Academic Article

Ensuring Financial Stability Amid Heightened Volatility and Fast-Paced Innovation: Necessary Tools, Research and Regulations

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ABSTRACT

This article highlights the key principles, methodologies and tools used in the risk assessment, risk mitigation and financial stability policy making across regulatory agencies. In addition, this article also addresses the new regulations and policy to ensure financial stability and security amid the ever-changing dynamics of financial development, notably financial innovations and financial technology. This is to ensure that the financial system remains sound, the financial development continues smoothly and efficiently and the public is well protected against potential risks.

Keywords: Financial Stability, Systemic Risk, Financial Development, Financial Innovation, Fintech, Payment System

การรักษาเสถียรภาพระบบการเงินท่ามกลาง
ความผันผวนที่สูงขึ้นและการพัฒนาเทคโนโลยีด้านการเงิน :
เครื่องมือ การวิจัยและเกณฑ์การกำกับดูแลที่สำคัญ

ดร.รุ่งพร เริงพิทยา
รองผู้อำนวยการ กลุ่มงานด้านเสถียรภาพการเงิน
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บทคัดย่อ

บทความนี้ได้ระบุถึงหลักการ วิธีการและเครื่องมือที่สำคัญในการประเมินและรับมือกับความเสี่ยง รวมถึงการดำเนินนโยบายด้านเสถียรภาพระบบการเงินร่วมกันของหน่วยงานกำกับดูแลต่าง ๆ นอกจากนี้ บทความนี้ยังได้กล่าวถึงเกณฑ์การกำกับดูแลระบบการเงินใหม่ ๆ เพื่อที่จะส่งเสริมเสถียรภาพและความปลอดภัยของระบบการเงินท่ามกลางพลวัตด้านการพัฒนาระบบและบริการทางการเงินที่เปลี่ยนแปลงอย่างรวดเร็วและเปลี่ยนแปลงอยู่ตลอดเวลา โดยเฉพาะอย่างยิ่งด้านนวัตกรรมและเทคโนโลยีด้านการเงิน ซึ่งทั้งหมดนี้ก็เพื่อให้เกิดความมั่นใจว่าระบบการเงินมีเสถียรภาพ การพัฒนาด้านการเงินสามารถกระทำได้อย่างต่อเนื่องและมีประสิทธิภาพ รวมถึงบริการด้านการเงินที่ให้แก่สาธารณชนมีความปลอดภัยอีกด้วย

คำสำคัญ : เสถียรภาพระบบการเงิน ความเสี่ยงเชิงระบบ การพัฒนาทางการเงิน นวัตกรรมด้านการเงิน เทคโนโลยีด้านการเงิน ระบบการชำระเงิน

INTRODUCTION

In the past decade or so, the financial landscape and businesses in Thailand have changed considerably and so do the policy and supervision frameworks accompanying them. With heightened interconnectedness and volatility in the global financial market and the financial system, central bankers face with a greater challenge of balancing between ensuring stability while fostering financial development and innovation to support economic growth. In Thailand, such balance has been carefully maneuvered by means of having quality tools and research while introducing new policies and regulations to keep up with the fast-changing landscape and environment. The following presents the overview and examples of the tools and policies introduced in recent years by the Bank of Thailand (BOT) as a part of the goal to strike such balance.

1. FINANCIAL STABILITY TOOLS

Ensuring financial stability involves the 3-stage process: (1) "detecting the smoke" refers to the on-going assessment and monitoring of systemic risk and channels through which different risks can be transmitted while conducting stress tests to assess risks during the plausible crisis time; (2) "putting out the fire" represents the potential actions taken by the central bank after risks are detected and are deemed non self-correcting, which hence require further policy actions and the assessment of the policy's effectiveness; and (3) "preventing the fire from spreading" means fostering a close coordination among regulators as well as having an institutional arrangement that can limit the risk transmission across players in the financial market.

1.1 Tools for Assessing Risks in Both Normal and Stressed Time

The first stage process of on-going monitoring involves a number of tools employed by BOT to quickly detect any emerging risk, which nowadays can materialize without warning. These tools range from different types of dashboards to detect possible risks in financial markets, macroeconomics and bank financial and liquidity positions. In addition to such monitoring tools, BOT also monitors systemic risk, which can arise from having connections between financial institutions, financial markets and the real sector as well as having accumulate risk over time, hence forming the "bubbles."[1] **More specifically, BOT has developed tools to assess systemic risk, both cross-sectionally and accumulation over time.** The principle behind the development of these tools is to be able to: **(1) address how risks are transmitted across entities and/or markets** ("cross section" or "interconnectedness") both under

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[1] According to the IMF, FSB and BIS, systemic risk can be defined as "a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and has the potential to have serious negative consequences for the real economy." This translates to having negative externalities from risk spillovers, market and infrastructure failure or risk accumulation over time.

normal and stressed time. Such transmission is generally captured by some types of network modelling to assess the relationship structure between nodes in the network, which can be entities, markets or even countries; and **(2) gauge the degree of risk build up over time** where the interplay between the real sector and the financial sector can lead to the build-up of risk, especially when the build-up is related to asset prices. Generally, once the asset prices accelerate, risks are usually underpriced and credit is easily obtained, pushing asset prices even higher until the bubble bursts and a recession or even a financial crisis set in.

