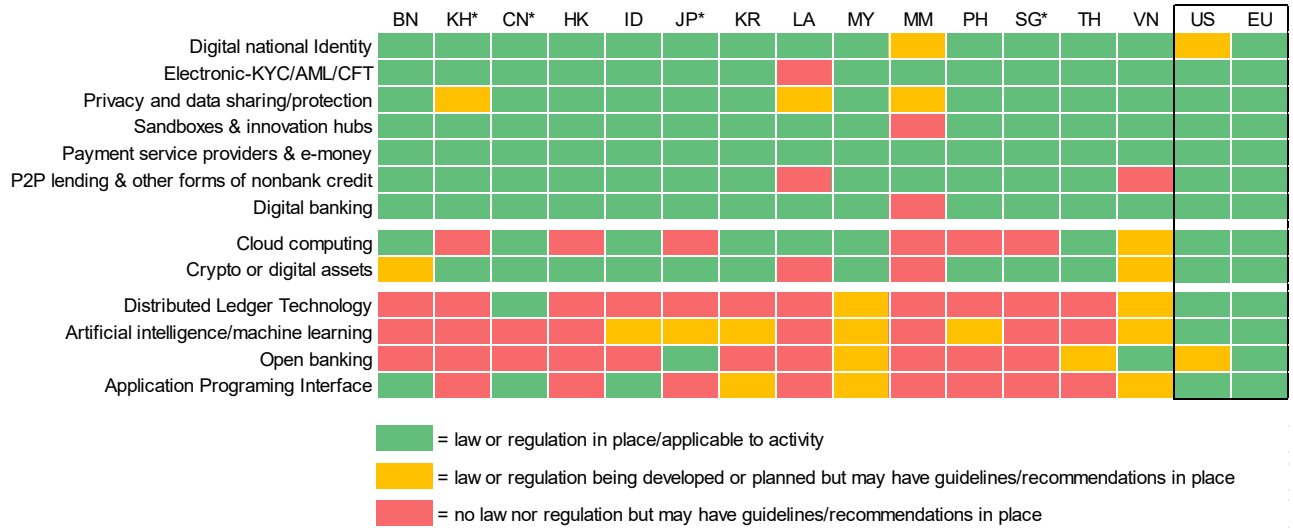
Cross-jurisdiction comparison of regulatory frameworks

Over the years, ASEAN+3 regulators have strengthened rules and laws, some guided by global best practices and some dictated by idiosyncratic factors, to address different aspects of emerging financial digitalization and its effect on the banking sector. We identify 13 areas for regulatory oversight of financial digitalization relevant for banking and compare the stringency of these laws in different economies (Figure 3.24).

While most jurisdictions have established frameworks to manage fundamental issues such as national digital identification, data privacy and protection, and AML/CFT compliance, some are still considering clear guidance or regulations for newer technologies like AI and DLT.

Figure 3.24. ASEAN+3, US, and EU: Fintech Regulations in Place, September 2025

The region has diverse regulatory treatments across technological areas.



Source: National authorities; AMRO staff compilation.
Note: Asterisk (*) denotes regulations of a particular economy have not been cross validated with authorities' survey inputs. In the heatmap, green means there is at least one legally binding law or regulation in place for the specific activity. Yellow means related policies are still in development or the planning phase, while red indicates that no regulations have been imposed on the activity. Laws include acts, decrees, ordinances, prakas, and regulations. Associated guidelines and recommendations are not considered as legally binding. Guidelines and recommendations include standards, principles, guidance frameworks, and sandboxes. AML/CFT = anti-money laundering and combating of the financing of terrorism; BN = Brunei; KH = Cambodia; CN = China; EU = euro area; HK = Hong Kong; ID = Indonesia; JP =Japan; KYC = know your customer; KR = Korea; LA =Lao PDR; MY = Malaysia; MM = Myanmar; P2P = peer-to-peer; PH = Philippines; SG = Singapore; TH = Thailand; VN = Vietnam; US = United States.

