

# Gaining from digital disruption

## The Thai financial landscape in the digital era<sup>1</sup>

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### *Abstract*

*This paper examines competitiveness of the Thai financial sector through the dimensions of depth, access, efficiency, and stability, as compared to peers. The paper finds that while the Thai financial sector compares reasonably well with peers in most dimensions, it does not fare well in term of SME access to bank credit. Using Panzar-Rosse H-Statistic, the paper also examines competition in the Thai banking sector and finds that the level of competition in the Thai banking sector is consistently high over the sample period. The results raise the question: Why does SME access to bank credit remain low, despite high level of competition in the banking sector? This puzzle is important since SMEs are a key driver of the Thai economy. Reviewing results from various studies and interviews with SMEs and bank credit officers, the paper identifies several bottlenecks in the SME lending process that may lead to market failures. Using data from 1.29 million individual SME loan contracts obtained from 15 Thai commercial banks, and six Specialized Financial Institutions (SFIs), the paper finds that only a few banks attempt to penetrate SMEs at the lower tiers of loan size and income. Although SME lending by SFIs are found to be a good complement to SME lending by banks, the fact remains that fewer than half of SMEs in Thailand have loans from these financial institutions. The paper then discusses how several initiatives have been attempted to harness the power of technology and data to help improve SME access to finance, whether from traditional banks or other types of players. Lessons from the case of SME financing and from other segments of financial sectors in selected countries are then drawn into common themes that might help guide the design of financial landscape in the digital era.*

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## PART I – INTRODUCTION

The financial sector is essential in facilitating efficient resource allocation in the economy. The ability of the financial sector to perform its functions well has important policy implications. An economy with a financial sector that can cheaply and quickly turn savings into consumption and investment is often found to attain higher long-term growth<sup>2</sup>. The level of financial development is also found by many researchers to also influence income inequality, whether directly or indirectly<sup>3</sup>.

This paper first presents stylized facts of the Thai financial sector, before assessing competitiveness of the Thai financial sector in terms of depth, access, efficiency, and stability, using the framework proposed by Cihak et al. (2012). Focusing on financial institutions, the paper finds the Thai financial sector's competitiveness to be in line with ASEAN-5 on most measures, except SME access to bank credit.

The paper also assesses degree of competition among Thai banks, dominant players in the Thai financial sector. Using Panza-Rosse H-Statistic framework together with consolidated balance sheets of 15 Thai commercial banks and their subsidiaries, the paper finds the degree of competition among the 15 Thai commercial banks to be quite high. Thai banks and their subsidiaries do not seem to possess much market power, and have been competing rather intensely.

A puzzle thus emerges: if the 15 Thai banks are already competing intensely, why does Thai SME access to credit remain low? There seems to be market failures, since in a competitive market, theory dictates that SMEs' demands for credit should be reasonably well met. Delving into the roots of these market failures is important because SMEs are a key driver

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<sup>2</sup> See for example, Knoops (2008), Cihak et al. (2012), Wongswan, Luengnaruemitchai, and Boonthaveepat (2013).

<sup>3</sup> Cihak et al. (2012), Belly & Lochner (2007), Kerr & Nanda (2009), Beck et al. (2007), Demirguc-Kunt & Levine (2009).

of the Thai economy, accounting for around 80 percent of employment, and 40 percent of value added in the GDP. The paper thus investigates and analyzes what might be the causes of such market failures in SME access to credit.

Reviewing results from various studies and interviews with SMEs and bank credit officers, the paper identifies several bottlenecks and market failures that are hampering SME access to finance. These includes burdensome manual processes, heavy paper documentation, and lack of data. In particular, the latter is also a key bottleneck in term of credit decision, as credit risk models rely heavily upon availability of reliable data. In other words, information asymmetry, frictions in processes, and unintended consequences of regulations have all contributed to market failures in SME access to credit. Our conjecture is that the presence of these bottlenecks make SME lending costly, time consuming, and perhaps too risky for banks.

Using data from 1.29 million individual SME loan contracts from the Bank of Thailand's (BOT) SME Database (SMD) and Loan Arrangement Database (LAR) to check the profile of these loans, the paper finds that only a few banks have attempted to penetrate SME market at the lower tiers of loan size and income. The paper observes that smaller SME loans also incur more NPLs. SFIs are observed to have stepped in and complement banks in their lending to SMEs at the lower tiers. Despite the presence of SFIs, fewer than half of the SMEs use credit from banks or SFIs.

In the digital era, however, rapid development of digitization and process automation offer promising potential to unlock those bottlenecks. The paper thus reviews the efforts by a number of Thai players including FinTech, banks, SMEs themselves, and regulators to harness the power of technology and data to solve these bottlenecks, and help improve SME access to finance.

By reviewing the initiatives being implemented in Thailand, along with those being implemented or proposed in other countries, the paper finds that digitalization and data are being leveraged to help alleviate market failures presented in the financial sector, not only SME access to credit.

Ultimately, the paper identifies three common themes that might help the financial sector harness the power of technology and data to improve competitiveness in the digital era. These themes include: (1) interoperability to reduce switching costs, encourage competition, and allow for better collection, flows, and usage of data; (2) a robust ecosystem with various types of players collaborating, competing, and innovating to meet customers' needs; and (3) a more flexible and forward looking regulatory framework to reduce unintended consequences of regulations, while ensuring that stability and consumer protection are not compromised.

## **PART II – THE THAI FINANCIAL SECTOR: STYLIZED FACTS**

Part II highlights stylized facts regarding the Thai financial sector which reflect the underlying trend of competition within the Thai financial sector. The stylized facts are shown from both the macro view, reflecting the evolution of the Thai financial sector in terms of key services providers, and micro view, reflecting the evolution of usage of financial services by households and firms<sup>4</sup>.

### **1. Macro view: Evolution of the Thai financial sector**

The landscape of the Thai financial sector has undergone a number of transitions over the past 20 years – from post-1997 Asian Financial Crisis reforms that strengthened core financial system and established important infrastructures to a number of initiatives that helped improve access, efficiency and resilience of the financial system. Over the years, the Thai financial sector, particularly the banking sector, has adopted a number of important international standards and practices to comply with the Basel Core Principles. Thailand has also setup important infrastructures such as the Deposit Protection Agency to protect depositors against failing of financial institutions, thus creating a resilient financial system in supporting growth of the Thai economy.

Scanning the current landscape, the Thai financial sector consists of six main groups of players, namely:

- 1) Commercial banks (banks),
- 2) Specialized Financial Institutions (SFIs),
- 3) Other deposit-taking institutions including saving cooperatives and credit unions,

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<sup>4</sup> The macro view represents those regarding financial institutions and markets while the micro view represents those associated with individuals.

- 4) Mutual funds,
- 5) Insurance, and
- 6) Other non-bank financial institutions.

From regulatory perspective, formal financial institutions include banks, SFIs, mutual funds, insurance, other deposit-taking institutions and non-bank financial institutions under the regulatory purview of financial regulators. Semi-formal financial institutions refer to financial institutions whose legal status are granted by specific laws and are supervised by other government agencies, such as cooperatives, village funds, and leasing companies. A breakdown of the financial sector players and their asset sizes is displayed in Figure 1.

Banks and SFIs account for the majority of total financial sector assets, making up over 60 percent. At the end of 2018 total financial sector assets reached 270 percent of GDP. It is worth noting that while banks continue to account for a sizable share of the financial sector, its share of total asset has declined over the past decade. This may reflect an important transition in the Thai financial sector, that banks' competitiveness is being challenged by greater competition from other players. It also begs the question whether banks can remain competitive going forward.

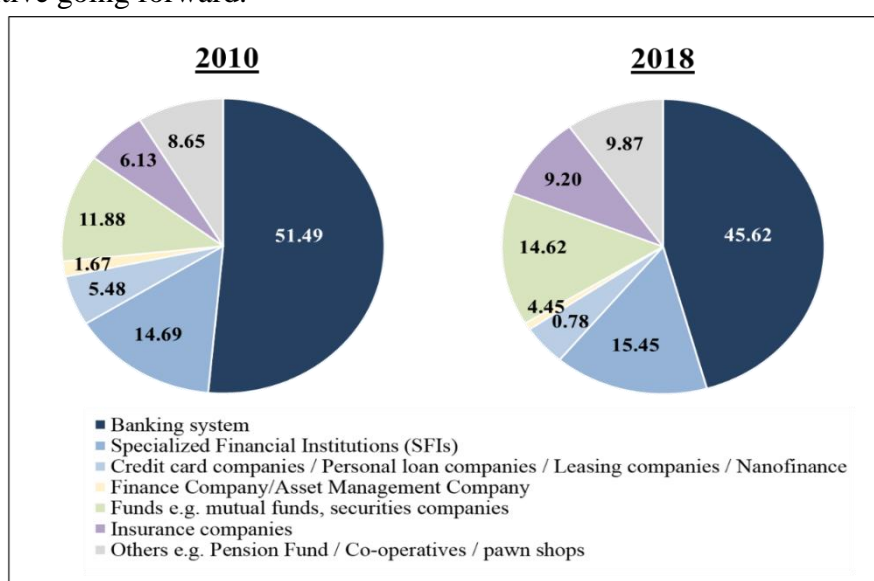
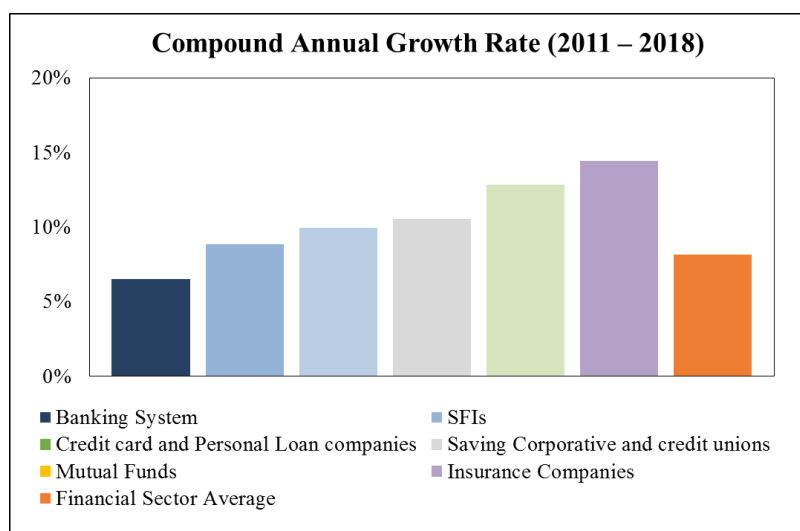


Figure 1 Asset shares of the Thai financial Sector 2010 and 2018



Review of financial system assets (Figure 1) shows that since 2010, banks' share of financial sector assets has declined by around 6 percentage points, from around 52 percent to 46 percent in 2018. Instead, asset shares of mutual funds, SFIs, saving cooperatives and credit unions have seen notable increase, likely diverting the funds that would have gone into bank deposits and lending activities. Meanwhile, asset share of insurance companies has increased markedly.



*Figure 2 Compound annual growth rate of important financial sector participants*

Figure 2 shows that while banks' assets continue to grow, their growth rate is slower than those of other players. Banks' assets exhibit compound annual growth rate of 6.5 percent since 2011, compared with the average growth of the financial sector of 8 percent. These indicators suggest growing roles of non-bank players in the Thai financial system.

## **2. Micro view: Thai financial services from the users' perspectives**

Analysis of the demand for financial services provides better clarity on the changing financial landscape. For households, the Financial Access Survey of Thai Households<sup>5</sup> assesses households' demand for financial services and access channel. The survey measures

<sup>5</sup> Conducted by the Bank of Thailand and the National Statistical Office of Thailand

levels of households' financial access<sup>6</sup> to eleven key financial services,<sup>7</sup> commonly provided by financial institutions.

According to the latest survey conducted in 2018, banks remain the overall primary provider of financial services for households (Table 1 and Table 2). In fact, more households are using banks compared with the 2016 survey result, while access through other players remains largely unchanged. The most used financial services are deposits, payments, money transfers, and loans, with reported usage of 80 percent, 68 percent, 45 percent, and 36 percent, respectively.

	Deposits/ Saving			Loans	
	2018	2016		2018	2016
<b>Banks</b>	64%	60%	<b>SFIs</b>	33%	38%
<b>SFIs</b>	29%	30%	<b>Banks</b>	19%	18%
<b>Village Funds</b>	1%	2%	<b>Village Funds</b>	19%	19%
<b>Cooperatives</b>	3%	4%	<b>Leasing companies</b>	11%	10%

*Table 1 Primary providers of financial services*

	Transfers			Payment	
	2018	2016		2018	2016
<b>Banks</b>	79%	82%	<b>Banks</b>	26%	25%
<b>SFIs</b>	15%	15%	<b>SFIs</b>	15%	19%
<b>E-payment providers</b>	2%	1%	<b>E-payment providers</b>	13%	10%
<b>Individual providers</b>	0%	0%	<b>Village Funds</b>	7%	8%

*Table 2 Primary providers of financial services (cont.)*

Among these users, banks remain the primary service providers for deposits, transfers, and payment services. For deposits, 64 percent of household reported banks as the primary service provider, a notable increase from 2016. For payments and transfers services, banks are also the primary service providers, with reported usage of 26 percent and 79 percent, respectively. Banks' dominance in these services is likely augmented by the introduction of

<sup>6</sup> Defined as households who have used at least one financial service and those who have access to a financial service but choose not to use any financial service.

<sup>7</sup> The eleven financial services include (1) deposits/ savings, (2) loans (excluding credit cards), (3) money transfers, (4) payments, (5) credit cards, (6) life insurance, (7) non-life insurance, (8) mutual funds, (9) government and central bank debt securities, (10) private securities, and (11) rotating savings groups

PromptPay payment service as well as standardized QR Code for payment, which allow convenient and instant payments through banking mobile application at zero fees.

Another interesting observation is the increasing usage of payments through e-payment service providers including banking agents, counter services and convenience stores. This evidence may point to changing structure of the financial landscape. As banks transition towards greater digital adoption, they may outsource basic services to banking agents or counter-services. These service points also provide easy access points and convenience for consumers to access financial services (Lamsam et al. 2018).