For the tool to address the risk build-up, apart from having different types of dashboards, BOT also investigated the risk build up assessment by estimating the "financial cycle," as first introduced by Drehman, et al. (2012). This method employs the Christiano-Fitzgerald filter (CF-filter) to selected key financial variables in order to extract their cyclical components, which are deviations from the long-run trend, in order to construct a "smooth" financial cycle that exhibits longer horizon, which is the behavior of a financial risk build-up that usually takes longer than, for example, business cycle upturn.

Figure 1: Interconnectedness measure using ΔCoVaR
Source: BOT Financial Stability Report 2017

To note a few tools to measure interconnectedness, BOT used the delta CoVaR (ΔCoVaR) measure by Adrian and Brunnermeier (2011) to assess the interconnectedness between each bank in the banking system as well as the connection between the banking sector and 26 other sectors in the economy, using the balance sheet and stock return data (Figure 1). The estimation of ΔCoVaR yields two factors: (1) β, which captures the co-movement of negative asset returns between two sectors and is estimated using quantile regressions at 99th percent worst loss and (2) a stand-alone VaR, which reflects the severe negative return of a particular sector. The CoVaR estimation yielded

two interesting results: (1) sectors that interconnect with other sectors most may not have the largest market cap; and (2) sectors that can exert high transmission impact on other sectors usually have supply chains involving multiple sectors.
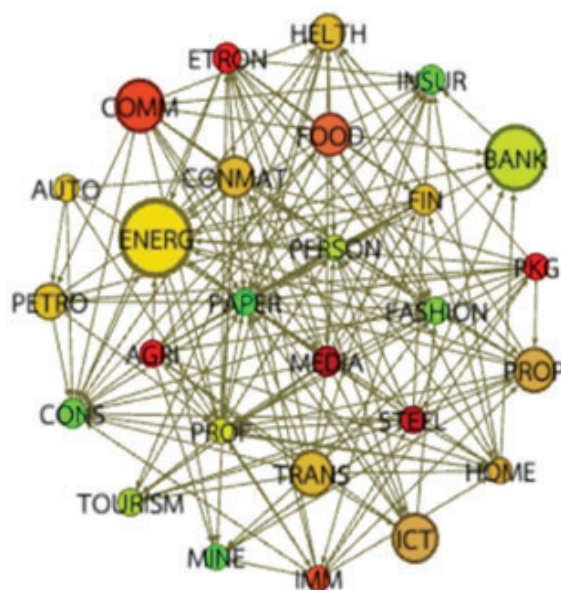

Figure 2: Interconnectedness measure using Diebold-Yilmaz
Source: BOT Financial Stability Report 2017

In addition, by using the same set of data, BOT also assessed the interconnectedness between the banking sector and the real sector by measuring the volatility spillovers in asset returns using the method developed by Diebold and Yilmaz (2014) (Figure 2). The spillover estimation is based on forecast error variances of asset returns where, if the forecast error variance of one asset can be attributed to shocks in the other asset, then both assets should be highly connected. This method involves two estimation steps: (1) estimating the asset return volatility via VAR model and (2) measuring the degree of connectedness using the variance decomposition, yielding the "from" connectedness, representing the spillover that one sector receives the other sector, and "to" connectedness, reflecting the spillover that one sector sends to the other sector. The results from the Diebold-Yilmaz method are: (1) sectors that have high volatility connectedness with other sectors do not have large assets; (2) sectors that export higher amount of volatility to other sectors are often smaller sectors; and (3) the banking sector is a receiver of shocks on a net basis and has low volatility connection with other sectors.