We can broadly divide these areas of regulations based on the extent of implementation across economies. The classification is subjective and based on information available as of September 2025. It is likely that some of the less-regulated areas will become more regulated as more countries furnish their regulatory frameworks.

1. **Widely regulated:** These areas can be classified as either enablers of digitalization or those where digitalization has progressed significantly. Regulations related to digital national identification, electronic KYC/AML/CFT, and data privacy and protection are central to the establishment of systems to enable digital onboarding of customers and adherence to compliance standards. Therefore they have well established laws and enforcement guidelines. Since authorities appreciate the importance of testing fintech products, services, or business models in a controlled environment, regulatory sandboxes[21] have emerged as a key component in building an inclusive digital financial ecosystem—enabling innovation to thrive while managing risks (APEC Secretariat 2021). The immense adoption in payment systems and alternative lending (such as P2P) and the strong push from various authorities on digital (or virtual) banking initiatives have played an important role in strengthening the relevant regulatory frameworks.

2. **Regulated in most economies:** This category includes regulations around cloud computing, which is a cost-effective solution to infrastructure needs, and crypto (or digital or virtual) assets, which have acted as an alternative investment asset, mostly outside the banking system. Cloud computing regulations may include outsourcing/vendor requirements and data-sharing agreements. Regulations around crypto assets have seen wide dispersion in the region. While some authorities have adopted a wait-and-see approach, others have been proactive in minimizing risks posed by crypto assets. Some countries have also banned specific activities related to crypto assets. Many authorities in the region have allowed banks to engage with crypto assets but under very stringent risk management, enhanced compliance requirements, and controls for financial stability and user protection.

3. **Emerging areas with limited regulations:** These predominantly include technologies still in exploratory stages and generally being considered to improve operational efficiencies. Technologies such as DLT and AI/ML are being extensively explored but have seen limited adoption in the wider financial system. Thus, there are generally fewer regulations around these technologies in most ASEAN+3 economies. Similarly, though the concept of open banking and API standardization is gaining traction and has found use in integrating various parts of the financial system, it remains one of the less-regulated aspects.

Policy recommendations

Regulating the evolving environment of banking services

There is immense diversity in the progress of banking service digitalization within the region. This extends across types of firms, the stages of financial development and digitalization of economies, and the approach toward regulations.

Assessing the different types of firms, diversity is highest among fintechs and least among incumbent banks. Digital banks are still evolving and though the diversity is much lower than for fintechs, the business models and services portfolio varies among them. Also, fintechs, bigtechs, and digital banks are still much smaller than incumbent banks in ASEAN+3, giving the authorities some flexibility to assess the developments and gradually impose or adjust related regulations. In case of incumbent banks, while digitalization helps reduce risks in many dimensions, it can amplify or redistribute other types of risks. To appropriately regulate such an environment, authorities may adopt approaches that are most suited for their specific country and industry circumstances (Table 3.4).

The approaches are not mutually exclusive; regulators often blend elements from multiple frameworks to design customized regulatory systems. For example, Singapore requires digital banks to comply with the same regulatory standards as traditional banks under the Banking Act (i.e., an entity-based regulatory requirement). However, the digital banks must meet a separate set of requirements (Eligibility Criteria and Requirements for Digital Banks) specific to their operations (MAS 2019) and which has elements of an activity-based system, such as value proposition and track record of the applicant groups. Thus, both approaches are amalgamated to regulate digital banks prudently.

[21] Regulatory sandboxes are frameworks that allow firms to test innovative financial products, services, or business models under a specific testing plan, which is agreed upon and supervised by a designated unit within the competent authority. In contrast, innovation hubs serve as dedicated contact points where firms can submit inquiries related to fintech and receive nonbinding guidance on regulatory and supervisory expectations, including licensing requirements (ESMA 2018). According to the Cambridge Centre for Alternative Finance, the region currently hosts 17 active financial services sandboxes and 16 innovation offices.

