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The Bank Vulnerability Index: A Health Check on ASEAN+3 Banks and Banking Sectors

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Abstract

This paper formulates a Bank Vulnerability Index (BVI) for ASEAN+3 banks and banking systems to facilitate the early detection of vulnerabilities for a more informed approach to surveillance and policymaking. The BVI is adapted from the conventional CAMELS rating system, with the use of granular bank-level data. The results suggest that the impact of the COVID-19 pandemic on ASEAN+3 banking sectors was temporary, likely attributable to the healthy buffers in place, and the implementation of strong prudential policies over time. Nonetheless, several soft spots have been identified, notably, that banks' earnings could be improved, and some domestic systemically important banks should work on strengthening their governance and liquidity profiles. Further, ASEAN+3 banks could reduce climate change-related loans more concertedly, given rising concerns about global warming.

JEL classification: G21, G32, O44, P52

Keywords: banking sector, banks, CAMELS, climate change, domestic systemically important banks, financial stability, risk, vulnerability

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Abbreviations

AEs	advanced economies
ASEAN	Association of South-East Asian Nations
ASEAN+3	ASEAN plus China (including Hong Kong), Japan, Korea
BN	Brunei Darussalam
BVI	bank vulnerability index
CAMELS	capital adequacy, assets, management capability, earnings, liquidity, and sensitivity
CN	China
COVID-19	coronavirus disease 2019
CPMI	Committee for Payments and Market Infrastructures
D-SIBs	domestic systemically important banks
EMEs	emerging market economies
ERPD	economic review and policy dialogue
HK	Hong Kong, China (“Hong Kong”)
ID	Indonesia
IFCs	international financial centers
G-SIBs	global systemically important banks
GFC	global financial crisis
JP	Japan
KH	Cambodia
KR	Korea
LA	Lao PDR
LIDCs	low-income developing countries
MM	Myanmar
MY	Malaysia
NPL	non-performing loan
PH	the Philippines
SG	Singapore
TH	Thailand
VN	Vietnam

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"The report card helps give us a focus, and it frames the dialogue for moving forward."

~ Adam Smith (1723–90), Economist

I. Introduction

The global financial crisis (GFC) has shown that surveillance at the individual bank level is crucial in monitoring and assessing any build-up in systemic risks. The collapse of one bank during the GFC—Lehman Brothers—had significant negative knock-on effects for the rest of the US banking sector, sparking a crisis that eventually threatened the stability of the broader global financial system. Unsurprisingly, policymakers worldwide have been very concerned about potential spillovers and contagion from the recent failure of several banks in the US, as well as the collapse of Credit Suisse, a designated global systemically important bank (G-SIB). Put simply, the failure of a single bank might not be just an idiosyncratic event. Spillovers could occur as a result of direct financial linkages, such as deposits or lending relationships, with the failed bank; and/or liquidity shocks, arising from bank runs when depositors panic (Heitfield, Richardson, and Wang 2017). Relatedly, contagion could occur as a result of the pro-cyclical nature of leverage, prices, and market herd behavior (Sun 2020).

Prevention is better than cure, given the high costs of financial crises. However, not all banks diligently maintain high prudential standards to avoid the disastrous consequences. Previous crises are proof of the lack of discipline in some banks to ensure that they have adequate capital and liquidity buffers. Supervisors should therefore stand ready to signal and mitigate the risks posed by weak banks (Basel Committee for Banking Supervision (BCBS) 2015). It underscores the importance of having strong micro-prudential oversight in place, to identify and prevent any excessive risk-taking behavior by individual banks. To assist the authorities in determining if preemptive intervention may be necessary, the monitoring of vulnerabilities should be forward-looking in nature (BCBS 2012a). One such approach is the use of financial soundness indicators that could provide early indications of financial sector distress (Pietrzak 2021; International Monetary Fund (IMF) 2022a).

Threats to financial stability have increased in the wake of the COVID-19 pandemic. The resilience of bank balance sheets, including those in the ASEAN+3 region, are being tested. Risks of higher non-performing loans (NPLs) rose during the pandemic as the ability of corporates and households to service debt came under severe pressure with the collapse of economic activity. Many banks in the region had to set aside higher provisions against anticipated future losses (Loh 2020). Although forbearance and other policy measures provided temporary relief to distressed corporates and households, and allowed banks to support their borrowers, the expiration of such support might well end up aggravating underlying vulnerabilities and exacerbating the credit risks to banks (Hodge and Moussa 2021).

The increasingly challenging macroeconomic environment, with the sharp tightening in global monetary and financial conditions, is reinforcing the need for close monitoring of banking sector risks. The housing booms and low lending rates during the pandemic led to fast accumulation of leverage (Adrian 2021). And given that financial crises have often been preceded by rapid credit rises, the ballooning debt could spell trouble for the banking sector (Barajas and Natalucci 2021). High and still rising interest rates, targeted at managing

historically high inflationary pressures, could potentially send credit risks soaring, as bad debts become more prevalent (Loh 2022).

Banks' business models, management's risk appetite and risk management capacity are key to determining the degree of prudence adopted in their operations. Based on the Moody's Analytics BankFocus database of 595 banks in the ASEAN+3 region, a large proportion of the region's bank funding (78 percent) is sourced from typically more stable household and corporate deposits, with the balance (22 percent) sourced from the interbank and wholesale markets in 2022.[3] Hence, the region's banks should be less exposed to market volatility compared to wholesale-funded commercial banks and capital market-oriented banks (Roengpitya, Tarashev, and Tsatsaronis 2014). Furthermore, the assets of most banks in the region are typically in the form of cash and balances with their central banks (5.6 percent) and loans to corporates and households (58.9 percent), which tend to be less market-sensitive than bond or equity securities.