In terms of loan service, the household survey finds that SFIs remain the primary usage channel for household loans. Moreover, a large proportion of households reported usage of semi-formal service providers as their main loan providers. In fact, 35 percent of households use semi-formal financial institutions, including saving cooperatives, village funds, and leasing companies, as the primary lending channel, a proportion far outweighed usage of banks.

While households' demand and usage of financial services can be analyzed through households' survey, a similar analysis for corporate is made more challenging due to data availability. Instead, this paper used the data on corporate financing activities to imply corporates' demand and usage of financial services. Figure 3 shows corporate financing activities based on bank loans, corporate bonds, and equities. The figure shows that corporate financing through commercial banks remains the primary channel, but its proportion has declined substantially.

Corporates have relied much more on debt and equity financing compared to their financing activities in the past. Increased financing activities through the financial market are likely a result of relatively eased financial market conditions in Thailand and globally while domestic policy interest rate was kept near historical low – at 1.50 percent – from April 2015 to December 2018. These have resulted in lower funding costs for corporate than in the past, as indicated by corporate new loan rates<sup>8</sup> that continued to decline and remained at low level during the BOT rate-cutting cycle (Figure 4). Furthermore, corporate credit spreads have remained relatively range-bound since the end of 2009 (Figure 5).

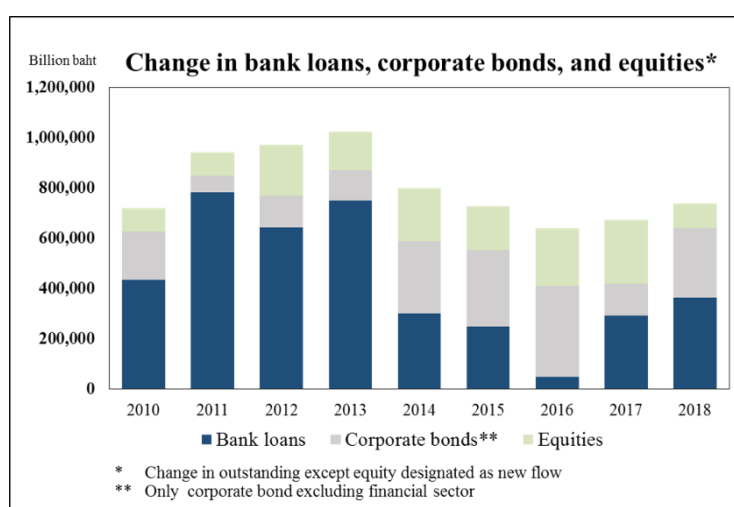


Figure 3 Corporate financing activities

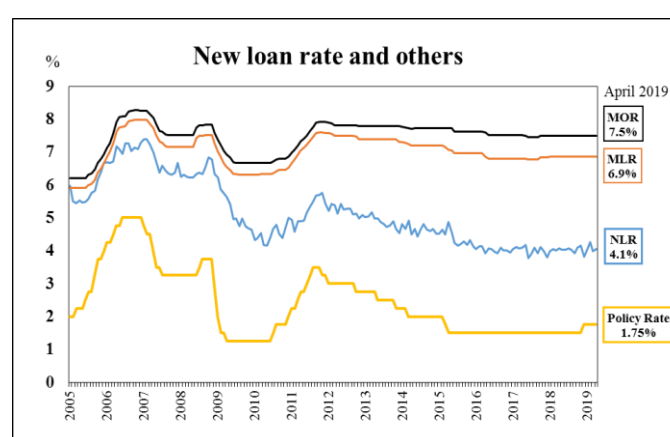
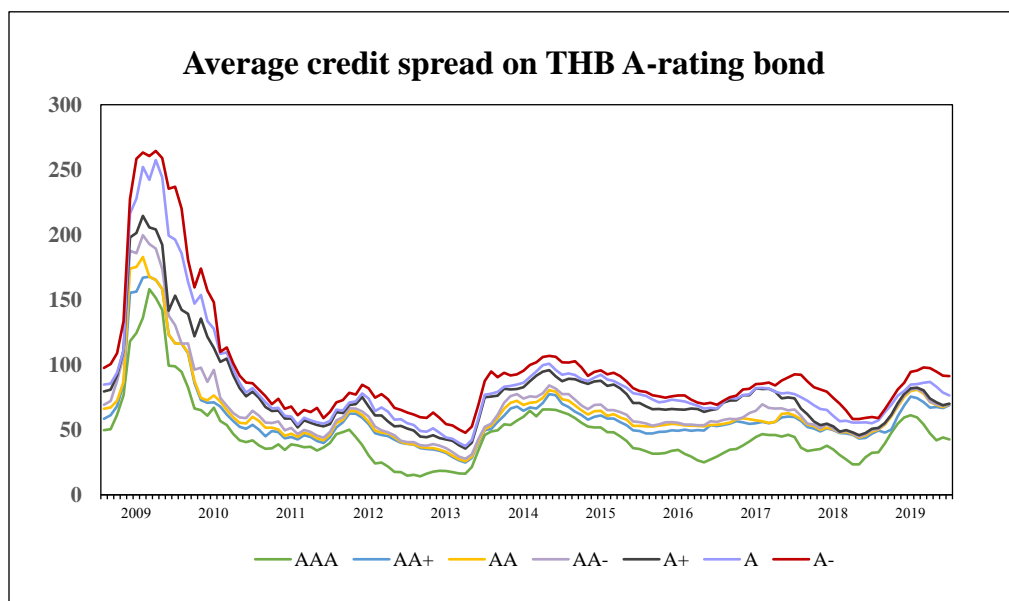


Figure 4 New loan rate and other rates

<sup>8</sup> New loan rate (NLR) is the rate of interest payments on loan contracts excluding loans to households and financial intermediaries and is weighted by loan size. It is calculated from the median rate of individual loan contract with credit amount above THB 20 million from database of loan arrangements (LAR) reported to the Bank of Thailand from 14 Thai commercial banks.



*Figure 5 Average credit spread on THB A-rating bond*

From the supply of financial service perspective, the accessibility of financial products, including savings and credits, is supported by continued expansion of physical financial access points, such as increases in numbers of branches, ATMs, and EDCs relative to the number of adult population (Lamsam et al. 2018)).

However, there is a large variation of coverage of financial service infrastructures across different regions of Thailand, with higher concentration in larger cities. In fact, it is estimated that 23.2 percent of villages in Thailand do not have access to financial access points within five kilometers.<sup>9</sup> Nevertheless, two-third of these villages are located in areas with good mobile broadband coverage, suggesting potential for increasing access through mobile and internet banking (Chantararat et al. 2018).

<sup>9</sup> Access points include the formal channels such as banks and SFIs, semi-formal channels such as cooperatives and village funds, and potential banking agents such as convenience store, gas stations, post-offices, and shops with EDCs.

Moreover, continued increase in mobile and internet broadband usages also provides support for further financial access through internet and mobile banking channel (Figure 6). Thus far, increasing digitization of banking services along with establishment of key financial infrastructures – such as the PromptPay faster-pay infrastructure – have enabled greater electronic payment usage by consumers. The volume of e-payment has increased substantially over the past five years, from around 35 transactions per person per year in 2014 to almost 90 transactions per person per year in 2018.

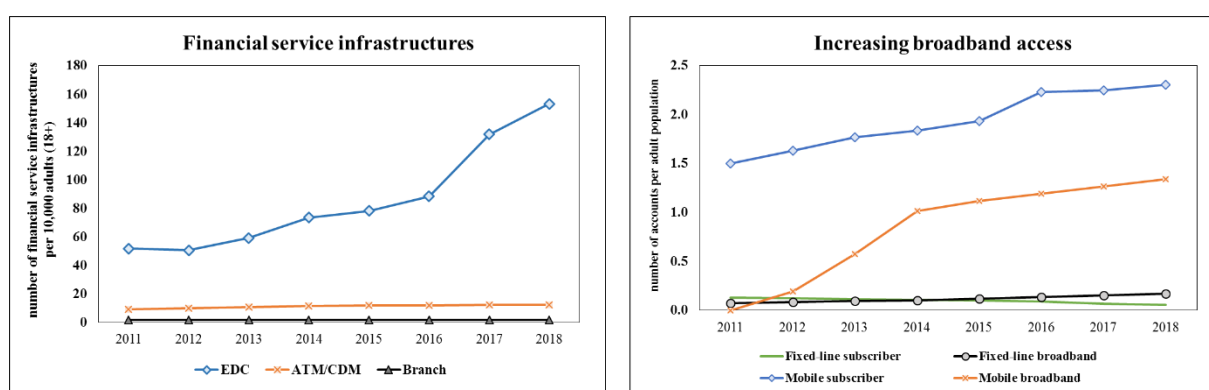
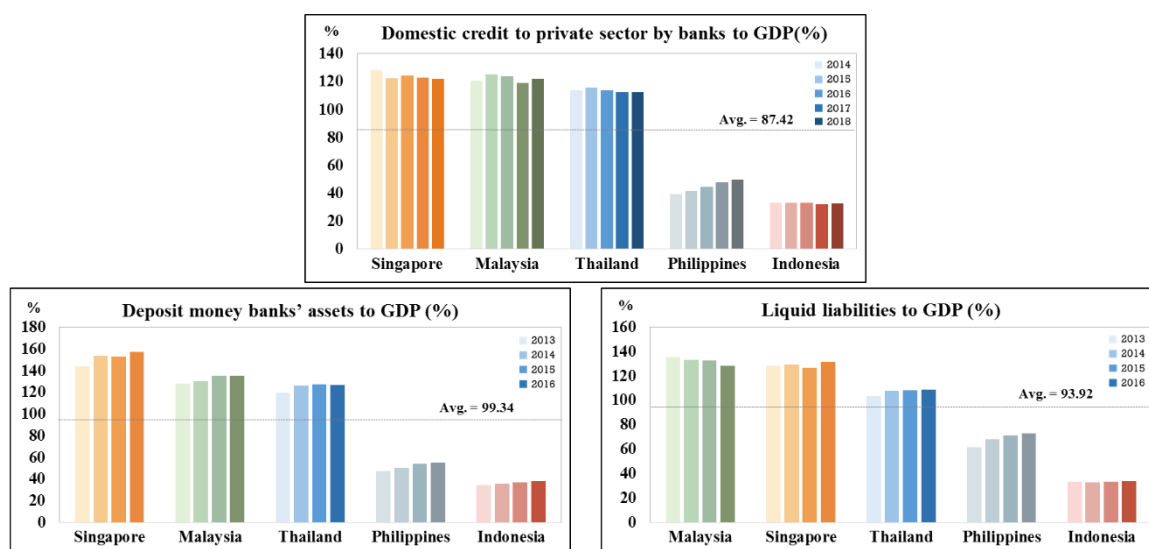


Figure 6 Infrastructures for financial services

### PART III – COMPETITIVENESS IN THE THAI FINANCIAL SECTOR: DEPTH, ACCESS, EFFICIENCY, AND STABILITY

Part III aims to assess competitiveness of the Thai financial sector, compared with ASEAN-5 peers. As noted by Yokoi-Arai and Yoshino (2006), competitiveness of the financial sector can be an elusive concept, and hence reference to various indices will provide a starting point for discussion. This paper follows framework set by Cihak et al. (2012) for the benchmarking of global financial systems, a foundation for Global Financial Development Database developed by the World Bank.

According to the framework, competitiveness of the financial sector could be assessed through four dimensions: (1) depth, (2) access, (3) efficiency, (4) stability<sup>10</sup>.



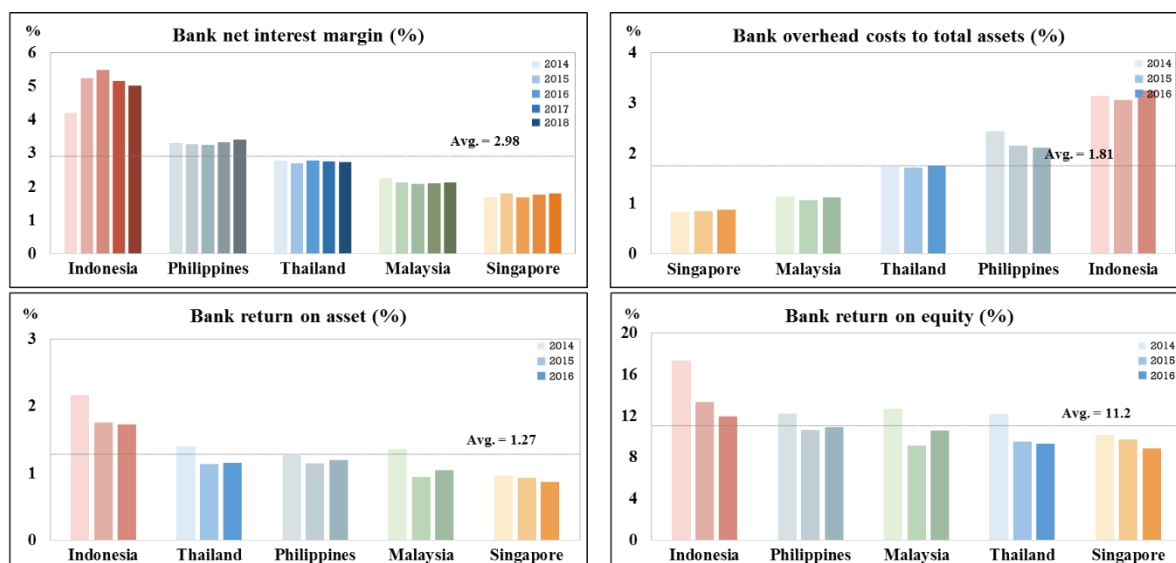
Source: World Bank

Figure 7 Competitiveness of financial institutions (in terms of depth)

Figure 7 measures depth of the financial sector through the lens of domestic credit to private sector by banks to GDP, deposit money banks' assets to GDP, and liquid liabilities to GDP. Such measures reflect how deep the financial sector is embedded in the economy. Using

<sup>10</sup> Competitiveness of financial markets will need a separate paper on its own. These four characteristics can be measured on two fronts: financial institutions and financial markets. This paper will only focus on competitiveness of financial institutions.

latest data from Global Financial Development Database, it could be seen that from 2013-2016, Thailand is around the ASEAN-5 average for the period in all measures.