Finally, BOT also employed the "network model" framework to measure interconnectedness within the banking industry, the interbank market and the payment system. Such network model utilizes the concept of centrality and eigenvectors, or more specifically the Bonacich's Eigenvector Centrality measure, to evaluate the principal eigenvector associated with a matrix of a pair-wise connection strengths. The payment system network model yields 3 types of indices: closeness centrality index, betweenness index and eigenvector index. The closeness centrality index assess how "central" a financial institution is by measuring the "average shortest path" of a node that represents a financial institution to other nodes. The node with the low path score indicates that it is the important node or coming close to being the "central" point of the system. The betweenness centrality index represents how a node becomes the connecting path of other nodes by measuring the number of times a specific node is used as a part of the "shortest path" of transmissions by other nodes. The higher the value of betweenness index is, the more important a specific node is to the entire system. Eigenvector centrality measures how many nodes are connected to a specific node and how those other connected nodes connect with additional nodes and so on. If the number of direct and indirect connections to a node increases, and so is the eigenvector centrality index, the more important that node is to the network of additional nodes.

Apart from tools to assess the systemic risk during the normal time, BOT also developed tools to assess the possible risk transmission during the stressed time. Starting in 2017, BOT has developed and executed the "macroprudential" stress testing framework. Unlike the regular stress test performed by banks that concern the ability to withstand shocks of each institution, macroprudential stress test actually test the ability of the *financial system* to withstand shocks during the stressed time. This involves developing tools to link macroeconomic factors to all types of financial institutions' balance sheet and profit-loss statements and coordinating with other regulators to determine a framework to capture the behaviors of other players, such as mutual funds, securities companies and insurance companies, during the stressed time and incorporate them into the stress test results. This latter part is called the "feedback loop" effect, which can easily amplifies the severity of the financial crisis. In our 2017 most severe stress scenario, the sluggish Thai economy and the corporate bond default create a disruption in the bond market and the stock market, hence having an impact on mutual funds and insurance companies. The feedback loop analysis framework incorporates the behaviors of these entities during the crisis time as shown in Figure 3. Such framework enables BOT to take into account and assess the additional effects of severe shocks from the market and other institutions on banks' capital and liquidity positions.
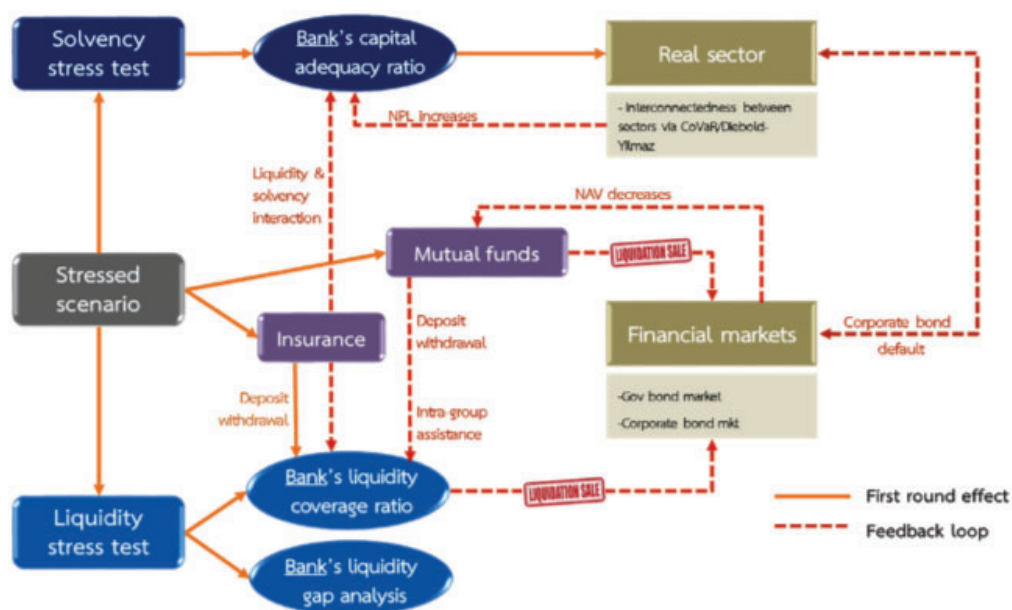
Figure 3: 2017 Macroprudential Stress Test Framework