This paper introduces a method for monitoring individual banks in the ASEAN+3 region**.** It details the construction of a bank vulnerability index (BVI) to assess the soundness of individual banks relative to their peers, both over time and at a particular point in time.[4] The index could be used to supplement other analyses that utilize both qualitative and quantitative information, in that it could highlight idiosyncratic characteristics across various risk categories at the entity-level. Supervisors could use the information to support both their on-site engagements with individual banks and off-site analyses, and offer more specific recommendations that target any identified weak area.

This paper also attempts to incorporate climate change risks into the BVI (henceforth termed "Green BVI"). Sustainability and financial stability are increasingly recognized to be closely intertwined.[5] ASEAN+3 banks, in particular, are highly affected by both physical and transition risks of climate changes (Wong, Gabriella, and Durrani 2022). Assessments of banks' greening efforts could shed light on potential disruptions to their balance sheets should economies transition too abruptly toward low or no greenhouse gas emissions.

The findings indicate that ASEAN+3 banks and banking systems have generally become more resilient following the GFC. The improvement could be attributable to the suite of regulatory reforms that were introduced in the wake of the crisis, to strengthen the global banking system, as well as banks' own desire to build greater buffers against future shocks. The BVIs did worsen during the COVID-19 pandemic, following the take-up of additional leverage by borrowers. The profitability of banks was also negatively affected by the deterioration in asset quality, as they were forced to increase provisions on top of the losses in revenue. From a climate change perspective, ASEAN+3 banks do not appear to be making any uniform effort in tackling such risks. Hence, there is room for a joint regional undertaking to cut back on credit to non-environmentally friendly sectors.

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[3] The banks covered hold more than 70 percent of the region's aggregate loans and overall assets. The estimation of funding sources considers all forms of deposits, plus securities financing and subordinated borrowings.

[4] This paper presents findings on various groups of banks to illustrate the uses of BVIs, given the potential sensitivity in relation to reporting of individual bank data.

[5] For instance, the Financial Stability Board (FSB) has published a roadmap to address climate-related financial risks (FSB 2021). Separately, the Basel Committee on Banking Supervision (BCBS) issued principles for the effective management and supervision of climate-related financial risks last year (BCBS 2022).

The rest of the paper is structured as follows: Section II presents the methodology and data to construct the BVI. It is followed by the main findings on bank vulnerabilities in Section III. Section IV introduces climate change risks as an additional factor in the BVI and discusses the corresponding results. Section V concludes.

II. Methodology and Data

A. Adapting the CAMELS Rating System

The construct of the BVI is premised on the well-recognized, international CAMELS rating system used by bank supervisory authorities. The CAMELS acronym represents six factors, namely capital adequacy, assets, management capability, earnings, liquidity, and sensitivity to market risks.[6] It is well-documented that the individual category and composite CAMELS ratings have significant predictive power for future bank performance (Gaul and Jones 2021), and can inform supervisors about the vulnerabilities of banks, as well as areas that require better management of risks. Indeed, bank financial ratios have been found to be very useful for predicting bank failures (Lopez 1999; Crystal, Dages, and Goldberg 2002). Such a risk-based framework could support the authorities in taking action pre-emptively to enhance banks' resilience when necessary (BCBS 2018).[7]

This paper extends existing work on assessing bank soundness. Specifically:

- It analyzes the health of individual banks—both listed and unlisted—relative to selected benchmarks, as an extension to Ong, Jeasakul, and Kwok (2013), and in contrast to Ong and Gabriella (2020), who use aggregate, system-wide indicators.

- It includes a much more comprehensive set of indicators compared to those used by Ong, Jeasakul, and Kwok (2013) and Ong and Gabriella (2020), to ensure better representation within each BVI factor, and consequently, allow more detailed analyses of designated risk areas. The choice of indicators not only considers relevance for banks' resilience, but also whether they display easily interpretable relationships with bank vulnerabilities.

Consistent with those papers, this paper extends coverage beyond the conventional CAMELS factors to account for vulnerabilities attributable to high and rising leverage that had resulted in crises in the past. An additional factor "Ł" representing "leverage" is introduced (Figure 1) to better represent credit risks. As lending activities continue to dominate banks' business profiles, leverage risk remains the primary source of shock threatening individual banks' stability. The importance of "Ł" becomes more salient alongside the elevation of risk appetite during property market booms and/or higher leverage take-up