Source: EMEAP and World Bank

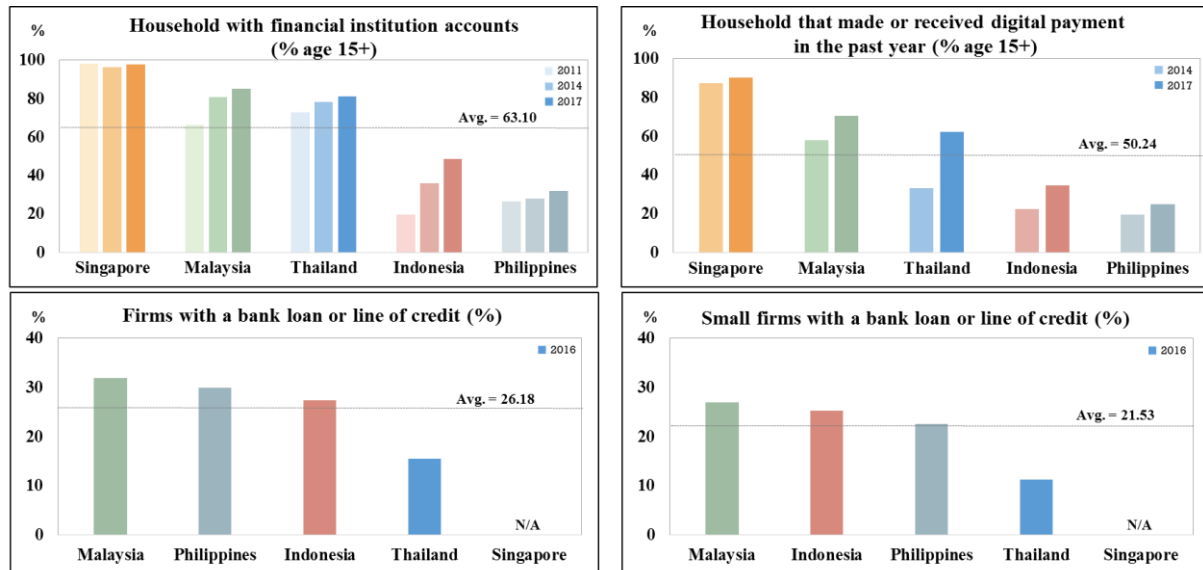
Figure 8 Competitiveness of financial institutions (in terms of efficiency)

Figure 8 measures efficiency of the financial sector through the lens of bank net interest margin, bank return on assets, bank overhead costs to total assets, and bank return on equity. These measures reflect the ability of banks to squeeze down their costs and generate returns. It should be noted, however, that Indonesia is rather an outlier, whether in terms of bank net interest margin and bank return on asset, pushing the average of the sample up above considerably in these measures. Among ASEAN-5, Thailand, on average over the sample period, ranks third in terms of bank net interest margin, second on bank return on asset, and fourth on bank return on equity. It is thus safe to say that Thai banks are somewhat middling in terms of efficiency.

Figure 9 measures access to the financial sector through the lens of percentage of population aged 15 and above with accounts at financial institutions, percentage of population aged 15 and above who made or received digital payments in the last year, firms with a bank loan or line of credit, and small firms with a bank loan or line of credit. The first two measures



reflect financial access of households, while the last two reflect financial access of firms and SMEs.



Source: Global Findex and World Bank Enterprise Survey

Figure 9 Competitiveness of financial institutions (in terms of access)

In terms of households, Thailand is above average in terms of both access to accounts at financial institutions and usage of digital payments. What should be noted is the significant increase of percentage of those who made or received digital payments in Thailand from around 30 percent in 2014 to almost 60 percent in 2017, reflecting the fast rise of digital access in Thailand.

However, in terms of firm access to a bank loan or line of credit and small firms with a bank loan or line of credit, Thailand ranks last in both measures, excluding Singapore whose numbers are not available. This point will be explored in depth later in the paper, as small

firms and SMEs are a key driver of the Thai economy, and the inability of Thai firms to access services from financial institutions warrant an investigation<sup>11</sup>.

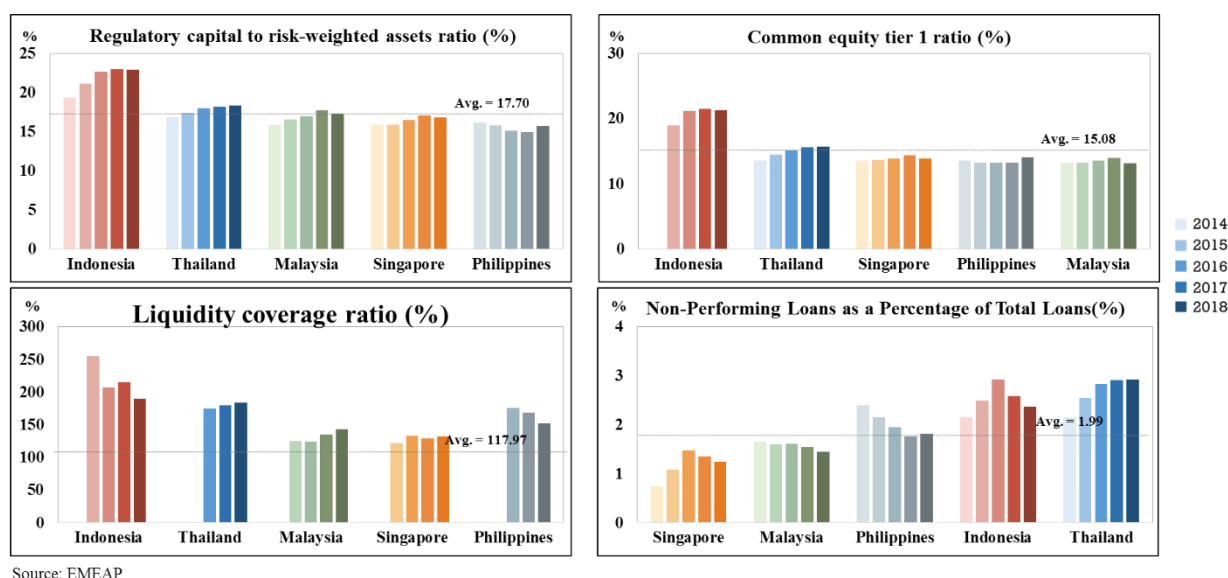


Figure 10 Competitiveness of financial institutions (in terms of stability)

Figure 10 depicts measurement of stability in terms of regulatory capital to risk-weighted assets (CAR), common equity tier 1 (CET1) ratio, liquidity coverage ratio (LCR), and percentage of non-performing loans (NPL) to total loans. According to Figure 10, using numbers from EMEAP, the Thai banking sector holds high buffers in terms of CAR, CET1, and LCR against possible shocks, ranking second in the three areas on average over the sample period. Thailand, however, ranks last in terms of NPL ratio. The levels of Thailand's NPL ratio, however, is not much higher than the sample average, roughly about 1 percentage point above.

From the assessment of the four dimensions of Thai financial sector competitiveness, namely depth, access, efficiency and stability, it is reasonable to say that the Thai financial

<sup>11</sup> Firms surveyed in World Bank Enterprise Survey include large, medium and small, with the number of small firms dominating in terms of number. It should be note large firms can also access financial markets as their external funding source, while small firms typically cannot easily do so.

sector is performing in line with peers. However, one notable weakness of the Thai financial sector is its ability to serve SMEs.

## **PART IV – COMPETITION IN THE THAI FINANCIAL SECTOR**

Part IV assesses competition in the Thai financial sector. Understanding competition is important, as various studies have shown that competition in financial sector matters in terms of allocative, productive, and dynamic efficiency, as well as depth.<sup>12</sup> Part IV starts by reviewing several literatures on how competition might affect competitiveness of the financial sector as reflected by access, efficiency, and stability. Finally, Part IV measures the degree of competition among Thai banks, dominant players in the Thai financial sector.

### **1. Competition and competitiveness: Depth, access, efficiency, and stability**

A number of studies have attempted to establish links between competition and competitiveness of the financial sector particularly in terms of access, efficiency, and stability<sup>13</sup>.

#### **A. Competition and access**

Researches on the effects of competition on firms' access to finance suggest complex relationship between competition and financial access, with results depending on factors such as the levels of competition, development, and financial inclusion of the countries. Many findings indicate a positive relationship between competition and firms' financial access, while others present evidences otherwise. Beck et al. (2003) finds for a panel of countries that bank concentration raises firms' financing obstacles and thus reduces the likelihood of firm's receiving bank finance with the effect being exacerbated by more restrictions on banks' activities. Based on data from 16 countries, Claessens and Laeven (2005) finds that more

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<sup>12</sup> See for example, Beck et al. (2008).

<sup>13</sup> It should be noted that there is not much literature that aims to capture the relationship between competition and depth of the financial sector. Financial depth captures the financial sector relative to the economy. It is the size of banks, other financial institutions, and financial markets in a country, taken together and compared to a measure of economic output. As such, it could be said that competition does not have a direct influence on depth of the financial sector, but possibly works through access, efficiency, as well as stability, since we would need to take account of both the size of the financial sector and the size of economic output of the economy.

competitive banking systems exert a positive effect on firm access to finance. Love and Peria (2012), using Lerner index for a sample of 53 countries, finds that competition is positively related to firm's access to finance. Using data from a sample of 55,596 firms in 79 developing countries to study the effect of financial market structure and financial inclusion on firm performance, Chauvet and Jacolin (2017) finds that more competitive banking systems favor firm growth at only high level of financial inclusion, while bank concentration has a positive impact on firm growth at low levels of financial inclusion.

In contrast, Fungacova et al (2017), using both structural (e.g. concentration ratios) and non-structural (e.g. Lerner index) indicators for a panel of firms from 20 European countries finds that competition increases the cost of credit and the effect is stronger for smaller firms. Cetorelli and Gambera (2001) also finds that more concentrated banking systems increase firms' access to finance. However, lack of competition that leads to high switching cost may strictly tie borrowers to an individual institution, making the borrowers less willing to engage with other institutions (Petersen and Rajan, 1994; and Boot and Thakor, 2000).

## **B. Competition and efficiency**

Intuitively, competition is expected to provide welfare gains by reducing monopoly rents and cost inefficiencies, and thus reducing the loan rates and encourage investment. Despite such intuition, however, theoretical literatures provide arguments for both positive and negative relationships between banking competition and efficiency. The intuitive Hicks' (1935) "quiet-life" hypothesis suggests that competition has a positive influence on efficiency, as a higher degree of banking competition should prevent monopoly power of banks, and therefore a reduction in banking prices. An alternative "efficient-structure" hypothesis proposed by Demsetz (1973) suggests a negative impact of efficiency on competition as the most efficient banks would benefit from lower costs and therefore higher market shares.

Furthermore, the reduced competition is argued to be an allowance for banks to benefit from scale economies in monitoring and form a stronger relationship with customers.

The relatively scarce empirical literature on the topic of the relationship between competition and efficiency also suggests mixed results, with both positive and negative relationships being found. E.g. Berger (1995), Goldberg and Rai (1996). Using the data from the European banking industry, Punt and Van Rooij (2003) finds that X-efficiency<sup>14</sup> helps improve both banks' profitability and market share, as on average X-efficiency and profitability have improved after bank consolidation. However, Punt and Van Rooij (2003) finds no indications of unfavorable price setting behavior as a result of increased market power.

### **C. Competition and stability**

Competition also has a complex relationship with stability. While there is no consensus on the definition of stability, or definite conclusion on the relationship between competition and stability, some literatures opt to define stability by attempting to define its counterpart. For example, instability often refers to as individual or systemic banking distress. See for example, Claessens (2009), and Carneiro (2011).

Intuitively, when banks compete to attract customers by relaxing their lending standards, this may lead to bad credit culture where banks underprice risks. Increased competition can, for example, lead to more access, but also to weaker lending standards, as observed in the sub-prime lending market in the US. See for example, Dell'Ariccia, Laeven and Igan (2008). However, many of theoretical literatures prior to the depth of global financial crisis of 2008-2009 suggest that tradeoff between competition and stability does not necessarily

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<sup>14</sup> X-efficiency theory is introduced by Harvey Leibenstein who suggests that under imperfect competition, firms can maintain some degree of inefficiency or, in other words, "X" level of efficiency.

hold. See for example, Carletti and Hartmann (2002), Boyd and Niccolo (2005), Allen and Gale (2004), and Perotti and Suarez (2002).

Theoretical arguments of these papers prior to the global financial crisis, often rely on modelling incentive structures of bank and their behavior. Boyd and Niccolo (2005), for example, argues that there exists fundamental risk incentive mechanisms that cause banks to become riskier as their markets become more concentrated. Perotti and Suarez (2002) suggests that the behavior of banks today will be affected by both current and future market structure and the contestability levels that their authorities impose, e.g. open system in the future. In such a dynamic model, concentration level at the present day does not necessarily reduce risky lending. On the other hand, an expected increase in future market concentration could lead banks to pursue safer lending today.

Carneiro (2011) suggests that there is a trade-off between financial stability and efficiency of financial intermediation. Specifically, large buffer on stocks of capital may actually curtail intermediation activity. Carneiro (2011) also finds that non-high-income countries were more protected from the global financial crisis of 2007-2010, but that protection appeared to be originated from less efficient, less globally integrated but more capitalized financial systems. In designing a policy to encourage more competition, regulators thus need to consider tradeoffs among competition, stability, and access.<sup>15</sup>

## **2. Measuring competition in the financial sector**

In practice, measuring competition is rather difficult. Various measures used in several literatures can be broadly classified into three groups. First group of measures are market structure measures such as concentration ratios, number of banks or Hirschman-Herfindahl

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<sup>15</sup> To reduce complexity, authors such as Carneiro (2011) sometimes collapse the potential tradeoffs among different factors into that between efficiency and stability.

Indices (HHI) assessments. Such measures consider only market shares without allowing inferences on the competitive behavior of banks. For example, these measures do not take into account that banks with different ownership behave differently, or banks might not compete directly in the same line of business.

Second groups of measures, such as H-Statistic, assess the reaction of revenue or output prices to input prices, and thus gauge the competitive behavior of banks. Under perfect competition, increases in input prices would cause marginal cost and marginal revenue to move together, while in imperfect competition they do not. H-Statistic imposes certain restrictive assumptions on the banks' cost functions, and is only valid if the market in the study is in equilibrium.