While there are multiple approaches to regulations, authorities need to be flexible in gradually shifting their regulatory frameworks with changes in the landscape. An emerging financial service or business model could be managed by a risk-based approach in its nascent stages but as its adoption and acceptance grows, authorities may move toward formalizing its regulations. The regulations can be based on principles and activities to provide some flexibility for innovations. As the service or model matures, regulators can switch to use an entity-based and rule-based approach that provides more regulatory certainty.

Moreover, it is beneficial for regulators to engage with regional peers, exchanging experiences, insights, and practices. Cross-jurisdictional cooperation can help accelerate the learning curve and maximize the benefits of sandbox initiatives, especially in supporting cross-border innovation and regulatory harmonization.

Table 3.4 Summary of Regulatory Frameworks and Initiatives to Manage Risks

Framework and Approach	Circumstances	Use Case
Entity-based framework	Less diversity across firms; risks emerging from a combination of activities; a need to mitigate systemic risks	Traditional banks in all ASEAN+3 economies
Activity-based framework	High diversity across firms; firms providing a systemically important activity or service; "*same activity, same risk, same regulation*"	Payment solutions by fintechs, bigtechs and banks
Risk-based framework	Evolving services, businesses and technologies that are difficult to classify under existing activities; room to adjust regulatory intensity based on the likelihood and potential impact of identified risk; "*higher the risk, greater the controls*"	Emerging fields like digital finance, cybersecurity and AI deployment
Principle-based framework	A need to provide flexibility for rapidly evolving sectors; scope to define high-level standards; room to allow greater discretion to firms for compliance	
Rule-based framework	Strong requirement of detailed, prescriptive, clear, and consistent regulations across the industry	A new licensing regime and requirements for digital banks
Big-bang approach	A need for direct regulatory overhaul and dismantling outdated frameworks; higher tolerance for potential disruptions, steep learning curves and high implementation costs	
Adaptive approach	Existing regulatory frameworks can accommodate new products and services, business models and entities	Payments and e-KYC
Sandbox approach	Need to test innovative products, services or business models in a controlled environment; allows direct oversight from regulators	Emerging fintechs

Source: AMRO staff compilation.

Mitigating risks from digitalization of banking services

While the regulations, frameworks, and testing make sure that the risks to financial stability are mitigated, it could be useful to evaluate policy measures to contain different types of risks.

Operational risks: Cybersecurity, business continuity, and fraud risks are arguably the most significant risks from financial digitalization. While cybersecurity and business continuity risks can be viewed from the technological infrastructure perspective, fraud risks typically emerge from social engineering. Their management requires a multipronged approach:

- In order to ensure cybersecurity and operational resilience, governments can issue standards and guidelines for IT infrastructure. These include integrating cyber risk assessment frameworks in risk management, regular risk assessments, data protection policies, and cyber threats, and managing third-party or vendor risk. The companies should also have robust internal procedures to make sure that software upgrades are tested thoroughly before implementation.

- Financial institutions should also be required to have appropriate incident resolution and reporting protocols. The recovery should be governed by service level agreements (such has maximum downtime, response time, resolution time) while reporting protocols should be designed to learn from incidents and put preventive measures in place. The authorities may decide to penalize firms through fines or increased capital requirements if they fail to meet the standards for cybersecurity and operational resilience.

- The authorities should also encourage training and knowledge sharing between firms so that companies learn from each other's experience. This is an essential part of fraud risk management because most fraud is executed using social engineering. The customer becomes the weakest link in the banking value chain. Therefore, increased customer engagement and education is vital to prevent exploitation by fraudsters and many other operational risks for financial institutions.

- Increasing financial and digital literacy amongst end users of digital services is also equally important because, as seen in socially engineered frauds, the end user becomes the weakest link in the banking chain, which is exploited by the fraudsters. These efforts can be encouraged by authorities and provided by financial institutions as part of their regular customer engagement.

- Finally, the introduction of loss-sharing programs for cyber incidents and fraudulent transactions can help allocate liabilities, strengthen trust, and improve incentives for prevention. Many countries have been developing loss-sharing agreements for fraudulent transactions withing the banking value chain (Box 3.5). A lot of fraud includes activities conducted across borders—and hence call for increased cooperation between authorities.