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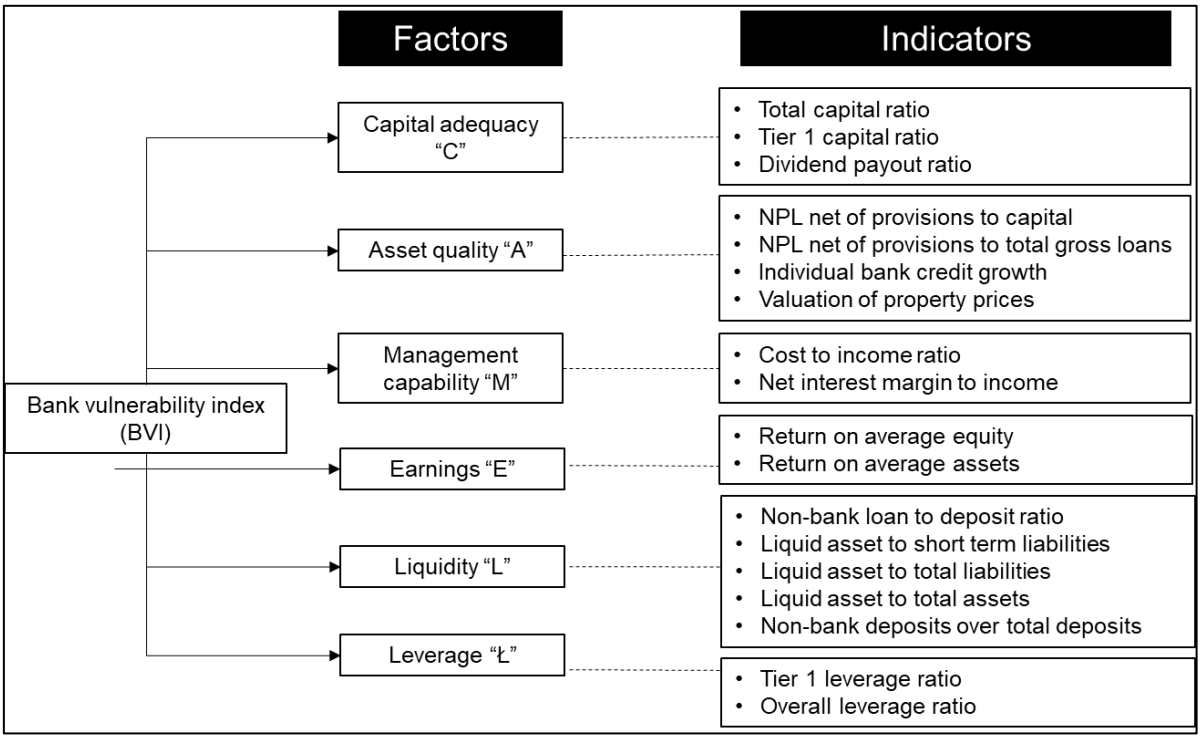
[6] The CAMELS rating system was originally developed in the United States to classify a bank's overall condition. In 1979, the Uniform Financial Institutions Rating System (UFIRS)—which subsequently became internationally known by the abbreviation CAMEL—was implemented for US banking institutions at the recommendation of the US Federal Reserve. In 1995, the Federal Reserve and the Office of the Comptroller of the Currency replaced CAMEL with CAMELS, adding the "S."

[7] For some supervisory authorities in the region that may have shifted from CAMELS to more sophisticated risk-based assessment frameworks—such as the Bangko Sentral ng Pilipinas (BSP), whose Supervisory Assessment Framework (SAFr) consider not only banks' risk profiles by also their impact on the financial system (BSP 2020)—the BVI could still be used as a supplementary tool to check for robustness of assessment.

during the pandemic. In the paper, bank-level leverage indicators are used to estimate "Ł". However, in the absence of reliable information on individual banks' exchange rate, interest rate, and derivative positions, any analysis on market sensitivity—the "S" in CAMELS—is necessarily excluded.[8]

Figure 1. BVI Analytical Framework



Source: Authors.

The information content captured in the multiple indicators is ultimately amalgamated into a single index—the BVI. Following the approach set out in Ong, Jeasakul and Kwoh (2013), the CAMEL plus "Ł" dimensions are aggregated into an equally-weighted index, which provides a first pass overview and enables a simple and easily operationalized assessment of individual banks' health. The key step to constructing BVIs is the standardization of indicators using z-scores, which facilitates comparability across banks:

$$z = (x-\mu)/\sigma$$

where x refers to the actual data for the factor or indicator examined; and μ and σ represent the selected benchmark group's mean and standard deviation, respectively.

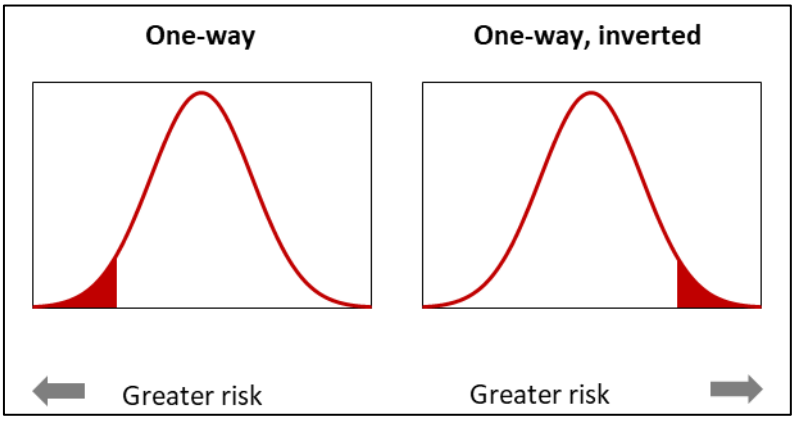
The indicators could be classified into two broad categories, namely "one-way" and "one-way, inverted" indicators, depending on the nature of those indicators (Figure 2). The corresponding z-scores are interpreted as follows:

- "One-way" (the more negative the z-score is from the Benchmark, the greater the risk); or

[8] Granular information on foreign exchange rate/currency mismatches (e.g., differences between foreign currency denominated liabilities and assets) and equity price risks (net open position in equities to capital) is not available for individual banks in the BankFocus database.