Third group of measures are indicators of the regulatory framework that provide indications of market contestability of the banking system. Such measures include entry requirements, formal and informal barriers to entry for domestic and foreign banks, activity restrictions and other regulatory requirements, which might prevent new entrants from challenging incumbents. Beck et al. (2008) also suggest that the wider institutional framework such as contractual and informational framework could also be included among these indicators.

Complexity in measuring competition is further compounded by the question of how to properly define the relevant market.

#### **A. Measuring degree of competition in the Thai banking sector using**

##### **H-Statistic**

While the stylized facts in Part II have shown that competition in the financial sector seems to be growing, with banks now competing with financial market players, non-banks, and payment service providers, intensity of such competition is not clearly seen. This section thus



uses Panza-Rosse (1987) H-Statistic framework, a New Empirical Industrial Organization (NEIO) approach to assess the degree of competition within the Thai banking sector<sup>16</sup>. The framework measures the degree of competition directly from market power of players within the market. According to Panza-Rosse (1987), degree of competition within a market is high, if revenues of firms in the market are sensitive to changes in input costs. That is, firms need to pass on changes in input costs to their customers. On the other hand, if revenues of firms are not sensitive to changes input costs, firms are considered to have sufficient market power as they can maintain their customers' base without altering their product prices even when there are changes in costs.

H-Statistic can be calculated by first estimating how revenues (TR/TA in the equation below) are sensitive to different input costs ( $w_i$  in Equation 1 below).

$$\log(\text{TR}/\text{TA}) = \alpha + \sum_{i=1}^n \beta_i \log w_i + \sum_{j=1}^J \gamma_j \log \text{CF}_j + \delta \log(\text{TA}) + \varepsilon,$$

*Equation 1 H-Statistic*

H-Statistic is then calculated as the summation of the elasticity of TR/TA to different input costs:

$$H^r = \sum_{i=1}^n \beta_i,$$

*Equation 2 H-Statistic (cont)*

If H-statistic is near zero, then changes in input costs do not affect revenues of firms in the industry. Firms are thus price makers as they have high degree of market power.

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<sup>16</sup> Note that Panza-Rosse (1987) H-Statistic is different from the traditional approach such as the Herfindahl-Hirschman Index (HHI) which measures the degree of competition indirectly through concentration ratio.

On the other hand, if H-statistic is equal to one, then firms in the industry pass on all the changes in input costs to the consumers. Thus, these firms are effectively price takers, operating in a perfectly competitive market.

<b>H-Statistic</b>	<b>Competition Level</b>
<b><math>H \leq 0</math></b>	<b>Monopoly or Collusive Oligopoly</b>
<b><math>0 &lt; H &lt; 1</math></b>	<b>Monopolistic Competition</b>
<b><math>H = 1</math></b>	<b>Perfect Competition</b>

*Table 3 H-Statistic and competition level*

H-Statistic has recently been used as a preferred method for measuring the degree of competition within the banking industry. In contrast to previous measures used such as the HHI concentration index that infer the degree of competition indirectly from the level of market concentration, H-Statistic measures the degree of competition directly by assessing pricing behavior of the firms.<sup>17</sup>

In recent years, the use of H-Statistic to measure degree of competition in the financial sector, particularly the banking sector grown in popularity, and has been applied quite extensively<sup>18</sup>. Recent research such as Ventouri (2018), using data from 2007-2016, suggests that H-Statistic for the Thai banking sector is quite high at 0.823.

<sup>17</sup> It is also important to note that there is a strand of literature which argues that the level of concentration is a good indicator of competition. For example, Neal, P. (2011) ('Banking Competition: The Rhetoric and the Reality'. Adelaide) contends that the level of concentration, measured by concentration ratios or by HHI, is not enough to determine the level of competition. The article takes the view that contestability must also be examined, i.e., evaluating the ability for firms to enter and exit markets. Contestability is an issue that will be examined in the next section on promoting competition.

<sup>18</sup> See for example, Molyneux et al. (1994) for major European countries, Molyneux et al. (1996) for Japanese commercial banks, Bikker and Haaf (2002) for 23 industrialized countries, Claessens and Laeven (2004) for a 50-country study, and Liu et al. (2012) for Southeast Asian banking markets.

To assess how degree of competition in the Thai financial sector might have evolved over time, the authors apply the H-Statistic framework on the data from *consolidated* balance sheets of 15 Thai commercial banks from 2013Q1 to 2018Q4.<sup>19</sup>

The authors estimated H-Statistic, using a mixed effect model to allow variations in the coefficients of Equation 1 over time, to examine the dynamic of competition<sup>20</sup>. The dependent variable is “Total revenue / Total Asset” while the independent variables are three types of main costs, namely (1) funding costs, (2) labor costs, and (3) physical asset costs. The control variables are (1) “Total Equity / Total Asset”, (2) “Fixed Asset / Total Asset”, and (3) “NPL ratio” to reflect banks’ strategy and credit risk.

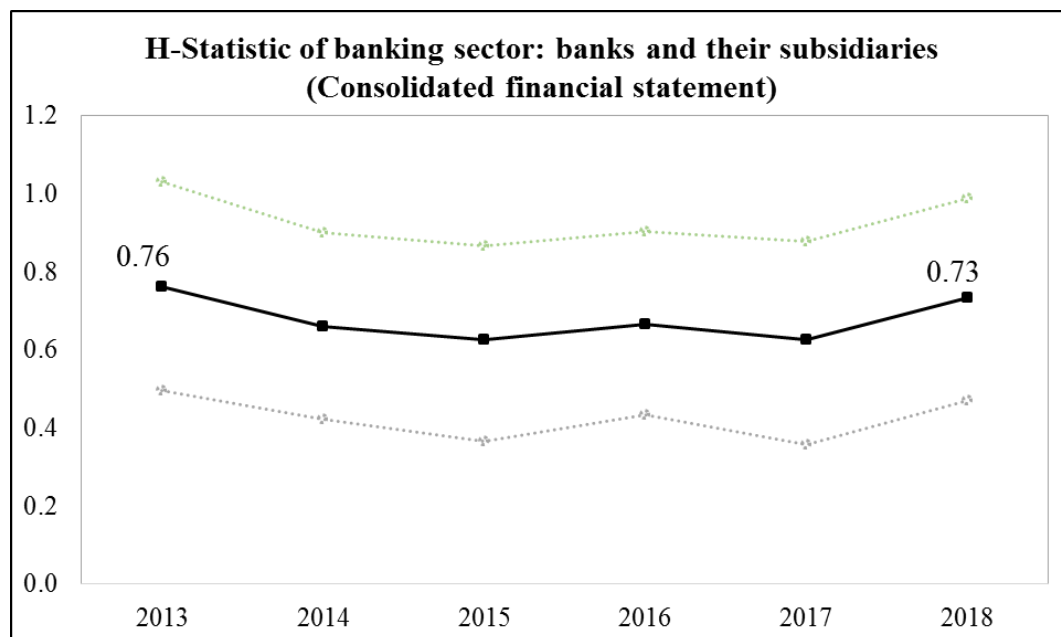


Figure 11 H-Statistic for the Thai banking sector

<sup>19</sup> Consolidated balance sheets also include data from the banks’ subsidiaries which include operations of their non-bank subsidiaries such as credit card and personal loans. Non-consolidated balance sheets and income statements, in contrast, include only data from the banks’ own operations.

<sup>20</sup> The estimation is done with Markov Chain Monte Carlo (MCMC) sampling, using *Stan*, the Bayesian probabilistic programming language, accessed through the *brms* package of the R programming language created by Bürkner (2017), with prior distribution of the coefficients assumed to be normally distributed with mean of zero and standard deviation of one, reflecting the fact that the authors do not assume much what the coefficients might be, but that extreme values of the coefficients are assumed to be very unlikely.

Figure 11 indicates that the degree of competition in Thai banking sector remains high over the sample period, although there are some inter-temporal dynamics worth noticing. The H-Statistic dropped from 0.76 in 2013 to the low of around 0.61-0.62 in 2014 and 2015 before edging up to around 0.73 in 2018, suggesting that the degree of competition did change over time. Allowing for uncertainty surrounding different estimation methods (mixed effect model with varying coefficients v. OLS), the results of this paper are in line with Ventouri (2018), which indicate that the sector is operating under monopolistic competition and consolidated revenues are relatively sensitive to changes in cost<sup>21</sup>.

### **B. Limitations of the H-Statistic as a measure for financial sector competition**

While recent figures for Thai banking sector's H-Statistic are relatively high, it should be reminded that for most countries, data available for the calculation of H-Statistic are only banking sector data. If anything, inferring degree of competition from the H-Statistic above requires at least two caveats.

First, while banking sector remains dominant in many countries, in Thailand, financial services are being offered not only by banks, but increasingly also by non-banks and financial market players. Competition in the banking sector as reflected by the H-Statistic thus does not wholly reflect degree of competition in the financial sector.

Second, high competition as reflected by high H-Statistic does not necessary mean that banks are all competing to serve *all* segments of the population. Given that banks are deposit takers and a bank failure could lead to contagion and financial instability that impose great costs to the economy, regulations are often put to restrict banking activities, limiting banks' potential to diversify, exploit scale and scope economies (OECD, 2011). As such, banks are

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<sup>21</sup> Dashed lines in Figure 11 represent upper and lower bound of 95 percent confidence band of the H-Statistic estimate.

only competing in limited segments of customers and markets (i.e. those allowed by regulations and those with relatively low risk).

On this second point, it should be noted that despite H-Statistic of the Thai banking being found to be high, the percentage of SME access to bank finance remains low. This is quite puzzling since in a market where competition is high, demand should be reasonably well met. Low SME access to finance warrants attention, given that (1) SMEs are a considered a key driver of the Thai economy, accounting for 80 percent of employment, and 40 percent of value added in GDP and (2) in many recent surveys, SMEs identified financial constraints and high funding costs as one key area of help needed. See for example, Angklomkliew & Phekanonth (2019), Nuntramas et al. (2019).

As such, it could be said that competitiveness of the Thai financial sector can still be very much improved upon, at least in terms of SME financial access, even if banking sector competition is already quite high when seen through the lens of H-Statistic. In Part V, the paper will explore more on the bottlenecks in SME bank finance, as it remains one key weak point in competitiveness of the Thai financial sector.

## **PART V – A PUZZLE: SME LOW ACCESS TO FINANCE**

Part V analyzes a puzzle arising from the analyses of Part III and Part IV. Despite high competition in the Thai banking sector, SME access to finance remains a weak point. This suggests that there are market failures in SME access to finance. The point is particularly important since SMEs are important for the Thai economy, whether in terms of employment, or value-added to GDP.

Part V delves into this puzzle of SME financing, by first examining what might be bottlenecks and market failures that limit SME access to finance. This is done by breaking down SME loan origination process and identifying bottlenecks and market failures using results from surveys and interviews of SMEs and bank credit officers. Part V then examines the implications that the bottlenecks and market failures have on SME lending, using data from 1.29 million individual loan accounts to SMEs. Later, Part V reviews various initiatives being done by various players including banks, FinTech, SMEs, and regulators to harness the power of technology and data to help alleviate some of the key bottlenecks and market failures in SME financing. Lastly, Part V discusses how technology and data might be used to help unlock bottlenecks and eliminate market failures in the financial sector as a whole.

### **1. SME bank financing: Where are the bottlenecks**

As discussed earlier, there seems to be both quantitative and qualitative gaps in SME financing, despite the result on Part IV indicating that competition in the Thai banking sector, as measured by H-Statistic, is high. As such, it is worth investigating what might be the bottlenecks that cause market failures in SME bank financing, i.e. why both quantity and quality gaps still appear.

### A. Obstacles to SME finance: A broad view

Reviewing various surveys and studies on Thai SME financing key obstacles to SME access to bank finance are found to include<sup>22</sup>:

(1) **The practice of collateral-based lending**, whereby banks require SMEs to pose assets such as real estate properties, manufacturing equipment, and financial securities as collaterals for loans. Such practice prevents SMEs, including those with high business potential, but without sufficient amount of assets to be posed as collaterals, from accessing bank loans.

(2) **High borrowing costs**, which partly arises due to the absence of reliable financial information owing to sub-standard accounting practices, lack of financial documents for verification and substantive business plans, the operator's lack of relevant experiences. Such factors make banks deem SMEs as being high risk and more likely to become NPLs, and thus charge SMEs higher borrowing costs.

Government and regulators, being well aware of the problems of SME financing, have introduced a number of initiatives to reduce obstacles to SME financing, including Credit Guarantee Scheme by Thai Credit Guarantee Corporation to partially eliminate collateral requirements in a traditional collateral-based lending. Several credit schemes were also introduced to help reduce financing costs for targeted SMEs such as those operating in the ten S-curve industries. In addition, SMEs are provided with credits for investment in technology and innovations and (R&D) to help enhance SMEs' competitiveness, and credit for SMEs to upgrade their water, air, and waste treatment systems in line with the policies to protect the environment and promote energy conservation (Nuntramas et al., 2019). Furthermore, several SFIs have stepped in to help with SMEs financing, yet SME access to finance remains low.

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<sup>22</sup> See for example Angklomkliew & Phekanonth (2019), and Nuntramas et al. (2019).

## **B. Bottlenecks in SME loan origination: A micro view**

While a number of schemes and measures have been introduced by the government and regulators to eliminate obstacles to SME financing, such schemes and measures are rather at the macro level. To specifically address the SME financing issues, it might still be worthwhile to drill down to check what could be the bottlenecks of SME financing at the loan origination process, and determine how these bottlenecks might have caused market failures. To do so, the authors review several surveys done on SMEs and bank credit officers. According to BOT's Regulatory Guillotine Project on SME Financing conducted between June – September 2018, in which representatives of various SME coalitions and bank representatives, bottlenecks in SME loan origination are summarized in Table 4 below.