An interesting aspect concerning the "feedback loop" impact assessment is to try measuring the interaction between capital and liquidity positions of banks. In principal, if a bank has quite an unfavorable capital position, the risk premium of this bank should increase, hereby increasing the cost of funding. Higher cost of funds then translates to lower profit and eventually lower capital (Figure 4).
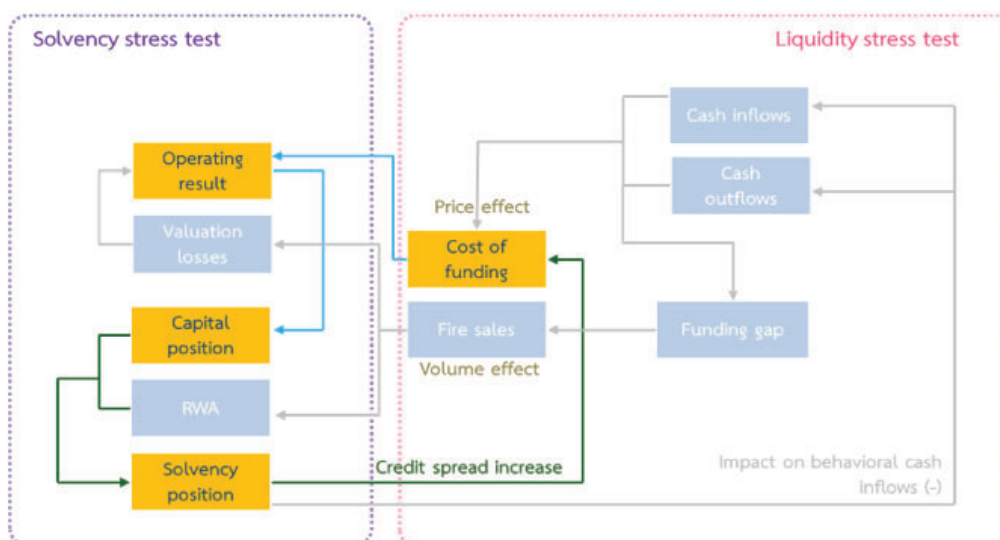

Figure 4: Interactions between capital and liquidity positions of a bank

BOT in the process of developing a quantitative method to assess this impact, following the work of Schmitz, Sigmund and Valderrama (2017). To estimate the simultaneous equations reflecting the interactions between the capital adequacy ratio and the funding cost, the research team performed the two-staged least square (2SLS) using the quarterly data from 2005Q1–2018Q1. The team also tested for the stationarity of the error term using 3 unit root tests—Im-Pesaran-Shin, Fisher-type unit-root test based on augmented Dickey-Fuller tests and based on Phillips-Perron tests. Thus far, the *primary results*, which may possibly change in the future, yielded that funding cost increased 0.03% per 1% decrease in capital ratio and also capital position decreased 2% per 1% increase in funding cost. However, this research is still in progress and further refinement must be executed before this model can be finalized.

Even though many tools have been developed to capture systemic risk, unfortunately, most tools are only capable of capturing the linear effect of the risk transmission and risk build-up. During crisis time, the behaviors of market players and financial institutions can be very non-linear; for example, asset fire sales. Hence, further down the road, BOT, as with other central banks, will aim to develop tools to capture the non-linearity of risk during the stress time, especially when it comes to assessing the impact of fire sales of assets which can introduce the downward spiral to the financial market which can quickly deteriorate the crisis situation. Apart from the traditional method of regressions, another approach worth investigating might be the agent-based simulation which starts to gain momentum, as already employed by the Bank of England.

1.2 Tools for Assessing The Effectiveness of Financial Stability Policies

After assessing and identifying the potential risks to financial stability, the next step is to gauge whether any policy actions are needed to address those risks. Generally, the policies associated with limiting systemic risk and, in turn, promoting financial stability is called the *macroprudential policies*. Basically, macroprudential policies aim at limiting (1) risk from interconnectedness among financial institutions (2) risk build-up that could lead to price bubbles and financial crises and (3) liquidity and market risks. There are several macroprudential policy tools which can be used to address different types of risk, as shown in Table 1.

Table 1: Different types of macroprudential policies

Risk factors	Risk dimensions		Macroprudential measures (MaPP)
Risk build-up from credit growth consequent of economic activities	1. Credit side	**Broad-based** (Overall credit cycle)	**Broad-based** • Countercyclical capital buffer (CCyB) **Sectoral** • Loan-to-value (LTV) • Debt service ratio (DSR) • Debt to Income (DTI) • Sectoral capital requirements (SCR) • Exposure limit • Targeted capital flow management (MaPP)
		Sectoral (Credit-related risks in specific sectors e.g. real estate, household)	
Spillover risks from the financial system structure	2. Financial system structure oversight	Systemic importance financial institutions (SIFIs)	• Capital surcharge on D-SIBs/G-SIBs
Risks from inappropriate Asset-Liability Management (ALM)	3. Liquidity side	3.1) Sources of fund Core and Non-core funding 3.2) Currency : local and foreign currencies 3.3) Maturity : Short term and long term	• Loan-to-deposit ratio (L/D) • Levy on non-core funding • Limit on net open FX position
Financial markets risks	4. Stabilitze financial market stability	Reduce impact on real economy from excessive financial market volatility	• Capital Flow Management (MaPP aspect) • Regulations on investment and leverage (MMF/FRBF) • Regulations on SBL

Source: Zhang and Zoli (2014) and Bruno, Shim and Shin (2015)