- "One-way, inverted" (the more positive the z-score is from the Benchmark, the greater the risk).

Figure 2. BVI: Interpretation of z-Scores



Source: Authors.

The signs of all the indicators are standardized to enhance clarity in interpretation. The z-scores of all "one-way, inverted" variables are multiplied by "-1." The BVIs are calculated based on percentiles corresponding to z-scores, on the assumption that the indicators are normally distributed (Appendix I).[9] Hence, all the BVI scores can be easily compared, to facilitate the vulnerability assessment of each bank. Lower BVIs for a bank relative to a particular benchmark group reflect higher vulnerabilities compared to its peers; conversely, higher BVIs indicate lower vulnerabilities in a bank relative to its peers. The BVI does not estimate the probability of a bank failing,[10] it only indicates whether a bank is weaker or more sound than its chosen peer group average across a range of metrics.

With the BVIs, analyses could be conducted at different levels of aggregation. Investigations at the indicator, factor, bank, economy, regional, and even global levels are possible. All estimations, from the lowest denomination (i.e., indicator level) to the highest denomination (i.e., global level), are based on equal weightings. Also, at the broader levels (i.e., economy, regional, and global levels), equal weights ensure that the large banks do not have an outsized impact on the estimates. Nonetheless, alternative estimates based on weights by loan amounts are also produced for comparison purposes. For instance, BVIs at the economy level consider the size of individual bank balance sheets and BVIs at the regional level take into account the size of each banking sector.

Several benchmark groups are constructed to evaluate the evolution of relative bank soundness. Comparisons can be made both over time and at a particular point in time. In the latter, a bank's vulnerabilities would be juxtaposed against pre-defined peer groups similar to those listed in Ong and Gabriella (2020); they may belong to the same economy, region, economic development level, or be of similar size or systemic importance (Table 1). The maximum historical data series available are used to provide sufficiently large benchmark

[9] Alternate estimations based on non-parametric percentiles, in the event that the z-scores are not normally distributed, are also available upon request.

[10] See Arregui and others (2013) for methodology for estimating the probability of a banking crisis in a particular country.

sample sizes for the BVIs; other benchmark period options, such as rolling 5-year and 10-year windows, are also estimated.

B. Data Description and Caveats

This paper analyzes annual bank data from 2013–22, published in BankFocus, a Moody's Analytics database. The time dimension of data facilitates historical comparisons, including assessments of whether an individual bank's performance has improved over time. While half the banks have published their 2022 financial statements at the time of publication of this paper, the rest have only published their 2021 financial statements, and are expected to publish their 2022 results during the remainder of this year.

The ASEAN+3 banking sectors are well covered in the BVI analyses. A total of 595 commercial banks across the 14 ASEAN+3 economies are included in 2022.[11] These banks account for more than 70 percent of both the total loans and overall assets (which include loans, securities, and other forms of reserves) of the aggregate ASEAN+3 banking sector. In addition to the more systemically important and larger banks, many of the smaller, regional banks are also captured in the sample. Among the assessed banks, D-SIBs and large banks account for 15 percent by count but represent more than 75 percent of total loans and total assets.

The computation of bank BVIs incorporates both bank- and economy-level information. Specifically:

- Financial information on individual banks balance sheets are obtained from the Moody's Analytics BankFocus database, which combines information from multiple sources—such as bank financial statements, spot and credit default swap markets, major credit rating agency' assessments, as well as ownership structures from merger and acquisitions (Moody's Analytics 2022). The database standardizes reported figures across all banks to facilitate peer comparisons.

- Statistics of financial and macroeconomic indicators for the various economies, such as overall banking sector loans, GDP, and property prices are sourced from public domains, namely, national authorities, the Bank for International Settlements (BIS), the IMF, and the World Bank, mainly via Haver Analytics.

There are a few other caveats in the evaluation of banks' vulnerabilities using the constructed indices, mainly in relation to data limitations. They include:

- Absence of qualitative information. Only quantitative information is incorporated in the BVIs. For instance, bank characteristics that are not easily quantified, such as heterogeneous business functions, presence of parent support, strength of guarantor support, substitutability of business products, interconnectedness with other banks, and quality of banking supervision and regulation are not incorporated within the BVIs.

- Inconsistent samples. While the construction of BVIs has standardized the computational steps and information types, there is little consistency in the depth and

[11] The number of banks covered includes the ones that have yet to publish their 2022 financial statements but have reported their 2021 financial information.

breadth of coverage across banks and countries over time. The sample is bound by the information available each year, which has grown alongside an increase in public disclosure requirements.