Step in SME loan origination	Actions	Pain points	Market failures
1. Borrower inquiry	Fill in an inquiry form and submit preliminary information	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input type="checkbox"/> Lack of data	<input checked="" type="checkbox"/> Process inefficiency <input type="checkbox"/> Information asymmetry <input type="checkbox"/> Unintended consequences of regulations
2. Prescreening and data collection	Fill in a loan application and provide required documents and additional documents that highlight creditworthiness	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input checked="" type="checkbox"/> Lack of data	<input checked="" type="checkbox"/> Process inefficiency <input checked="" type="checkbox"/> Information asymmetry <input type="checkbox"/> Unintended consequences of regulations
3. Verification	Review for accuracy and completeness. KYC a borrower and request additional information if needed.	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input checked="" type="checkbox"/> Lack of data	<input checked="" type="checkbox"/> Process inefficiency <input checked="" type="checkbox"/> Information asymmetry <input type="checkbox"/> Unintended consequences of regulations
4. Underwriting	Runs the application through a process of taking a variety of components into account: credit score, risk scores, and many lenders will generate their own unique scoring criteria	<input checked="" type="checkbox"/> Manual process <input type="checkbox"/> Paper documentation <input checked="" type="checkbox"/> Lack of data <input checked="" type="checkbox"/> Others: Need collateral	<input checked="" type="checkbox"/> Process inefficiency <input checked="" type="checkbox"/> Information asymmetry <input type="checkbox"/> Unintended consequences of regulations
5. Credit decision	The application is approved, denied or sent back to the originator for additional information. A denial may be revisited if certain parameters are changed	<input type="checkbox"/> Manual process <input type="checkbox"/> Paper documentation <input checked="" type="checkbox"/> Lack of data <input checked="" type="checkbox"/> Others: Model accuracy	<input checked="" type="checkbox"/> Process inefficiency <input checked="" type="checkbox"/> Information asymmetry <input type="checkbox"/> Unintended consequences of regulations
6. Quality control	An application would be sent to a quality control where the final decision will be analyzed against internal and external rules and regulation	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input type="checkbox"/> Lack of data	<input checked="" type="checkbox"/> Process inefficiency <input type="checkbox"/> Information asymmetry <input checked="" type="checkbox"/> Unintended consequences of regulations
7. Funding	Loan contracts are signed and money will be disbursed in accordance with the contracts	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input type="checkbox"/> Lack of data	<input checked="" type="checkbox"/> Process inefficiency <input type="checkbox"/> Information asymmetry <input checked="" type="checkbox"/> Unintended consequences of regulations
8. Collection and default	If the loan is due, collect payments and interests. If the loan is default, banks issue legal notices and file recovery suits to realize money or confiscate collateral.	<input checked="" type="checkbox"/> Manual process <input type="checkbox"/> Paper documentation <input type="checkbox"/> Lack of data <input checked="" type="checkbox"/> Others: No market for collateral	<input checked="" type="checkbox"/> Process inefficiency <input checked="" type="checkbox"/> Information asymmetry <input checked="" type="checkbox"/> Unintended consequences of regulations

*Table 4 Example of market failures in SME loan origination cycle*

The bottlenecks and market failures in SME loan origination process suggest that manual process, paper documentation, and lack of data are present at various steps of loan origination process. These bottlenecks have resulted in high transaction costs in loan origination, whether in terms of time, money, and opportunity cost. Furthermore, these bottlenecks prevent effective use of data to construct accurate credit risk models. Without a good credit risk model, banks find it difficult to distinguish between those SMEs that might be deserving of loans but might not have adequate collateral (“good” SMEs), and those that might

not be so deserving (“bad” SMEs). Such difficulty compounded with the fact that SMEs themselves typically have higher credit risk than large firms has resulted in SMEs’ failure to access financing.

The presence of bottlenecks in SME loan origination suggests that SME lending is costlier, more time-consuming, and riskier when compared to large corporate loans. In large corporate lending, banks often have more reliable information at hand, possibly owing to ongoing relationship, as well as public information and audited financial statements that can be used to assess the risk of the loans, and can price the loans more accurately. It is also quite safe to say that for a bank to lend THB 1 billion to a large corporate in a single transaction, it would take much less time and effort than to lend to 100 SMEs at THB 10 million each. Furthermore, large corporate, being large and well-organized entities, with verifiable and public information, tends to be less risky for banks to lend to, when compared to SMEs that are still young, not well-supported, and with less verifiable information.

These obstacles to SME access to bank finance reflect market failures in various dimensions: (1) information asymmetry, where banks are unable to easily assess risks of consumers well enough and thus are opted to collateral-based lending; (2) behavioral distortions resulting from high transaction costs, whereby banks neglect SME lending in favor of other types of lending, despite potential immense demand from SMEs.

## **2. Implications of market failures in SME bank financing**

To assess how market failures might have affected SME bank financing, this paper uses data from 1.29 million individual SME loan contracts from BOT’s SME Database (SMD) and Loan Arrangement Database (LAR), to assess how SME loans are distributed, where SMEs are defined according to the criteria set by Thailand’s Ministry of Industry in 2002. These loan contracts are collected from 15 Thai commercial banks as well as six SFIs.

Mapping our SME loan contract data to SME data from Office of SME Promotion (OSMEP), the paper finds that a mere 16 percent of SMEs use loans from banks, 26 percent use loans from SFIs, while the majority (56 percent) do not use loans from banks or SFIs, reflecting either self-exclusion or lack of access to loans, or they do not use loans at all. Despite the fact that the authors cannot distinguish SMEs that self-exclude from usage of loans from banks or SFIs, and those who actually lack access to loans, the fact that more than half of SMEs do not use loans from banks or SFIs should raise some concerns. SMEs often rely on bank or SFI credit for external funding, as they typically cannot easily raise funds in financial markets or other means. See for example Yokoi-Arai and Yoshino (2006) and Nuntramas (2019).

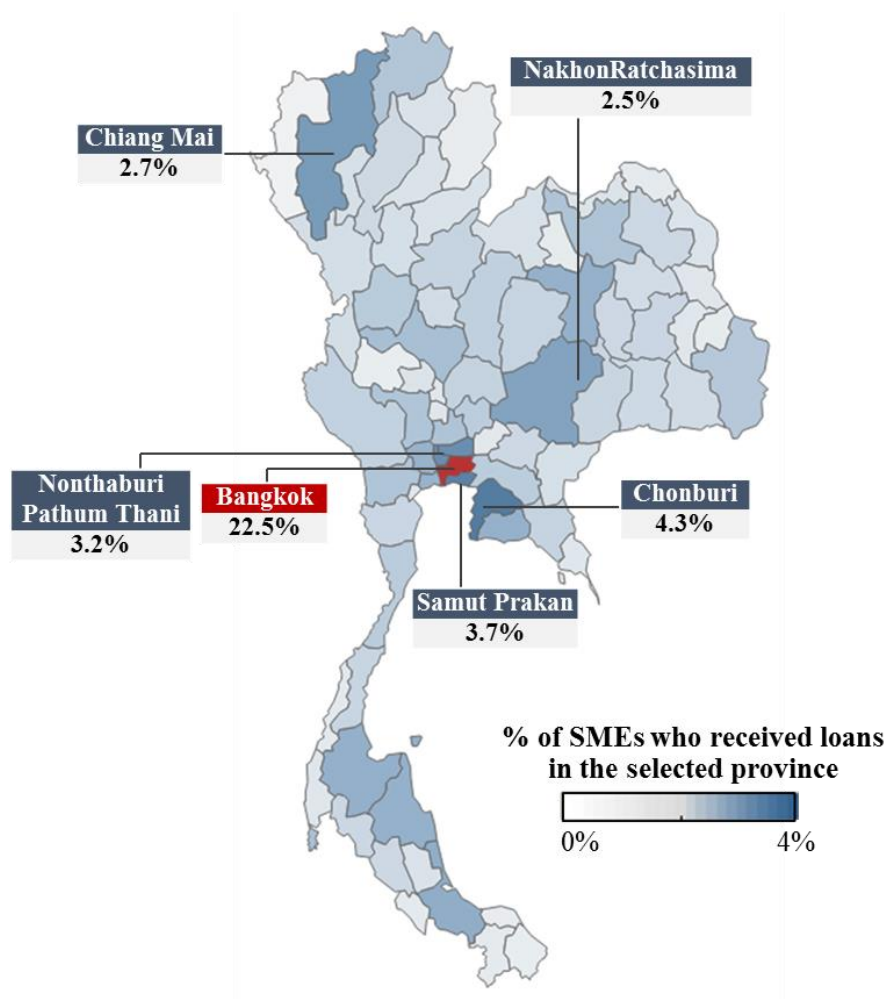


Figure 12 SME loans provided by commercial banks, by location

From Figure 12, it could be seen that SME loans provided by Thai commercial banks concentrated mainly in Bangkok and its vicinity, and the central region of Thailand.

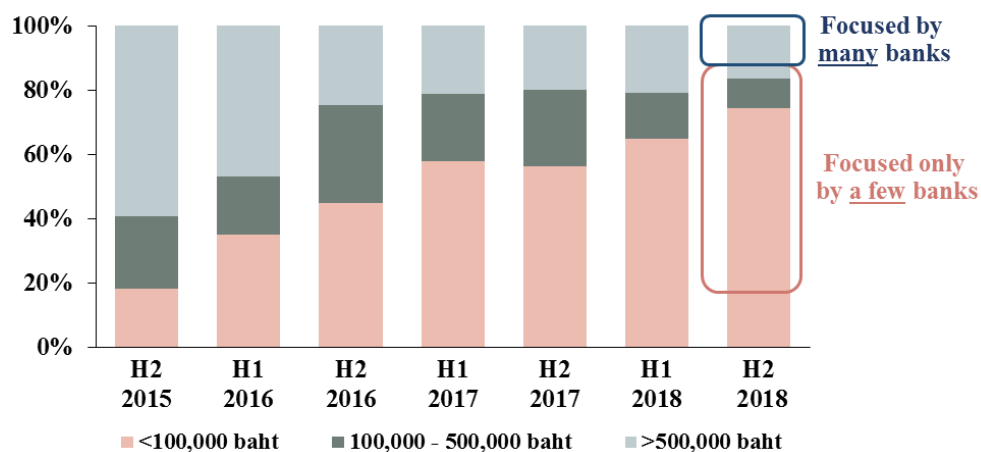


Figure 13 Size of new SME loans provided by banks

Drilling down to SME loan sizes as originated by banks, the results suggest that most of the banks concentrate on SME loan size larger than THB 500,000 (Figure 13). Although the number of loan below THB 100,000 grew rapidly in the past few years, from less than 20 percent in 2015H2 to more than 70 percent in 2018 H2, it is found that only two banks concentrated in this small loan segment.

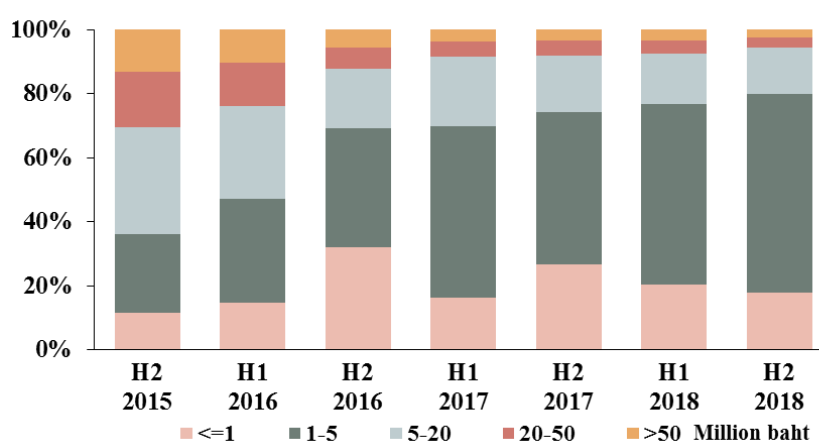


Figure 14 Income of SME customers who got new loans

Considering income of SMEs who got new loans in Figure 14, the number of SMEs with income between THB 1-5 million who are able to get loans has risen considerably over time. Again, loans to the lower income tiers (less than one million baht and THB 1-5 million) concentrated mainly among two banks.

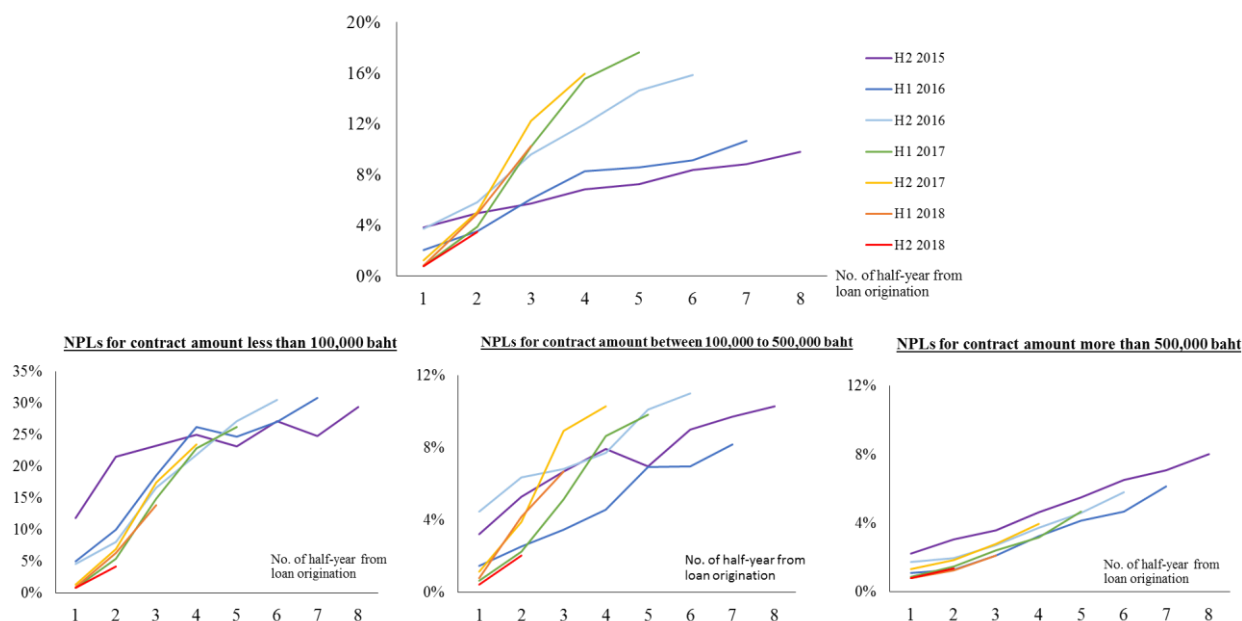


Figure 15 NPLs of new SME loans over time

Looking at NPLs of SMEs by loan size, we could also see that smaller SME loans are riskier than larger SME loans (Figure 15). This is consistent with our hypothesis that higher transaction costs and higher credit costs of lending to smaller borrowers would lead banks to lend to larger firms with larger loan size.