One aspect that is very important in "putting out the fire" effectively, apart from choosing the appropriate policy and implementing it at the right time, is to be able to assess the possible impact of the policy of choice. In this aspect, BOT research by Tantasith, et al. (2018) investigated the effectiveness of various loan-to-value measures implemented in 2009, 2011 and 2013. The authors used the dynamic panel approach and found that banks responded to the implemented policies by reshaping the LTV distribution of housing loans in a way that was consistent with the objective of such macroprudential measures. In fact, banks responded strongly to the tightening LTV measures in 2011 and 2013, as seen from the share of housing loans with LTV above the threshold decreasing over time, with the effect wearing off after the third quarter following the implementation (Figure 5). They also found that banks which carried more housing loans in their portfolios responded more strongly to the measures and different types of banks responded differently as well. That is, large and small banks behaved as expected by the policy maker while medium banks behaved differently, possibly due to their different business strategies.
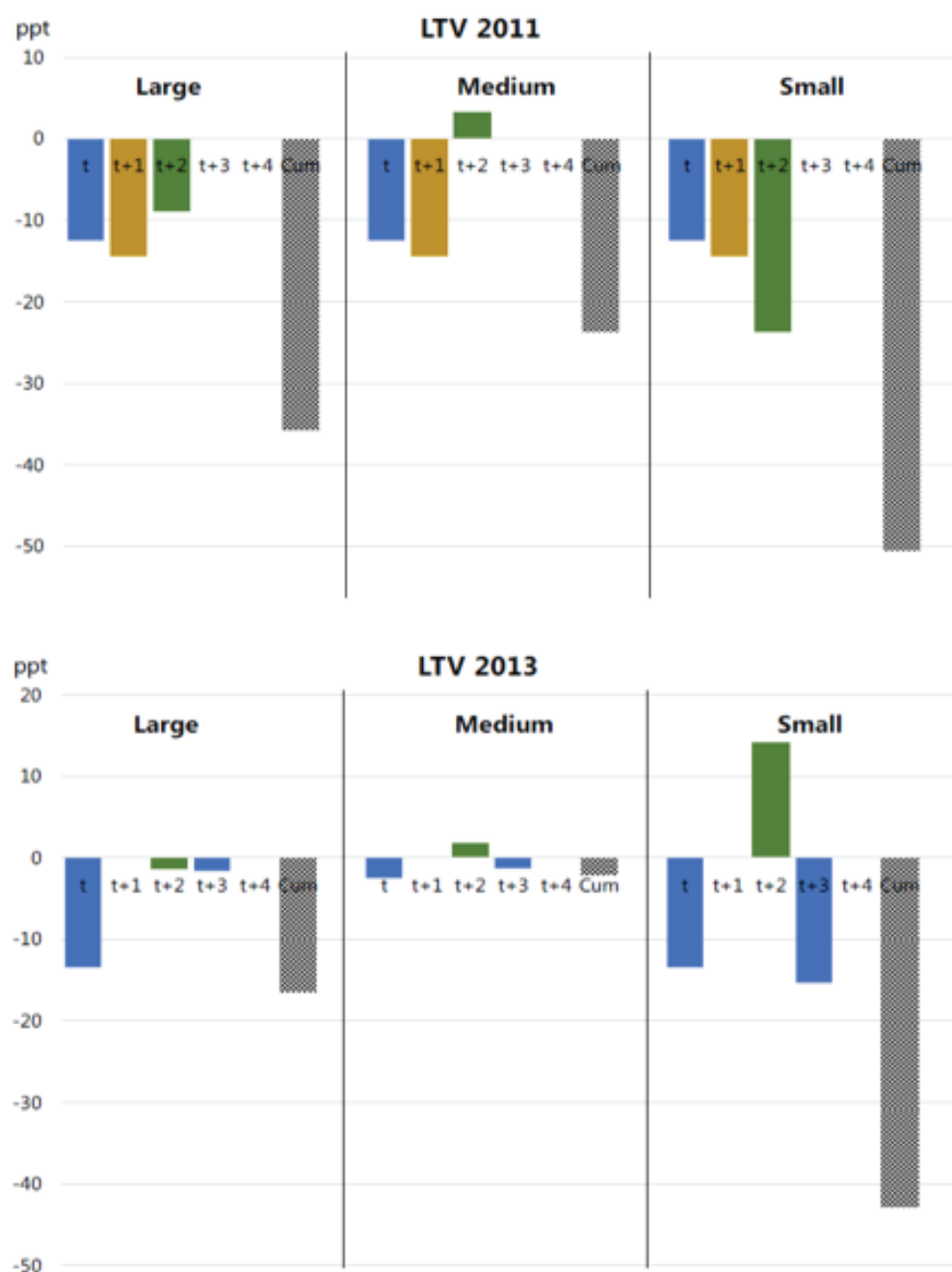
Figure 5: Impact from LTV Implementation in 2011 and 2013

Source: Tantasith, et al. (2018)

The development of tools to assess the financial stability-related risks as well as to measure the effectiveness of financial stability-related policies must continuously evolve with the ever changing and more volatile risk environment so as to be able to safeguard the financial system from adverse circumstances timely and appropriately.