Table 1. Benchmark Groups and Coverage

Level	Benchmark Group	Coverage
Individual bank	Bank history	The individual bank's historical performance.
Banking sector	Domestic banking sector	All the banks residing in a particular economy.
	Domestic systemically important banks (D-SIBs)	All the D-SIBs residing in a particular economy. Note: This benchmark is only available for economies that have implemented the D-SIB framework, where the authorities have already designated certain banks as D-SIBs.
	D-SIBs and large banks	All the banks covered by "Domestic D-SIBs", plus large banks in a particular economy. Large banks are defined as banks that either (i) rank as one of the top five banks in the economy, based on asset size, and (ii) have a total bank asset size that exceeds five percent of the economy's GDP. Note: The definition of "large bank" could vary from year to year, depending on whether either of these conditions are fulfilled.
Region	ASEAN+3	All the banks residing in ASEAN+3 region.
	ASEAN+3 development level peers	All the banks residing in ASEAN+3 economies that are of equivalent economic development level. The ASEAN+3 economies are categorized into four economic development levels, namely: (1) advanced economies (AEs); (2) international financial centers (IFCs); (3) emerging market economies (EMEs); and (4) low-income developing countries (LIDCs). The classifications for ASEAN+3 economies are as follows: • AEs ─ Japan and Korea; • IFCs ─ Hong Kong and Singapore; • EMEs ─ Brunei, China, Indonesia, Malaysia, the Philippines, and Thailand; and • LIDCs ─ Cambodia, Lao PDR, Myanmar, and Vietnam.
Global	Global development level peers	All the banks residing in economies that are of equivalent economic development level world-wide. Similar to the group "Equivalent ASEAN+3 peers", the economies are classified and mapped into four peer groups (i.e., AEs, IFCs, EMEs, and LIDCs), which are aligned with the definitions used in IMF's Fiscal Monitor (IMF 2022b) and Pogliani and Wooldridge (2022). Note: Please refer to Appendix II on the more detailed mapping of economies.
	G-SIBs	All the G-SIBs identified by the BCBS. Note: The Financial Stability Board (FSB) publishes an updated list of G-SIBs annually (FSB 2022), based on the methodology published by BCBS (2013).
	Top 30 banks	The top 30 banks by asset size in the world. Note: The top 30 banks could vary from year to year.

Source: Authors.

Also, the interpretation of BVIs is in relative rather than absolute terms is worth noting. A higher BVI score simply reflects lower levels of vulnerabilities when compared to a specific benchmark group but does not necessarily indicate lower credit risks for the bank or banking sector in absolute terms. For instance, a weak bank with lower capital adequacy ratios and less healthy balance sheets could still attain a good BVI score when comparisons are made against peers that are even less sound. The choice of appropriate benchmark groups should be dependent on the objectives of any analysis. For example, if the aim is to assess the performance of a particular bank within a homogeneous environment, then the appropriate benchmark group would be the banks in a domestic economy. If interest likes in the performance of a particular bank among its global peers, then banks of similar size or from countries of similar development level should be selected, and so forth.

III. Analysis

A. Regional Overview

The resilience of ASEAN+3 banking sectors has increased over the past decade, relative to their global peers. Compared to the rest of the world with similar economic development levels, the majority of ASEAN+3 banking sectors have higher BVI scores in 2022 than 2013, relative to their global peers by development level (Table 2), despite experiencing some deterioration in their financial soundness during the COVID-19 pandemic (Table 3). ASEAN+3 LIDC banks, which had weaker BVI scores from 2013 to 2015, compared to their LIDC counterparts, showed improving performance over time up to 2022. The health of ASEAN+3 banks is generally expected to remain robust, in line with the region's economic growth (Fitch Ratings 2022).

The observed improvements in BVIs could be attributable in part to banks' efforts in enhancing risk management practices and strengthening of regulatory frameworks, in accordance with guidelines prescribed in the relevant Basel requirements (BCBS 2023). Compared to a decade ago, the banks in the region are visibly less vulnerable in two areas (Table 4), namely:

- ***Capital adequacy*.** Many ASEAN+3 jurisdictions have adopted, or are in the process of adopting, the Basel III framework to strengthen the capital requirements of their banks (BCBS 2021). At the onset of the pandemic, some regulators imposed caps on bank dividends (Bank of Thailand 2020; Monetary Authority of Singapore 2020; Trang 2022), which supported the retention of capital during a period of heightened uncertainties.[12]

- ***Leverage*.** ASEAN+3 banks' leverage profiles have improved as a result of the implementation of the Basel III framework, which restricts excessive on- and off-balance sheet leverage (BCBS 2014).

That said, bank balance sheets did deteriorate during the pandemic. The worsening in asset quality and profitability among banks in the region were unsurprising, but the provision of liquidity eased the pressure on balance sheets. Specifically:

[12] The recent episode at Credit Suisse, in which Additional Tier 1 (AT1) bonds were wiped out, is expected to result in the tightening of regulations for replenishing capital through the issuance of such bonds (Segar 2023).

Table 2. ASEAN+3: BVI Heatmap, Benchmarked against Global Peers, by Development Level
(Percent)

Peer group	Economy	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AE	JP	48	50	50	50	50	49	49	48	48	49
	KR	50	50	50	50	51	50	49	47	47	47
EME	BN	51	52	51	51	52	52	52	51	51	51
	CN	48	48	49	48	48	48	47	48	48	49
	ID	50	49	49	50	50	50	50	50	51	52
	MY	49	49	50	50	51	51	52	51	52	52
	PH	50	49	49	49	50	50	50	48	50	50
	TH	47	47	49	50	50	50	50	49	50	50
IFC	HK	52	56	55	57	56	54	55	53	55	55
	SG	53	53	53	53	54	51	49	46	47	47
LIDC	KH	57	55	57	56	55	54	54	53	53	53
	LA	41	39	40	49	49	53	51	51	53	51
	MM	40	35	37	41	45	46	45	44	46	46
	VN	48	48	49	49	45	46	47	48	47	47
ASEAN+3 average		**49**	**49**	**49**	**50**	**50**	**50**	**50**	**49**	**50**	**50**

Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: The latest BVIs reported are preliminary, given that some banks might only publish their 2022 annual reports towards the end of 2023. BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam. The benchmark group is "Global development level peers" in Table 1.