Box 3.5:

Loss–Sharing Schemes in ASEAN+3

The rise of digital financial services has driven a surge in scams and fraud. Sophisticated phishing, social engineering, and fake apps have led consumers to authorize transfers to fraudsters. Where data are available, reported losses are large and increasing. Singapore recorded over SGD 1.1 billion (USD 860 million) in scam losses in 2024 (a 71 percent year-on-year increase),[1] while Hong Kong reported HKD 9.2 billion (USD 1.2 billion) lost in 2024.[2] Thailand's online scams totalled THB 96 billion (USD 3 billion) between March 2022 and July 2025,[3] and Vietnam recorded losses of VND 18.9 trillion (USD 723 million) in 2024.[4] Given this rapid growth of scam losses, protecting victims is crucial to maintaining confidence in digital financial services and the overall integrity of the financial system.

Traditionally, victims were left to bear the full financial loss. Banks often deny liability unless a transaction was clearly unauthorized in a technical sense (e.g., hacking without the customer's involvement). However, with scams now operating at industrial scale, this model is increasingly viewed as unfair to consumers who may have been tricked despite taking precautions. In response, authorities across ASEAN+3 are developing loss-sharing programs that distribute scam losses more fairly among customers, banks, payment providers, and telecommunication firms. These frameworks aim to protect victims while pushing all players to strengthen fraud prevention.

Loss-sharing models typically aim to create a fairer system. Rather than placing the entire burden on victims of the scam, these frameworks set clear obligations for all parties affected. Banks, payment providers, and telecom companies (telcos) are expected to implement robust security measures such as multifactor authentication, real-time alerts, transaction monitoring, and SMS filtering. To minimize moral hazard risks, consumers also have responsibilities to exercise caution and follow security best practices. Liability is then allocated based on whether each party has met these obligations. If a bank or telecom provider fails to meet the standards required, it is responsible for reimbursing the victim. If all parties have fulfilled their duties and the customer has been negligent, the loss may remain with the customer, balancing customer protection with personal responsibility.

ASEAN+3 jurisdictions are at varying stages in adopting such loss-sharing frameworks. Singapore launched its Shared Responsibility Framework in late 2024, mandating clear duties for banks, payment providers, and telcos, with liability determined by compliance with these duties. Korea has long had a legal basis for freezing and refunding scam proceeds under the Special Act on Telecommunications-Based Financial Fraud, with new reforms to expand and speed up compensation. Malaysia adopts a joint responsibility approach where both banks and consumers bear shared losses from unauthorized online fraud, while consumers can seek redress through the ombudsman. In contrast, China and Japan place greater focus on prevention and asset recovery. Their regulations prioritize identifying and freezing fraudulent accounts to return seized funds to victims but do not formally mandate banks to cover unrecovered losses, which may leave victims exposed if the funds cannot be fully recovered (Table 3.5.1).

Beyond loss-sharing programs, protecting consumers will require a comprehensive approach. Staying ahead of evolving scams will require advanced detection systems, strong regulation enforcement, and targeted consumer education to ensure safety and sustain the growth of digital financial services.

The author of this box is Benyaporn Chantana.

1 Singapore Police Force Annual Scams and Cybercrime Brief (2024).
2 Hong Kong Police Force, Law and order situation in Hong Kong in 2024.
3 Cyber Crime Investigation Bureau.
4 Vietnam News. 2024. "Online frauds caused $774 million in damages in 2024." Vietnam News, 16 December.