2. POLICIES AND REGULATIONS TO ENSURE FINANCIAL STABILITY AND ENCOURAGE FINANCIAL INNOVATION

It is undeniable that financial innovation, digitization and financial technology ("fintech") have become increasingly more popular in the past few years. With the wide range of products and platforms available, making the system safe for consumers has become an additional mandate of central banks around the world. Here are some policies and regulations implemented by BOT to ensure the balance between financial stability and innovation is achieved.

2.1 The Payment System Act

With an increasing number of financial transactions being done via electronic channels and with an increasing number of new players in the payment business in the past years (Figure 6), BOT and the Ministry of Finance (MOF) saw fit to improve and unite all the existing payment system-related laws into one legislation and hence introduced the Payment Systems Act, B.E. 2560 (2017) so as to supervise the payment systems more efficiently and to be at par with the international standard. The Act became effective on 16 April 2018.

Figure 6: Growth rate of electronic transaction volume from 2012 to 2016
Source: BOT Payment System Report 2016

Under this new law, the supervision of the payment system covers three types of payment categories: **(1) important payment systems**, referring to the national primary payment systems such as BAHTNET and ICAS; **(2) payment systems under regulation**, representing central systems that provide the payment data services and conducting settlement (i.e. switching, clearing, or settlement

services) for member institutions; and **(3) payment services under regulation**, notably payment services serving the general public through certain instruments or channels such as credit cards, debit cards, e-Money cards, and money transfers.

The supervisory framework of the Payment System Act consists of five key components: **(1) risk management and security** to ensure risks related to the payment system is well managed; **(2) financial strength of service providers** to ensure the continuation of services being provided; **(3) governance** to ensure proper check and balance; **(4) consumer protection** to ensure customers are treated fairly and appropriately; and **(5) efficiency and competitiveness** to ensure that the supervision is fair and encourages competitiveness and innovation. With this framework in place, BOT also moved forward with promoting different channels of electronic payments, such as the PromptPay, QR code, and debit cards with the promotion of electronic data capture (EDC) devices at point of sales. These policies are implemented in line with the changing trend of payments channels which have become more electronic-based.

2.2 The Emergency Decree on Digital Asset Businesses 2018

To ensure that the regulation is catching up with the development of digital assets, the Emergency Decree on Digital Asset Businesses 2018, which became effective 14 May 2018, granted **the Ministry of Finance (MOF) and the Office of the Securities and Exchange Commission (SEC) power to supervise digital token issuers and portal service provider** (ICO issuers and ICO portals). In addition, such oversight is applied to digital asset businesses including (1) digital asset exchanges, (2) digital asset brokers, (3) digital asset dealers, and (4) other businesses related to digital assets, as prescribed by MOF with recommendations from SEC.

In accordance with this latest legislation, **BOT has issued guidelines to financial institutions and entities under the financial group, outlining the types of business operations and transactions related to digital assets that could be undertaken by these entities**. Under the guidelines, financial institutions and related entities can conduct digital asset transactions or operations deemed appropriate by regulatory bodies. In addition, they are allowed to invest in digital assets with the purpose to enhance service efficiency to clients or promote financial innovation. Additional guidelines by BOT regarding the supervision and risk management related to digital assets should soon follow.

2.3 The Payment System Roadmap IV (2019–2021)

Following the Payment System Roadmap III, **Roadmap IV features five approaches to the payment system development: (1) Interoperable Infrastructure development** to enhance the efficiency and security of the payment system to the ISO20022 standard to support business data network and international transactions; **(2) Encouraging innovation** by means of creating types of

services to match the dynamic needs of domestic and international target groups; **(3) Promoting inclusion** through expanding the digital payment coverage and creating the common understanding among all related parties; **(4) Building immunity against cyber threats** through proper supervision and risk management in order to empower the service providers with ability to cope with such threats as well as to protect digital payment clients; and **(5) Enhancing information** in a way that will holistically incorporate all payment system-related information together with enriching the in-depth analysis and information processing for the payment system.

2.4 Three-Year Strategic Plan for Cyber Resilience (2017-2019)

With the increase in banking transactions being made digitally, BOT introduced the three-year strategic plan for cyber resilience. The purpose of this plan was to ensure that financial institutions had sufficient ability to cope with possible cyber threats.