Table 3. ASEAN+3: BVI Heatmap, Benchmarked against ASEAN+3 Peers
(Percent)

Peer group	Economy	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AE	JP	44	45	45	46	46	46	46	45	45	47
	KR	45	45	46	47	48	48	47	46	44	45
EME	BN	50	56	54	52	52	52	53	53	54	54
	CN	49	49	49	46	46	46	46	46	46	47
	ID	52	50	50	52	53	53	53	51	53	54
	MY	50	50	49	51	53	53	53	50	52	53
	PH	52	49	49	50	52	53	53	48	52	52
	TH	48	48	49	52	52	52	52	48	49	51
IFC	HK	50	54	53	56	55	54	55	54	56	56
	SG	49	50	50	50	51	49	47	44	46	46
LIDC	KH	54	53	53	54	54	54	53	52	51	51
	LA	53	47	48	49	47	47	49	49	50	48
	MM	45	38	45	47	47	47	46	46	47	48
	VN	53	50	51	54	49	50	50	50	49	50
ASEAN+3 average		**49**	**49**	**49**	**50**	**50**	**50**	**50**	**49**	**50**	**50**

Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: The latest BVIs reported are preliminary, given that some banks might only publish their 2022 annual reports towards the end of 2023. BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam. The benchmark group is "ASEAN+3" in Table 1.

Table 4. ASEAN+3: BVI Factor Heatmap, Benchmarked against Global Peers, by Development Level
(Percent)

BVI Factor / Indicator	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Capital adequacy	**46**	**46**	**47**	**50**	**49**	**49**	**48**	**48**	**49**	**50**
Total capital ratio	45	44	45	48	48	49	48	48	49	49
Tier 1 capital ratio	45	45	46	49	48	48	46	47	48	48
Dividend payout ratio	54	52	52	53	49	51	51	50	50	50
Asset quality	**49**	**49**	**51**	**52**	**54**	**53**	**51**	**47**	**50**	**51**
NPL ratio net of capital	47	48	47	49	45	49	50	49	49	50
NPL net of provisions to total gross loans	60	52	57	56	55	54	54	51	51	51
Individual bank credit growth	50	49	49	47	51	52	51	51	53	52
Valuation of property prices	41	52	54	60	62	54	49	31	46	54
Management capability	**46**	**48**	**49**	**49**	**48**	**48**	**48**	**48**	**49**	**48**
Cost to Income ratio	45	48	49	49	49	48	48	48	49	48
Net interest margin to income	48	48	48	48	48	49	48	49	49	48
Earnings	**55**	**53**	**52**	**52**	**53**	**54**	**54**	**51**	**52**	**53**
Return on avg equity (ROAE)	57	55	53	52	53	54	53	52	52	53
Return on avg assets (ROAA)	53	51	51	52	54	54	54	51	52	52
Liquidity	**52**	**53**	**53**	**52**	**51**	**51**	**51**	**51**	**52**	**50**
Non-bank loan to deposit ratio	52	52	52	52	52	52	52	52	52	52
Liquid asset to short term liabilities ratio	47	48	48	48	48	48	48	48	48	48
Liquid asset to total liabilities ratio	52	53	54	52	50	49	48	49	50	49
Liquid asset to total asset ratio	43	45	42	42	41	40	39	41	43	39
Non-bank deposits over total deposits ratio	69	67	67	65	64	65	65	66	65	64
Leverage	**45**	**44**	**44**	**47**	**46**	**47**	**47**	**48**	**47**	**47**
Tier 1 leverage ratio	44	43	44	46	46	47	47	48	48	48
Overall leverage ratio	45	43	43	46	46	47	47	47	47	47

Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: The latest BVIs reported are preliminary, given that some banks might only publish their 2022 annual reports towards the end of 2023. The benchmark group is "Global development level peers" in Table 1.

- ***Asset quality.*** At the onset of the pandemic, both the household and corporate sectors experienced a deterioration in their balance sheets. Concerns about household financial soundness arose from the sharp spikes in unemployment rates as economic activity slumped (AMRO 2021). Correspondingly, corporate revenues were impacted as a result of mobility restrictions and physical containment measures. There could also be "hidden" NPLs on bank balance sheets as well, as a result of the regulatory forbearance measures that were introduced, and which remain in place in some economies.

- ***Liquidity.*** The government had introduced a range of support measures, including cutting policy rates, easing loan requirements, and facilitating greater access to business financing, to tide over the cashflow difficulties of individuals and firms, as well as provide liquidity to the banking system. These measures were effective as temporary lifelines to the borrowers, but appear to have boosted overall credit (Ho and Ong 2022).