Table 3.5.1. Loss-Sharing Programs in ASEAN+3

Economy	Law or framework	Key Features
Schemes already in effect		
China	Anti-Telecom and Online Fraud Law (2022)	• Telecom providers, financial institutions, and internet service providers (ISPs) are required to have monitoring and risk management measures to reduce suspicious behaviours • No mandatory reimbursement for unrecovered losses
Japan	Criminal Accounts Damage Recovery Act (2007)	• Enables banks to swiftly scammer bank accounts and channel seized funds to victims • No general bank liability for unrecovered losses
Korea	Special Act on Prevention of Loss Caused by Telecommunications-Based Financial Fraud (2011, reform in 2025)	• Enables rapid freezing of suspicious transfers and returning funds to victims • Reforms will likely shorten payout times and broaden eligible fraud scenarios to improve consumer protection
Malaysia	Policy Document on Ensuring Fair Treatment for Victims of Unauthorised e-Banking Transactions	• Banks must promptly investigate fraud and communication outcomes • For unauthorised online fraud- - banks bear full responsibility if the fraud is due to security measure failures - banks and customers jointly share the liability for cases with element of joint culpability • If victims disagree with the decision or compensation offered, they have the right to submit a dispute to the ombudsman
Singapore	Shared Responsibility Framework (2024)	• Mandatory regulatory framework which sets clear duties for banks, payment providers, and telcos (e.g., transaction blocking, real-time alerts, SMS filtering) • Establishes a 'liability waterfall' where if a bank or telco fails to meet required duties, it must reimburse the victim • If all providers meet standards and the customer is negligent, the customer bears the loss • Introduces new tools such as account kill switches to let customers immediately freeze their account
Thailand	Royal Decree on Measures to Prevent and Suppress Technology Crimes No. 2 (2025)	• Sets a shared-responsibility framework across banks, payment providers, telcos, social media platforms, and digital asset firms and holds them liable for losses if they fail to meet regulatory standards • Liability is assigned proportionally based on court assessments of negligence and failure to meet standards • Regulatory standards are being issued across agencies. BOT and SEC focus on KYC and mule account suspension; ETDA assigns social platforms to curb scam-related and false information; NBTC requires telecom operators to verify customer identity, monitor SIM use, regulate automated messaging, and suspend suspicious activities
Schemes under development		
Hong Kong	HKMA-proposed approach for handling customer claims for losses arising from authorized payment scams (under consultation)	• HKMA is consulting on the adoption of a more aligned approach for banks to assess customer claims for losses arising from authorized payment scams

Source: AMRO staff compilation.

Systemic risks: The high dependency of financial institutions on a few service-providers is one of the more recent risks that digitalization has introduced to the financial system. To minimize these, governments should encourage key financial institutions to seek services from different vendors. Over the longer horizon, the development of high-tech technology service providers within the economy could help reduce the external dependency of the financial system.

Traditional systemic risks could also be amplified as financial institutions (banks, fintechs, and virtual banks) become increasingly interconnected. Connections between traditional financial institutions pose a systemic risk in the event of stress in the financial system or the real economy. Digitalization has put fintechs and bigtechs into this mesh. In many economies, fintechs and bigtechs are not large enough to pose systemic risks, but their growth has been strong. This calls for robust monitoring of their linkages with the financial systems, encouraging diversification of financial partners, and considering appropriate macroprudential frameworks to limit spillovers from individual firms or sectors to the broader financial system.

Credit risks: The credit risk profile for incumbent banks has not changed much through digitalization, with elevated risks concentrated more in those fintechs, bigtechs, and digital banks using alternative credit-scoring models. Partly, this is due to lack of centralized credit data. With rising interconnectedness, spillovers can occur from fintechs, bigtechs, and digital banks to traditional banks.

- Many of these entities try to mitigate the risks themselves. Where lending is enabled by a digitalized ecosystem, many firms typically wait for some transaction history to accumulate before offering loans to their customers. The size and tenor of the loans are also adjusted based on the data available. Typically, customers with limited data will be offered smaller loans for short durations and vice versa. This allows the firms to risk-adjust their exposures. Such prudence should be encouraged where possible.

- The use of the alternative credit-scoring models can initially expose entities to the risks of higher nonperforming loans as the model learns from the data, but this phase is also critical for calibrating the models. Calibration can be expedited if appropriate data-sharing policies exist within the financial system, between both private and public institutions. It will also allow parallel development of various models, allowing diversity in their evolution.