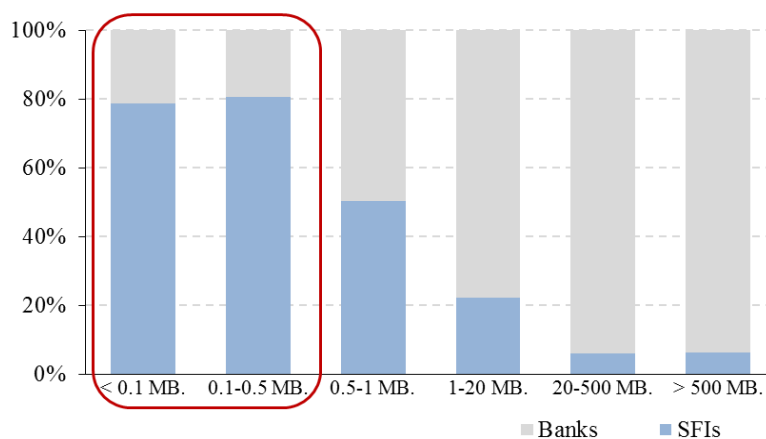


Figure 16 SME loan size provided by banks v. SFIs

From Figure 16, the results suggest that for tiny loan sizes, SFIs are key players to meet SMEs financing needs. SFIs account for around 80 percent of SME loans with size less than THB 100,000, and more than 70 percent of SME loans with size between THB 100,000-500,000.

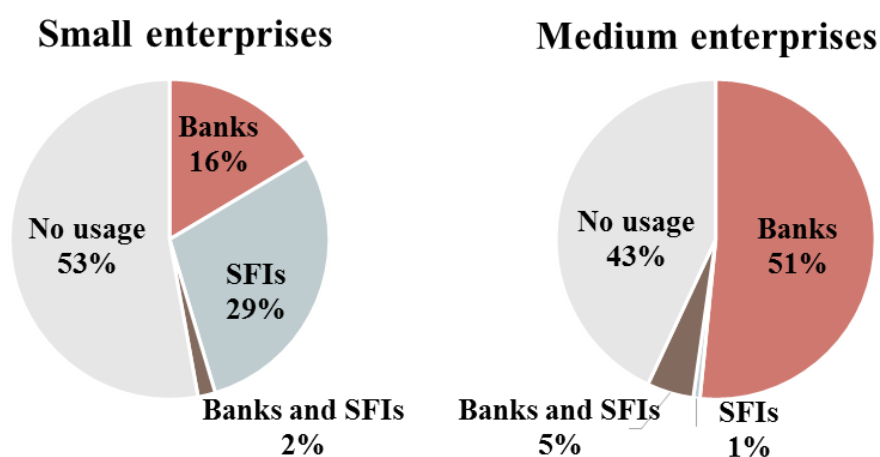


Figure 17 SME customers of Banks and SFIs

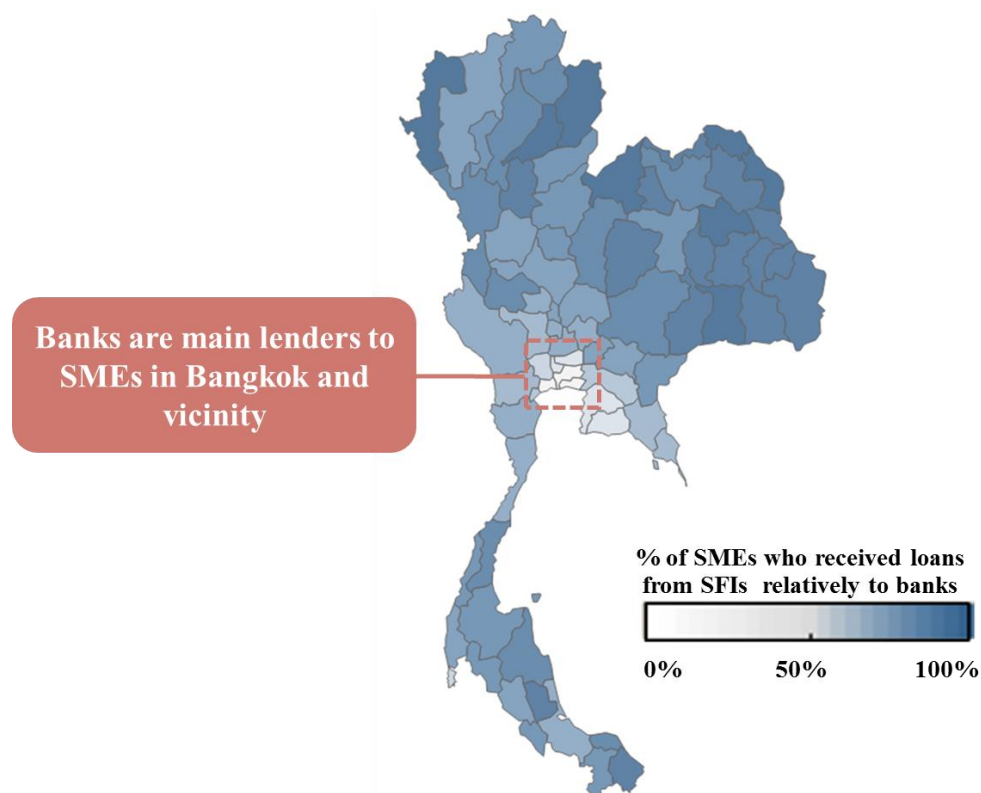


Figure 18 SFIs' contribution to SME financing

	Numbers	Proportion
Customers of banks only	511,590	35%
Customers of SFIs only	886,102	61%
Customers of banks and SFIs	54,843	4%
<b>SMEs with access to either SFIs or banks</b>	<b>1,452,535</b>	<b>100%</b>

*Table 5 SME customers of Banks and SFIs*

Figure 17 indicates that medium-sized enterprises use bank loans rather than SFI loans, while the reverse is true for small-sized enterprises. However, the presence of SFIs is found to greatly contribute to SME financing especially SMEs in areas where banks are not concentrated. For example, rural areas outside Bangkok, as illustrated by Figure 18. Table 5 illustrates that banks and SFIs serve distinct groups of SMEs. Only 4 percent of SMEs have loans from both banks and SFIs.

### **3. Addressing SME financing challenge using technology and data: Banks, borrowers, FinTech, and regulators**

Despite having SFIs stepped in to address market failures in SME lending, it is worth exploring whether bottlenecks and market failures identified in the previous section could also be addressed by harnessing the power of technology and data. Digital disruption that is ongoing in various industries are also starting to pervade into the financial sector. Digital disruption has brought about innovative solutions that harness the power of technology and data to solve pain points in various industries. In SME financing, the success in harnessing the power of technology and data seems to require various players to work in tandem.

## A. Banks

In recent years, banks in many countries, acting alone or sometimes working with FinTech, have come up with a number of solutions that could help unlocking the bottlenecks in SME financing. Some of the solutions to relieve bottlenecks in SME credit origination identified from the BOT's Regulatory Guillotine Project on SME financing are summarized in Table 6 below, with many include the use of technology and data.

Step in SME loan origination	Pain points	Possible solutions to alleviate pain points
1. Borrower inquiry	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input type="checkbox"/> Lack of data	Online inquiry; online comparisons, and online applications
2. Prescreening and data collection	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input checked="" type="checkbox"/> Lack of data	Digitization of prescreening process
3. Verification	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input checked="" type="checkbox"/> Lack of data	e-KYC
4. Underwriting	<input checked="" type="checkbox"/> Manual process <input type="checkbox"/> Paper documentation <input checked="" type="checkbox"/> Lack of data <input checked="" type="checkbox"/> Others: Need collateral	Digitization; Information-based lending
5. Credit decision	<input type="checkbox"/> Manual process <input type="checkbox"/> Paper documentation <input checked="" type="checkbox"/> Lack of data <input checked="" type="checkbox"/> Others: Model accuracy	Data sharing to enhance credit risk models
6. Quality control	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input type="checkbox"/> Lack of data	Regulatory guillotine
7. Funding	<input checked="" type="checkbox"/> Manual process <input checked="" type="checkbox"/> Paper documentation <input type="checkbox"/> Lack of data	Regulatory guillotine
8. Collection and default	<input checked="" type="checkbox"/> Manual process <input type="checkbox"/> Paper documentation <input type="checkbox"/> Lack of data <input checked="" type="checkbox"/> Others: No market for collateral	E-Payments; Regulatory guillotine

*Table 6 Possible solutions to alleviate pain points in SME loan origination*

## B. Borrowers

Apart from banks, in this age of digital disruption, SMEs themselves, as borrowers, also have the potential to leverage technology and help alleviate bottlenecks in SME loan origination process. Among other things, SMEs could digitize their businesses, leverage cloud-based platforms for accounting, adopt digital payments, and automate invoicing and settlement processes to create digital footprints, substantiate their business activities and



become eligible for finance. Digitalization and adoption of technology by SMEs, however, might require right incentives, since they could incur short-term costs for SMEs before longer-term benefits, including access to finance, are realized.

### **C. FinTech**

In Thailand, FinTech players have also started to emerge – acting alone or working with banks – to provide solutions that help SMEs digitize their businesses and create digital footprints, as well as help banks analyze those footprints using artificial intelligence (AI) and machine learning (ML) algorithms. Many of these FinTech firms focus on providing solutions that allow SMEs to focus on their core businesses, by taking care of peripheral but necessary activities, e.g. accounting and logistics for SMEs. For example, FlowAccount is a cloud-based platform for business accounting. It is an online account management system that is linked to SME businesses. At the end of each day, total sales turnover and cost are updated on FlowAccount. SMEs spend almost no time in bookkeeping, effectively control their income and expenses, while account reports can be viewed anywhere and anytime. Currently, a large Thai commercial bank already allows its API to link the accounts of FlowAccount's customers to its SME online application.

Lenddo, Credit OK, and SCB Abacus, on the other hand, are Thai FinTech players that have emerged to leverage AI and ML on various sources of data including those from social network platforms, and telecom companies, to build credit scores which will make it easier for lenders to verify and make credit decisions for SMEs and micro entrepreneurs. Such FinTech also often work with banks, with SCB Abacus itself being a subsidiary of another large Thai commercial bank.

Apart from those FinTech players that *work with* banks, there are also FinTech players that *compete* with banks, at least indirectly, by offering alternative sources of SMEs financing.

In recent years, peer-to-peer (P2P) lending technology has taken root in Asia, particularly in China, Singapore, and Indonesia. P2P business models allow lenders and borrowers to link up via an online platform. For borrowers, this means that the underbanked are able to secure loans where previously a lack of credit history posed considerable obstacles. This may lead to faster access to capital for SMEs and a much simplified process for reaching a broader base of potential investors, rather than solely reliance on banks.

In Thailand, the BOT first announced their intention to regulate P2P lending in September 2018, and the BOT issued Notification 4/2562 regulating P2P lending on April 2019. The Notification imposes requirements and conditions for P2P platform providers, borrowers, and lenders. The applicants must also enter and pass the BOT regulatory sandbox before launching their services to the general public.

#### **D. Regulators**

Regulators are also looking for ways to help banks and FinTech leverage technology to help mitigate SME financing problems. Both the Bank of Thailand (BOT) and Securities and Exchange Commission (SEC) of Thailand have established regulatory sandboxes that allow banks and FinTech to test new innovations that have the potential to help alleviate bottlenecks in SME financing, from e-KYC to P2P debt financing and crowd funding platforms.

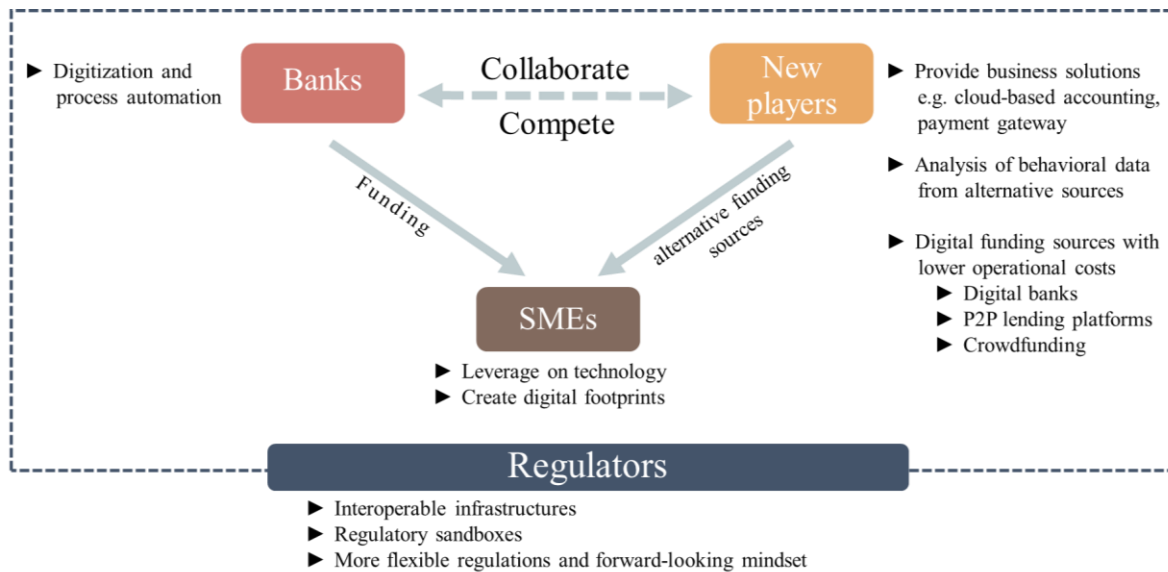


Figure 19 Reducing market failures using technology, data, and new players:

*The case of SME financing*

### E. The importance of data and data sharing

One key market failure that occurs throughout the SME loan origination process is information asymmetry. Data is essential in reducing asymmetric information, and reduce the degree of uncertainty associated with credit extension. The accuracy of credit risk models tends to increase as data pool becomes larger. More and better data should help lenders more precisely identify the probabilities of loan defaults and non-defaults, and thus reduce Type I and Type II error in lending.