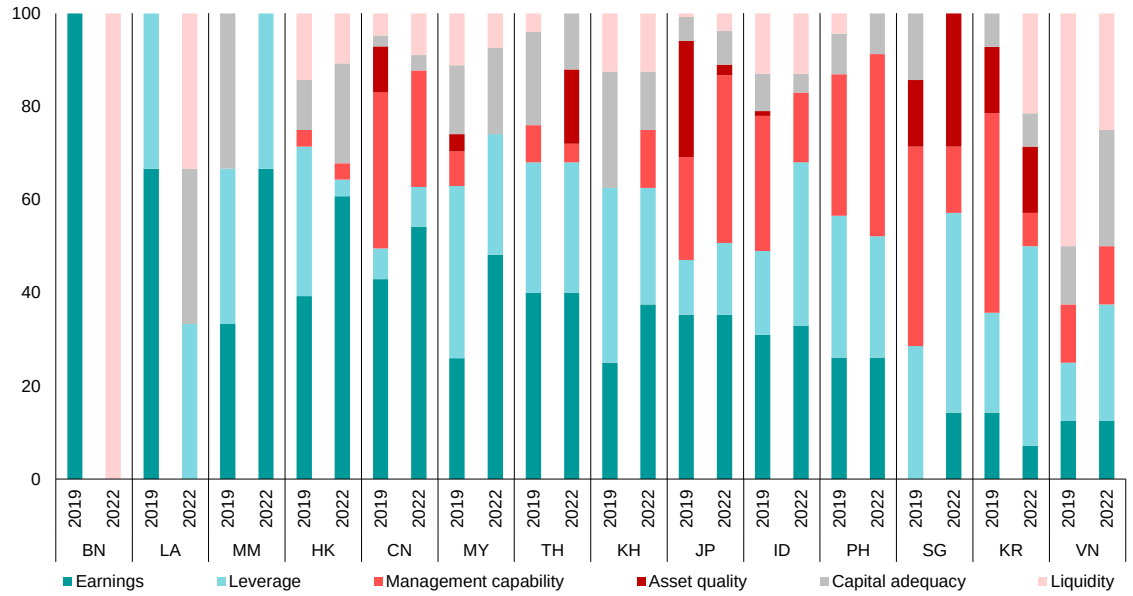
- ***Earnings.*** Low profitability in the banking sector appears to have become a long-term phenomenon, a byproduct of the prolonged low interest rate environment before the sharp reversal in monetary policy stance since 2022. Net interest margins were compressed because bank loans were extended at low interest rates, while deposit rates remained relatively stable with an effective zero lower bound (Hack and Nicholls 2021; Monetary Authority of Singapore 2021). The pandemic further stressed bank earnings, through lost revenues and increased provisions when credit risks spiked.

While the pandemic led to a weakening in banks' financial positions, the event did not appear to have caused any major structural adjustment within the ASEAN+3 banking sectors. Earnings were already among the weakest links pre-pandemic (Figure 3). Also, asset quality remains one of the better performing indicators (Figure 4), recovering rather quickly from the adverse effects of the pandemic. While the pandemic could have had scarring effects on the debt-servicing capacity of borrowers, the stepping up of provisioning for possible loan losses, highlighted by Loh (2020), has improved NPL ratios net of provisions, resulting in better bank asset quality ratings. The results also suggest that any change in transactional trends may have offset one another. For instance, social distancing measures promoted an increase in share of cashless transactions, but card payments were fewer with increased cash hoarding (CPMI 2021).

B. Domestic Bank Groups

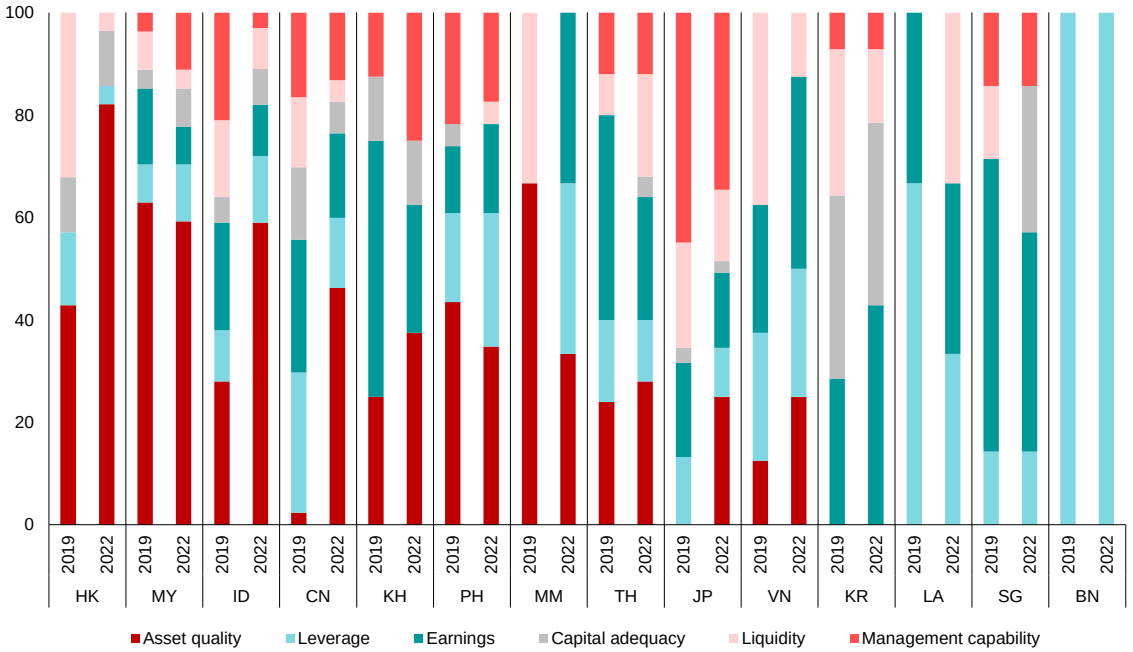
Unsurprisingly, heterogeneities exist within each banking sector. The median BVIs for individual banks differ across economies, as do the range of their distribution (Figure 5). The statistics also reflect the business composition and concentration within each banking sector. Interestingly, D-SIBs and large banks are not necessarily more resilient than the other banks, despite being subject to the Basel Committee's rules for the implementation of the D-SIB framework to guard against systemic risks (BCBS 2012b) (Figure 6). Indeed, only a few economies show more than half of their D-SIBs and large banks performing better than the economy median (Figure 7). Given the myriad risks to and vulnerabilities of ASEAN+3 banks, it is obvious that no one-size-fits-all surveillance and policy approach would be sufficiently robust, in particular for economies with more diverse banking sectors.