Thus far, there are two key actions following such plan: **(1) Developing the cyber resilience assessment framework** (Figure 7) consistent with the international standard to ensure financial institutions are prepared in dealing with cyber threats and in managing IT risks. In 2017, financial institutions were assessed on the level of cyber risk preparation based on the draft of this framework and were required, by 2018, to close all of the gaps found from such assessment; **(2) Enhancing collaboration in cyber threat response within the financial sector** which includes developing the supervisory framework for IT risk management and cyber resilience that is consistent with the guidelines issued by OIC and SEC
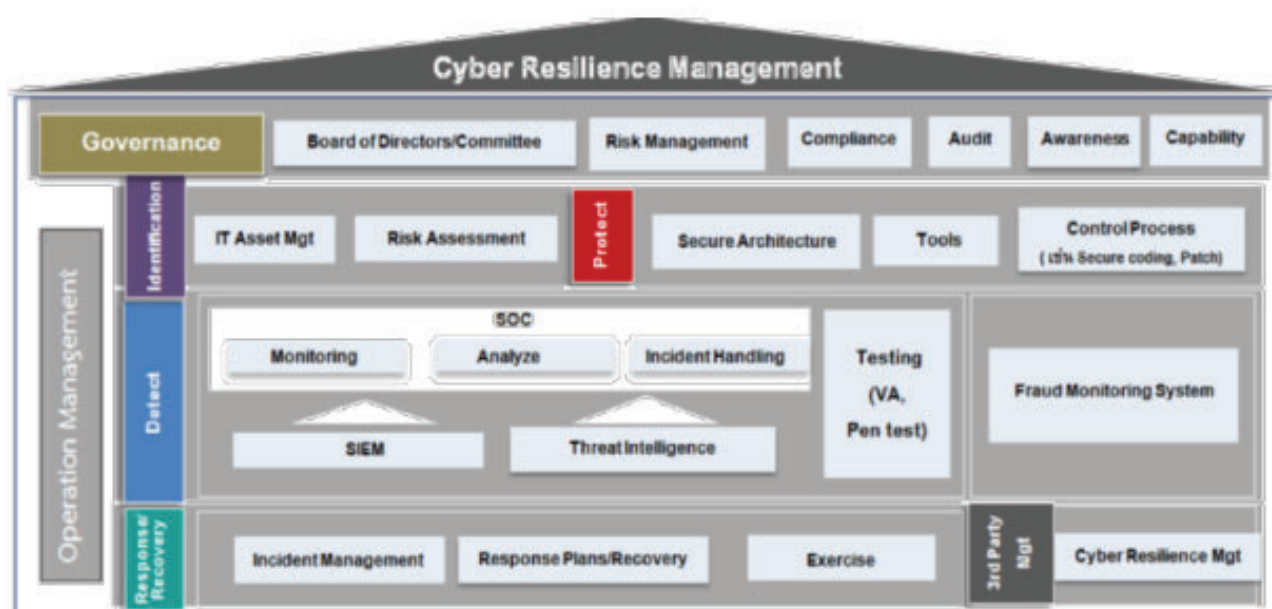

Figure 7: Cyber Resilience Assessment Framework
Source: BOT Financial Stability Report 2018

and establishing Thailand Banking Sector Computer Emergency Response Team (TBCERT) to be used as a platform for efficient and timely information sharing under the event of cyber attacks. In addition, BOT also pushed forward for financial institutions to have effective response and recovery measures by means of holding a workshop on procedures and plans to cope with cyber threats in order to help prepare those financial institutions as well as jointly creating the crisis management flows among the regulators in the financial sector, i.e. SEC and OIC. Such implementation is to make certain that cyber threats in the financial system are well handled and consumers are well protected.

2.5 The FinTech Development

In the next few years, the rapid development of what is called the 'financial technology' (or FinTech) is expected and is deemed quite inevitable. There are a few key FinTech revolutions being considered by players in the industry (Figure 8), notably:

(1) QR code development for mobile payments

(2) Blockchain and Distributed Ledger Technologies (DLT) with encryption for financial transactions

(3) Biometrics for verification and authentication of customers

(4) Machine learning and artificial intelligence (AI) for big data to offer are more targeted financial services and products