#### (1) SME databases

To create more value from data, many advanced economies have opted to create a platform to integrate, generalize, and share SME data among financial institutions and other players, such as FinTech firms. In Japan, for example, the Japan Risk Data Bank (RDB) and Credit Risk Database (CRD) cover most financial institutions including credit unions. Japan's RDB anonymously covers credit information on 910,000 companies, and the CRD covers 2.4 million companies (Nemoto and Koreen, 2019). In addition to financial data, data on

transactions through companies' bank account information are collected and constantly updated.

In France, the FIBEN (Fichier bancaire des entreprises) database collects a relatively comprehensive set of data on SMEs (Nemoto and Koreen, 2019). Such data has been used for loan reviews, interest rate setting, and portfolio management. They have also contributed to the advancement of credit risk analyses by banks. In Thailand, OSMEP is in the process of trying to connect databases that are pertinent for SME credit analysis, but the final design is yet to be decided.

## **(2) E-factoring platforms**

In recent years, there have also been initiatives in various countries including Mexico, Japan, and India to create “e-factoring” platforms, harnessing the power of data and technology to make factoring more efficient<sup>23</sup>. Through factoring, SMEs can obtain working capital by selling their account receivables (the rights to receive payments from buyers of SME products) to factors (i.e. lenders), at a discount. Pain points in a typical factoring process include information asymmetry and search cost. SMEs and factors might not know each other. It could take time to verify whether the account receivables are legitimate, and that they had not already been sold to someone else (i.e. double-financing problem). The electronic nature of e-factoring

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<sup>23</sup> Factoring is one of the main types of SME lending identified by Berger and Udell (2006), which include: (1) Financial statement lending, which is lending based on informative financial statements and expected future cash flow); (2) Small business credit scoring, i.e. lending based on hard information about the SME's owner as well as the firm; (3) Relationship lending, i.e. lending based on information through contact over time with the SME, its owner, and the local community; (4) Asset-based lending, where a subset of the firm's assets is pledged as collateral and as a primary source of repayment; (5) Factoring, involves the purchase of account receivables from an SME, by a “lender” known as a factor; (6) Fixed asset lending, i.e. lending, against assets that are long-lived and are not sold in the normal course of business, e.g. equipment, motor vehicles, or real estate; (7) Leasing, which involves the purchase of fixed assets by a “lender” known as a lessor and then simultaneously enters into a rental contract with the lessee, i.e. the “borrower” that specified the payment schedule. The first three are already information-based lending which could be directly enhanced with technology and data, while the latter four typically are seen as more collateral-based types of lending.

platforms ensure that the process is cheaper, faster, more transparent, and more secure than normal factoring process.

In an e-factoring platform, data on account receivables are verified and entered into the platform by a trusted party, in a secured way, and shared only on a need-to-know basis, among SMEs, buyers of SME products (whose account receivables are issued against), and factors (which may include banks, and also FinTech in some case). Parties can work seamlessly based on the data presented on the platform.

In some of the e-factoring platforms, SMEs can even post their account receivables onto the platforms, and interested factors (including banks) could come in and bid for those account receivables. Those account receivables that have been successfully bided are marked as such. In the case of India, three licenses have been by the central bank to banks and FinTech firms to operate e-factoring platforms, and each of the platforms' databases are connected to each other, and records are ensured consistency using distributed ledger technology (DLT) to guard against double-financing and fraud (See Ruksapol et al.).

## **PART VI – LESSONS LEARNED, POLICY RECOMMENDATIONS, AND CONCLUSION**

In Part V, we have discussed SME finance as a key pain point reflecting a gap in Thai financial sector competitiveness. We have discussed the bottlenecks that might have hampered the ability of banks to efficiently lend to SMEs, and explore how technology and data might help alleviate the bottlenecks. As discussed in Part V, to harness the power of technology, data, and competition to help improve SME finance, various players would need to work in tandem, whether banks work with FinTech to come up with new solutions, or SMEs work with FinTech and banks to create digital footprints. Competition from FinTech in alternative finance should also spur more innovations from banks themselves.

Going forward, given the ongoing digital disruption, it is legitimate to ask how the ability to harness the power of technology, data, and competition to unlock bottlenecks in SME financing might be applied to reduce market failures in other parts of the financial sector. In Part VI, drawing from the analysis done in Part V, along with reviewing lessons learned from various countries, the authors tease out guiding principles that might be applied to help reduce market failures and improve a country's overall financial sector competitiveness.

### **Lessons learned and guiding principles for policy recommendations**

The key question here is, how do we harness the power of technology, data, and competition to help reduce market failures and improve the competitiveness of the Thai financial sector in the digital era? Reviewing the case of SME financing, along with initiatives in various countries to harness the power of digital disruption, we identify three guiding principles that might help guide the Thai financial sector improves its competitiveness in the digital era.

## **A. Interoperability**

Interoperability in this context means the ability for data to be shared, or transactions to be made, across different platforms. Interoperability is beneficial to the improvement of financial sector competitiveness in at least three areas: reduction of information asymmetry; collaboration and competition among different players; the capture of network value.

### **(1) Reduction of information asymmetry**

As discussed in Part V, the ability to integrate, generalize, and share SME data among various players would allow for more efficient loan reviews, interest rate setting, and portfolio management by lenders, as well as contribute to the advancement of credit risk models. As such, this will help reduce information asymmetry, which is a key market failure in credit origination. This concept applies not only to SME financing but also to retail, and corporate financing. In the digital era, more digital footprints are being created in a variety of ways, and most likely in different platforms, including social media, e-commerce, e-payments, and in the near future, with the arrival of 5G, the internet of things (IoT). To capture the most value from such immense and diverse sources of data requires seamless integration, generalization and sharing across platforms. In other words, interoperability among different platforms will be key to help harness data that arise from separate digital platforms, and reduce information asymmetry.

### **(2) Collaboration and competition**

Apart from reduction of information asymmetry, interoperability could also enhance collaboration and stimulate healthy competition. In the Australia, UK, Hong Kong, and EU, interoperability through open banking and standard API initiatives has also been highlighted as a key to ensure collaboration and competition among banks and FinTech. While open

banking has many meanings, the gist is that it allows data of a customer in one bank to be shared electronically to another bank or FinTech firm, if the customer gives consent.

In terms of lending, this means a customer can give consent for its financial statements held in one bank to be seamlessly shared with another bank, so that the other bank can have a more complete view of the customer, and offer lending terms that are more attractive and accurate to the risk of that customer. The concept can also be applied to a customer desiring to optimize his savings and investments, whereby the customer gives consent allowing a FinTech firm to aggregate and present information from his accounts (savings, securities, and mutual funds) at several banks in one place, and help him optimize his allocations of funds among the accounts.

Interoperability could help spur collaboration as FinTech could work with banks to provide innovative products. Interoperability could also spur competition, as there will be a lower switching cost for customers shopping products from one bank or another as they see fit, and thus banks (and FinTech) will compete to innovate and improve the efficiency of their services.

### **(3) Capturing network value**

Interoperability is also essential to capture network value. In China, the emergence of BigTech companies such as Alibaba and TenCent highlights the issues of interoperability. Data from Alibaba and TenCent cannot be integrated and shared. The lack of interoperability between the two means that data from one platform cannot be easily combined for even more accurate analysis. Payments also cannot be made directly across accounts on the two platforms. The humongous size of these two platforms, however, compensates for the lack of interoperability. Both Alibaba and TenCent have their own separate ecosystems, each with many hundreds of millions of users. In a typically country whose size of the population is



much less than 100 million, the lack of interoperability could result in the inability of players to effectively capture network value as market becomes too fragmented.

### **B. A robust ecosystem**

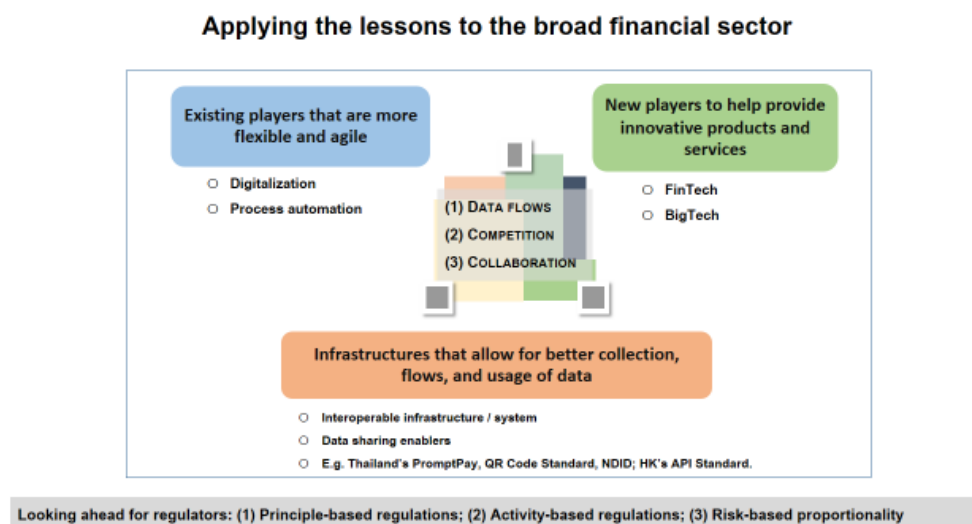
As seen in the case of SME financing, different players play different roles, collaborating, and competing, to help bring the power of technology and data to help solve bottlenecks and market failures. At a broader financial sector perspective, to harness the power of digital disruption, a robust ecosystem will also be needed. FinTech can bring in technologies and knowhow e.g. in payment solutions, biometrics, AI and ML, to help alleviate bottlenecks in other domains besides SME financing. Banks, meanwhile, can also adopt process automation in many of their business processes, and collaborate with FinTech. Banks can also collaborate with e-commerce or social network platforms of BigTech companies in areas such as customer acquisition, behavioral data analysis, and co-lending.

In many countries, the regulators also introduced new types of licensing to encourage new players with new technologies to come in the financial sector and serve the underserved segments, including SMEs and retail. For example, Hong Kong and Singapore recently introduced Virtual Bank licenses for new types of banks with no physical branches. These banks will rely on digital channels for interfacing with their customers, and thus save costs on staff and physical premises. Being start-ups, these new types of banks will also not be burdened with costly and inefficiency legacy systems. They can operate at fractions of the costs of traditional banks, and are more likely to be able to serve very small customers. With digitalization and the use of technology, they will be able to assess the customers in a more granular manner, and thus provide products that are tailored to individual customers' needs, whether terms of the loans (which may be priced daily) or deposits (which can offer more attractive rates to nudge saving behavior).

Meanwhile, the success in harnessing the power of technology and data also requires widespread adoption of technology by the users of financial services themselves. For users to adopt any new technology, they would need to see that benefits would outweigh the costs. Given that many of the benefits of technology adoption might occur at a later stage (e.g. the digital footprints that will enable the users to access financial services at cheaper costs later), while some of the costs are upfront (e.g. the cost of upgrading the systems, and the costs associated with digitalization process), right incentive structures, whether from financial services providers or from the regulators will be key.

### **C. Adaptive, forward looking, and agile regulatory framework**

Given a more diverse players in this ecosystem, many regulators are still grappling with the complexity that the new ecosystem might bring. On the one hand, the regulators might need to adopt a more activity-based approach to regulations, rather than purely entity-based regulations. In this new ecosystem, banks, non-bank players, FinTech, and BigTech might be competing with banks in certain market segments, e.g. lending, and payment. In such activities, regulations might need to ensure that there is a level playing field, e.g. between KYC of bank payment services and KYC of wallet provider services. However, given limited resources of the regulators, the regulators might also need to regulate on the basis of risk-based proportionality, e.g. supervisors might need to emphasize more on examination of systemically important institutions, which may not necessarily be banks. However, in many cases, financial regulators might not necessarily have the legal power to examine, for example BigTech firms, unless they have pertinent licenses issued by the regulators.



*Figure 20 How can technology, data, and competition be harnessed at a broader level in the order to reduce market failures?*

## Conclusion

The paper assesses competitiveness of the Thai financial sector in four dimensions, depth, efficiency, access, and stability. The paper finds the Thai financial sector to compare reasonably well to those of ASEAN-5 peers, except access to bank credit by firms and small firms. This point is particularly poignant since SMEs are a key driver of the Thai economy.

The paper also assesses the degree of competition among Thai banks, the dominant players in the Thai financial sector, using Panzar-Rosse H-Statistic framework. The paper finds consistently high degree of competition over the sample period, 2013-2018, with relatively high H-Statistic throughout the period.

The high degree of competition, taken together with SME lack of access to bank financing creates a puzzle: If competition among Thai banks is high, why does SME access to bank credit remain so low? Analyzing results from various studies and interviews, the paper identifies various bottlenecks present in SME loan origination process, including manual

process, paper documentation, and lack of data. These bottlenecks make SME lending costly, time-consuming, and risky.

Using data from 1.29 million individual loan contracts from 15 Thai banks and six SFIs, the paper finds that only a few banks are attempting to penetrate the SME market at lower tiers of loan size, and income. Smaller SME loans, however, are found to be also riskier, as their percentage of NPLs are higher. Bank lending to SMEs are also found to be concentrated in Bangkok and large provinces. The paper finds SFIs to be a good complement to commercial banks, both in terms of their focus on smaller size loans offered to SMEs and their geographical coverage. Still, when mapped to SME data from OSMEP, more than half of SMEs are not using credits from banks or SFIs.

In the age of digital disruption, however, the paper finds that banks, FinTech, SMEs and regulators are all attempting to harness the power of technology and data to help alleviate the bottlenecks in SME lending. In Thailand, banks are automating their processes. Some of Thai FinTech firms are collaborating with banks to offer innovative solutions and products, while others are competing with banks by offering platforms for alternative finance. SMEs themselves are also automating their process and create digital footprints. Regulators, meanwhile, are also adopting a more agile and forward looking approach to regulation, in order to reduce unintended consequence of regulations.

Teasing out lessons learned from various initiatives aimed to help alleviate bottlenecks in SME financing, along with lessons learned from other countries in other segments of the financial sector, the paper identifies three common themes that should help guide the design of financial landscape in the digital era: Interoperability of infrastructures that will help reduce information asymmetry, allow for collaboration and competition, and create network value; Robust ecosystem with various types of players (including new types

of digital players) competing and collaborating to better serve the needs of customers; and adaptive, forward looking, and agile regulatory framework that will help foster innovations that serve customer needs without compromising financial stability or consumer protection.