- The need to develop alternative credit-scoring models in some jurisdictions arises from the lack of credit data. In these cases, establishment of a comprehensive and centralized credit data registry may help alleviate such information asymmetry. Maintaining a central credit registry and sharing it with financial institutions (including fintechs) can also help as firms can monitor credit history and debt recovery status across the industry, before offering new loans. Adding alternative credit scores for unbanked customers in the credit registry could also help improve the credit screening process across the industry. Companies may augment these scores to their own credit-scoring models to have a robust credit risk evaluation.

- The authorities should monitor the lending using the alternative credit scoring system and introduce regulations, such as the size of the lending, and hence limit its potential spillover to the financial system, rises. They can also consider licensing frameworks for new lending models, such as P2P lending and BNPL, which are gaining traction as business models mature.

Liquidity risks: Technology, by reducing frictions, can increase the speed, scale, and scope of a digital bank run. While such an event may have roots in broader risks, technology may not give banks or the authorities enough time to react and put corrective measures in place. Financial safety nets will thus play a critical role in preventing bank runs:

- Regulators may require financial entities under their supervision to demonstrate intraday liquidity management as part of business continuity and recovery planning using real-time dashboards to ensure the entities have viable contingency plans.

- Deposit insurance programs could also be effective in reducing the severity of strong deposit outflows (AMRO 2023). In addition, authorities may design safety nets such as the emergency lending assistance to solvent financial institutions (including those fintechs and virtual banks that are well regulated and have growth to be systemically significant) facing temporary liquidity problems. That said, these facilities can generally be used only by entities regulated by the central bank.

- During the stress period, effective communication is crucial. One factor that can accelerate a digital bank run is the spread of information (or misinformation) through social media channels. This has prompted many banks to employ dedicated teams to monitor social media and intervene if the bank is targeted. Similarly, authorities can be active on social media platforms to monitor trending news and stop the spread of misinformation about the financial system.

Business or strategic risks: These are significant for fintechs, which are susceptible to failure in the first few years of operation. Similarly, many digital banks have moderately high exit risks. Among incumbent banks, the risks for larger banks may be low as they still derive revenue from traditional business streams and can use heavy technological investments to consolidate their position. However, small and mid-sized banks that could be squeezed by increasing competition from fintechs may not be able to invest enough in fortifying their technological defenses. Accordingly:

- The risk-based approach suggests that the life cycle of fintechs could be left untouched unless some become systemically important. Similarly, authorities should mandate digital banks to formulate an exit plan before they start business with an aim to allow a smooth closure of operations with minimal contagion risks.

- Risk monitoring on large incumbent banks, however, need to be more stringent. Most traditional banks do not have return-on-investments considerations when investing in cutting-edge technologies as they seek to stay ahead of competition. That said, mistakes in these big-ticket investments can lead to suboptimal performance and cause severe concerns among customers and shareholders. This calls for the implementation of a strong governance framework, thorough an investment review process, and clear articulation of underlying strategic objectives. The governance framework must include close monitoring of progress in fintech and financial digitalization projects with a well-defined exit strategy if the projects fail to provide the expected benefits.

- The largest challenge remains for mid-sized banks. The mid-sized banks will likely face the most challenging environment. These institutions may need government support to move to different ends of the barbell—either by becoming niche players or pooling resources through partnerships with other institutions to have enough resources to compete with larger banks. As seen in some advanced economies, to fend off competition small and mid-sized banks may need to either form alliances, consolidate through mergers, or integrate themselves into defensive ecosystems. In doing so, the authorities can ease and accelerate regulatory approval processes for mergers and acquisitions—especially between nonfinancial and financial entities and consider easing some regulatory burdens and capital requirements during the transitory stages.