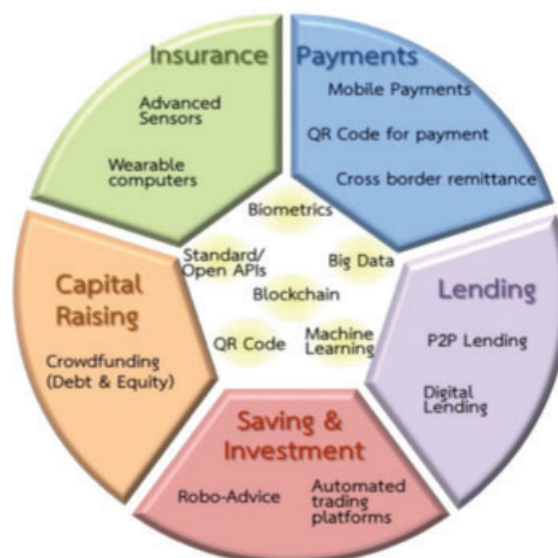(5) Standard/Open Application Programming Interfaces (APIs) for system connection and data exchange

Figure 8: Trend in financial innovations

Source: BOT Payment System Report 2016

Given the key trends, BOT has introduced initiatives in line with such trend; for example the QR code for mobile payments previously mentioned. In addition, in August 2018, BOT together with local financial institutions launched "Project Inthanon" to assess the potential use of Distributed Ledger Technology (DLT) for the efficiency enhancement of the future Thai financial market infrastructure via the issuance of wholesale Central Bank Digital Currency (Wholesale CBDC) for the wholesale fund transfer. These steps forward are a few examples of the way central banks have to adjust and catch up with the changing financial landscapes, services and development, while balancing the benefits of having innovation versus the benefit of having financial stability.

2.6 Regulatory Sandbox

Another policy taken by BOT to support the development of FinTech while maintaining stability is the introduction of the "regulatory sandbox" so that banks and non-banks can test their FinTech innovations in the closed environment with limited risk by means of providing services to a particular group of customers. In addition to the sandbox, BOT also provided the FinTech Clinic to offer advice to service providers that are interested in obtaining legal permissions or participating in the "regulatory sandbox."

Those participating in the "regulatory sandbox" will go through three steps (Figure 9): **(1) application** to determine the qualification for the sandbox such as having a new and beneficial technology and having a clear plan to execute from the beginning to end;
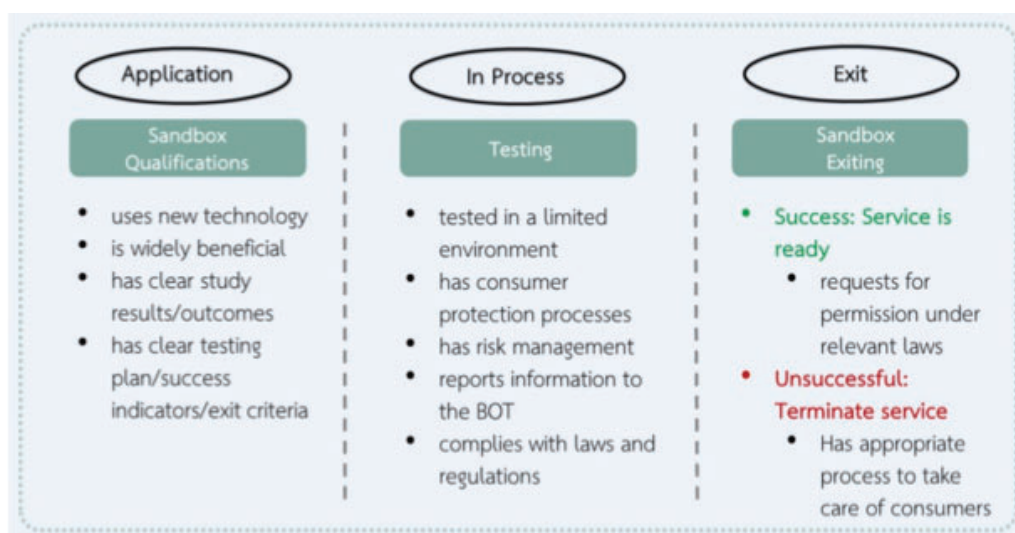

Figure 9: Regulatory Sandbox Framework
Source: BOT Payment System Report 2016

(2) testing refers to the process of implementing the innovation in a closed setting with consumer protection and risk management in place while complying with the current law, regulations and reporting; and **(3) exiting** where, if successful, then service providers are eligible for providing services to the general public upon being granted permission while, if unsuccessful, then the participants must have in place the plan to take care of consumers.

Given the above approaches, like other central banks, BOT is moving forward with encouraging financial innovations while safeguarding the stability of the financial system. This is to ensure that new financial services will be provided in a way that will enhance the efficiency of the financial system with more accessibility and convenience to the general public while, at the same time, the financial system remains resilient to shocks and emerging risks are well managed and limited. Striking such balance will always be the goal of all central banks alike, regardless of the change in financial landscape and financial environment that may come in the future.

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