## APPENDIX

### Appendix 1: Equilibrium test

Based on Panzar and Rosse (1987) methodology, the model valid if market is in equilibrium. The equilibrium test can be estimated from equation below;

$$\ln(\text{ROA}_{it}) = \alpha_i + \beta_1 \ln(W_{1,it}) + \beta_2 \ln(W_{2,it}) + \beta_3 \ln(W_{3,it}) + \gamma \ln(Z_{it}) + \delta D + \varepsilon_{it}$$

*Equation 3 Equilibrium test (Panzar and Rosse)*

where ROA is pre-tax return on asset. Due to the fact that ROA can be negative value, the authors apply  $(1+\text{ROA})$  instead of ROA to avoid the negative value. The dependent variables are “funding costs”, “labor costs”, and “physical asset costs”, denoted by W1 W2 and W3, respectively. The control variables are “Total Equity / Total Asset”, “Fixed Asset / Total Asset”, and “NPL ratio”.

The summation of coefficients of W1 W2 and W3 represents E-Statistic. If E-Statistic equal to zero, the market is in equilibrium, otherwise, no equilibrium.

Value of E-Statistic	Equilibrium Test
E = 0.00	Equilibrium

*Table 7 E-Statistic and equilibrium test*

Table 7 shows the result of equilibrium test from consolidated financial statement for 15 commercial banks. The result indicate that Thai banking sector has long run equilibrium. Thus, the measurement of competition in Thai banking sector can be measured by Panzar and Rosse Model.

## BIBLIOGRAPHY

- Allen, G. and Gale, D. (2004), “Financial Intermediaries and Markets”, *Econometrica*, 72, 1023–1061.
- Angklomkliew, S. & Phekanonth, T. (2019). “Unlock the Thai SMEs: how to adapt to grow”  
Retrieved September 2, 2019, from  
[https://www.bot.or.th/Thai/ResearchAndPublications/DocLib\\_/Article\\_17Dec2018.pdf](https://www.bot.or.th/Thai/ResearchAndPublications/DocLib_/Article_17Dec2018.pdf)
- Barth, J. R., Caprio, G., Jr., & Levine, R. (2007). “Reassessing the Rationale and Practice of Bank Regulation and Supervision around the Globe.” Retrieved July 31, 2019, from  
<https://www.imf.org/external/np/seminars/eng/2006/mfl/bcl.pdf>
- Bazot, G. (2018). “Financial consumption and the cost of finance: measuring financial efficiency in Europe (1950 – 2007).”, *Journal of the European Economic Association*, vol. 16(1), 123-160.
- Basel Committee on Banking Supervision (BCBS) (2003). “Sound practices for the management and supervision of operational risk.” Switzerland: Bank for International Settlements.
- Beck, T, Demirguc-Kunt, & V Maksimovic (2003), “Bank Competition, Financing Obstacles and Access to Credit” Policy Research Working Paper 2996. World Bank, Washington, D.C.
- Beck, T, A Demirgüç-Kunt, & R Levine (2007), “Finance, Inequality, and the Poor”, *Journal of Economic Growth*, 12(1): 27–49.
- Belley, P., & Lochner, L. (2007). “The Changing Role of Family Income and Ability in Determining Educational Achievement.” *Journal of Human Capital*, 1(1), 37-89.

- Berger, A. (1995). The profit–structure relationship in banking: tests of market power and efficient structure hypotheses. *Journal of Money, Credit and Banking*, 27 (1995), pp. 404-431
- Berger, Allen N. & Udell, Gregory F. (2006). "A more complete conceptual framework for SME finance," *Journal of Banking & Finance*, Elsevier, vol. 30(11), pp. 2945-2966
- Bikker, J.A., Groeneveld, J.M. (1998). “Competition and Concentration in the EU Banking Industry”, vol. 8. De Nederlandsche Bank NV.
- Boschmans, K. and Pissareva, L. (2018), *Fostering Markets for SME Finance: Matching Business and Investor Needs*, OECD SME and Entrepreneurship Papers No. 6.
- Boyd, John H., and Gianni De Nicolò, 2005, “The Theory of Bank Risk Taking and Competition Revisited”, *Journal of Finance*, Volume 60, Issue 3, pp. 1329-1343.
- Bürkner, P.C. (2017). “brms: An R Package for Bayesian Multilevel Models using Stan”, from <https://www.jstatsoft.org/article/view/v080i01/0>.
- Carletti, E. & Hartmann, P. (2002). “Competition and stability: what’s special about banking?”, *Monetary history, exchange rates and financial markets: essays in honour of Charles Goodhart Vol 2*, Cheltenham, Edward Elgar. (ECB Working Paper, no 146, May 2002.)
- Carneiro, Fábio Lacerda (2011). “Is there evidence of a trade-off between financial stability and efficiency of financial intermediation? Preliminary insights from the global financial crisis of 2007-2009”, from <http://programs.wcfia.harvard.edu/fellows/files/carneiro.pdf>, 3-42.
- Cetorelli, N. & Gambera, M. (2001) *Banking Market Structure, Financial Dependence and Growth: International Evidence from Industry Data*. *The Journal of Finance*, 56, 617-648.



- Citi GPS (2016). "Digital Disruption: How FinTech is Forcing Banking to a Tipping Point", from [https://www.nist.gov/sites/default/files/documents/2016/09/15/citi\\_rfi\\_response.pdf](https://www.nist.gov/sites/default/files/documents/2016/09/15/citi_rfi_response.pdf)
- Chauvet, Lisa & Jacolin, Luc, 2017. "Financial Inclusion, Bank Concentration, and Firm Performance," *World Development*, Elsevier, vol. 97(C), pages 1-13.
- Claessens, S., Laeven, L. (2004). "What drives bank competition? Some international evidence." *J. Money Credit Bank.* 36 (3), 563–583.
- CGFS and FSB (2017). "FinTech credit: Market structure, business models and financial stability implications", Report prepared by a Working Group established by the Committee on the Global Financial System and the Financial Stability Board, May.
- Claessens, Stijn (2009), "Competition in the Financial Sector: Overview of Competition Policies." IMF Working Papers, from <https://ssrn.com/abstract=1366175>, 1-35.
- Chantararat, S., A. Lamsam, and C. Rittinon (2018). "Landscape of Financial Services in Thailand: Availability and Efficiency," PIER Discussion Paper
- Cihak, Martin; Demirguc-Kunt, Asli; Feyen, Erik; Levine, Ross. (2012). "Benchmarking financial systems around the world (English)". Policy Research working paper; no. WPS 6175. Washington, DC: World Bank.
- Danneels, E. (2004). Disruptive Technology Reconsidered a Critique and Research Agenda. *Journal of Product Innovation Management*, 21, 246-258.
- Dell’Ariccia, G., Igan, D. and Laeven, L. (2008). 'Credit booms and lending standards: Evidence from the subprime mortgage market', IMF Working Paper No. 08/106.
- Demirgüç-Kunt, Asli and Levine, Ross Eric. (2009). "Finance and Inequality: Theory and Evidence." World Bank Policy Research Working Paper Series.

- Demsetz, H (1973), 'Industry Structure, Market Rivalry, and Public Policy', *Journal of Law and Economics* 16(1): 1-9.
- Frost, J, L Gambacorta, Y Huang and HS Shin (2019). "BigTech and the changing structure of financial intermediation", Bank for International Settlements Working Papers.
- Fungáčová, Zuzana & Shamshur, Anastasiya & Weill, Laurent, 2017. "Does bank competition reduce cost of credit? Cross-country evidence from Europe," *Journal of Banking & Finance*, Elsevier, vol. 83(C), 104-120.
- Goldberg, L. G. & Rai, A. (1996). The structure-performance relationship for European banking. *Journal of Banking and Finance*, 20, 745-71.
- Griffith-Jones, S. (2003). "International Financial Stability and Market Efficiency as a Global Public Good. Providing global public goods: managing globalization." The United Nations Development Program, Oxford University Press, 646.
- Hicks, J.R., (1935). Annual Survey of Economic Theory: The Theory of Monopoly, *Econometrica*, 3(1), 1-20.
- Hootsuite. Social Media Marketing & Management Dashboard, from <https://hootsuite.com/>
- IBM Software (2012). Smarter Commerce. "OCBC Bank nets profits with interactive, one-to-one marketing and service", from <http://public.dhe.ibm.com/common/ssi/ecm/en/zzc03162usen/ZZC03162USEN.PDF>
- Ikhide, S. & Yinusa, O. (2012). "Why is the Cost of Financial Intermediation Rising in Botswana?" *The Journal of Developing Areas* 46, 183-209.
- Jarmuzek, Mariusz and Lybek, Tonny (2018). "Can Good Governance Lower Financial Intermediation Costs?" IMF Working Paper No. 18/279, from <https://ssrn.com/abstract=3314616>

- Kerr, William R. & Nanda, Ramana (2009). "Democratizing entry: Banking deregulations, financing constraints, and entrepreneurship," *Journal of Financial Economics*, Elsevier, vol. 94(1), 124-149.
- Knoop, T. A. (2008). *Modern Financial Macroeconomics: Panics, Crashes, and Crises*. Wiley.
- Lamsam, A., Chantararat, S., & Rittinon, C. (2018). "Financial Services in Thailand: Banking Agent." Retrieved August 1, 2019, from [https://www.pier.or.th/wp-content/uploads/2018/03/aBRIDGED\\_2018\\_003.pdf](https://www.pier.or.th/wp-content/uploads/2018/03/aBRIDGED_2018_003.pdf)
- Liu, H., Molyneux, P., Nguyen, L.H., 2012. Competition and risk in South East Asian commercial banking. *Appl. Econ.* 44 (28), 3627–3644.
- Love, I., Peria, M. (2012). How bank competition affects firms' access to finance. *World Bank Policy Research Working Paper*, (6163).
- Metcalfe, B. (2013): "Metcalfe's law after 40 years of Ethernet", *IEEE Computer*.
- Molyneux, P., Lloyd-Williams, D.M., Thornton, J. (1994). "Competitive conditions in European banking." *J. Bank. Finance* 18 (3), 445–459.
- Molyneux, P., Thornton, J., Llyod-Williams, D.M. (1996). "Competition and market contestability in Japanese commercial banking." *J. Econ. Bus.* 48 (1), 33–45.
- Nemoto, N. and Koreen, M. (2019), Digital Innovation Can Improve Financial Access for SMEs. T20 Japan 2019 Policy Brief, from <https://t20japan.org/wp-content/uploads/2019/03/t20-japan-tf9-1-digital-innovation-improve-financial-access-smes.pdf>

- Nualsri, A., Thanavibul, N., & Sabborriboon, W. (2017). "Unit costs of Thai Financial Services." Retrieved August 1, 2019, from [https://www.bot.or.th/Thai/MonetaryPolicy/ArticleAndResearch/FAQ/FAQ\\_120.pdf](https://www.bot.or.th/Thai/MonetaryPolicy/ArticleAndResearch/FAQ/FAQ_120.pdf)
- Nuntramas, P., P. Sutthasri, N. Srithong, & Laosamrith, C. (2019), "Resources for SMEs...Ready for actions", Krungthai Bank, April [https://www.ktb.co.th/Download/economyresources/EconomyResourcesDownload\\_428SMEs\\_final.pdf](https://www.ktb.co.th/Download/economyresources/EconomyResourcesDownload_428SMEs_final.pdf)
- OECD (2011). Bank competition and financial stability.
- Oliver Wyman (2019). Time To Start Again: The State Of The Financial Services Industry. Retrived August 1, 2019, from <https://www.oliverwyman.com/our-expertise/hubs/the-state-of-the-financial-services-industry-2019.html>
- Panzar, J.C., Rosse, J.N., (1987). "Testing for "monopoly" equilibrium." *Journal of Industrial Economics*, 35, 443-250.
- Pejic, Igor (2019). "Blockchain Babel: the Crypto Craze and the Challenge to Business", Kogan Page.
- Perotti, Enrico C. & Suarez, Javier, 2002. "Last bank standing: What do I gain if you fail?," *European Economic Review*, Elsevier, vol. 46(9), pages 1599-1622, October.
- Philippon, T. (2015). "Has the US Finance Industry Become Less Efficient? On the Theory and Measurement of Financial Intermediation," *American Economic Review*, American Economic Association, vol. 105(4), 1408-1438.
- Philippon, T. (2017). "The FinTech Opportunity," BIS Working Papers 655, Bank for International Settlements.

- Punt, L., and Van Rooij, M. (2003). The Profit-Structure Relationship and Mergers in the European Banking Industry: An Empirical Assessment. *Kredit und Kapital* 36, 1, 1-29
- Ruksapol, W, Titasupawat, O, Kriengphan, C, Sungstittiwong, S, Pumim, T & Innukul, R. (2019). “e-Factoring platforms for SMEs.” Retrived August 1, 2019, from [https://www.bot.or.th/Thai/MonetaryPolicy/ArticleAndResearch/FAQ/FAQ\\_142.pdf](https://www.bot.or.th/Thai/MonetaryPolicy/ArticleAndResearch/FAQ/FAQ_142.pdf)
- U.S. Department of Justice & FTC (2010). Horizontal Merger Guidelines, § 5.3.
- Ventouri, A. (2018). “Bank competition and regional integration: Evidence from ASEAN nations” *Review of Development Finance* 8, 127–140, Retrieved August 1, 2019, from <https://bura.brunel.ac.uk/bitstream/2438/17482/1/FullText.pdf>
- World Bank (2019). *Enterprise Surveys - What Businesses Experience - World Bank Group*. From <https://www.enterprisesurveys.org/>
- Wongswan, J., Luengnaruemitchai, P., & Boonthaveepat, W. (2013). “Financial Development and Long-term Economic Growth.” Retrieved July 31, 2019, from [https://www.bot.or.th/Thai/MonetaryPolicy/ArticleAndResearch/SymposiumDocument/Paper3\\_2556.pdf](https://www.bot.or.th/Thai/MonetaryPolicy/ArticleAndResearch/SymposiumDocument/Paper3_2556.pdf)
- Yokoi-Arai, M., Yoshino N. (2006). “Concept of competitiveness in the financial sector.” Financial Research and Training Center Discussion Paper Series, Financial Services Agency.