Procyclicality risks: These risks appear to be peripheral for now, but could increase in scale if alternative lending grows significantly with higher interconnectedness to the broader financial sector. In such a scenario, authorities must upgrade their risk assessment frameworks to include the alternative lenders, and appropriately capture the exposure of vulnerable sectors (households, MSMEs, and so on) and the interconnectedness of the larger financial institutions with these lenders. The authorities may also need to closely track the credit-scoring models and lending standards used by these lenders to act as needed when vulnerability rises. Applicable macroprudential measures can also be applied to nonbank lenders based on proportionality i.e., their systemic importance and risk exposures.

The Way Forward

Digitalization is fundamentally changing the structure of the financial system. In economies where financial inclusion is low, digitalization has an important role in increasing the catchment area for customers of banking services. Engaging underserved and unserved segments of society will provide sufficient opportunities for new entrants into financial services to expand and gain sizable market share if they have robust business models and can adapt to customer needs.

On the other hand, for economies with high financial inclusion, new entrants will have to compete with strong incumbents who are investing heavily in upgrading service delivery through technology. Even as it seems many financial systems will gradually move toward a "barbell" structure, evidence from advanced economies suggests that niche players will find it difficult to survive as larger companies catch up. This dynamic will push the industry toward consolidation, alliances with financial and nonfinancial partners, and the development of defensive ecosystems. The trend in advanced economies is a good template for ASEAN economies with financial services that are still growing rapidly as inclusion picks up pace. That noted, issues for small and mid-sized firms will arise once financial inclusion reaches new heights, while further digitalization will have diminishing effect in expanding the financial industry's size. As these economies progress toward this stage, the authorities may need to be mindful of the risks posed by failures of niche players as well as the process of industry consolidation.

The profile of customers catered by newly digitalized financial services has been largely consistent across most economies. Retail customers, especially the young and financially excluded, have seen the most benefit from improvement in banking service delivery. However, digitalization in corporate banking has still been limited. Technological readiness is not likely an issue as many corporate banking services can be digitalized with the same building blocks used by retail businesses. But there needs to be a greater push for policymakers to facilitate these developments. Most economies still do not have the facility for firms to automate compliance procedures such as KYC and AML/CFT. Compared to national identification for individuals, corporate identification programs are lagging in most of the economies. Many processes, such as credit evaluation, are still using procedures which require physical submission of paper-based forms and documentary proofs (such as financial statements, contracts).

With retail services across many of the economies making substantial progress in digitalization, it is likely that authorities will shift focus to enabling the digitalization of corporate banking. Paperless processes will be a key stepping stone but will need to be followed up with multiple other changes as digitalization progresses. This would require a broader scale of digitalization beyond financial services. Nonetheless, several ASEAN+3 economies have already made progress with corporate banking digitalization. Examples include digital supply chain finance platforms in Thailand, digital trade finance in Malaysia, and APIs for enterprise resource planning (ERP) connectivity in Singapore.

An important aspect of corporate banking digitalization would be to ensure the 24/7 availability of financial services—including those which are market based. These services are provided to retail customers for small payments as financial intermediaries can manage market risks until markets open, given the transaction sizes. However, for corporate solutions, the significantly larger size of transactions would mean that intermediaries may not be able to manage risks when markets are closed. If markets need to operate 24/7, so would monitoring and supervision by authorities. Multiple initiatives by private and public sectors aim to automate many of these procedures so they can be operated beyond current market hours, but market development still remains a significant hurdle as liquidity dries up. Overall, while digitalization of corporate financial services is the logical next step, the impetus to facilitate it could be much higher than would be needed for retail services.

Finally, while there is no one-size-fits-all approach, authorities should take a holistic view and continue closing gaps in regulatory frameworks. Regulations across many parts of the digital economy are well developed in the region but some, such as for the use of AI and DLT, are still lagging. In light of this, cross-country collaboration and experience sharing could also facilitate the design of regulatory framework that encompasses a fast and nimble approach to innovation. At the same time, authorities must continue to monitor and assess risks that may develop as financial services, business models, and related entities evolve. A sound and prudent regulatory framework will be important to ensure that innovation in financial services continues to evolve while safeguarding financial stability.

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