Figure 3. ASEAN+3: Share of Most Vulnerable BVI Factors, 2019 vs. 2022
(Percent of domestic banking sector)



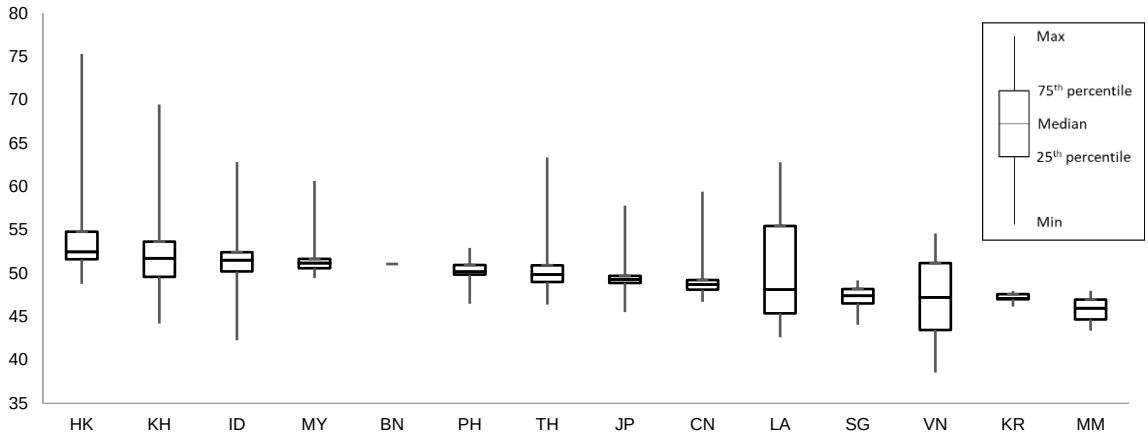
Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam. The BVIs for the economies are computed relative to their individual domestic banking sectors.

Figure 4. ASEAN+3: Share of Most Resilient BVI Factors, 2019 vs. 2022
(Percent of domestic banking sector)



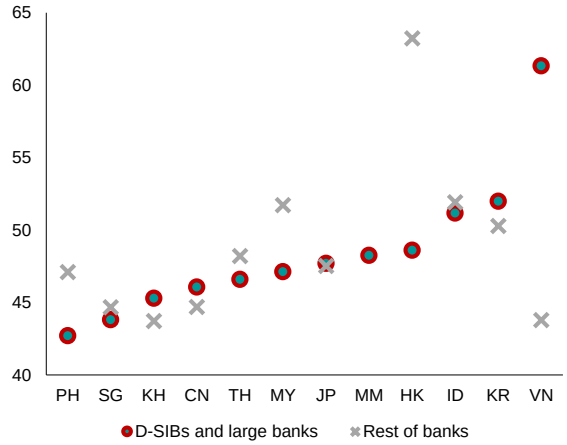
Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam. The BVIs for the economies are computed relative to their individual domestic banking sectors.

Figure 5. ASEAN+3: BVI Distribution, Benchmarked against Global Peers, by Development Level, 2022
(Percent)



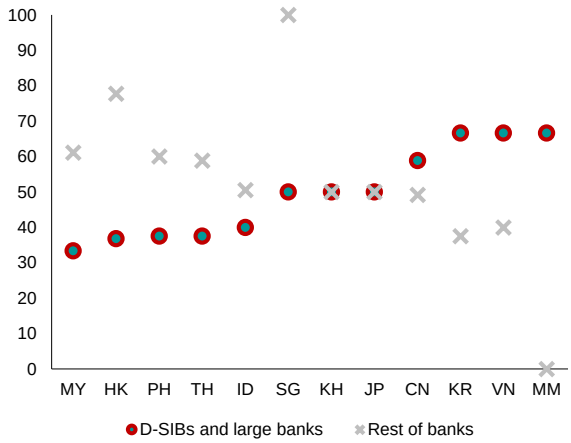
Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: The latest BVIs reported are preliminary, given that some banks might only publish their 2022 annual reports towards the end of 2023. BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam.

Figure 6. Selected ASEAN+3: Median BVI by Bank Size, 2022
(Percent)



Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam. The BVIs for the economies are computed relative to their individual domestic banking sectors.

Figure 7. Selected ASEAN+3: Share of Banks with Higher-than-Median BVI by Bank Size, 2022
(Percent)



Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam. The BVIs for the economies are computed relative to their individual domestic banking sectors.

Two areas, namely management capability and leverage, are the key weaknesses of D-SIBs and large banks. These major banks appear to be more vulnerable than their smaller counterparts in more than half of ASEAN+3 economies (Table 5 and Appendix III). A reason why the D-SIBs and large banks could be more vulnerable is that they tend to be expected to shoulder the national mandates. Some governments rely on the more systemically important banks to manage liquidity in the economy or intermediate credit to the more vulnerable segments, in some cases because of their state-owned affiliations/ownership structures. Micro, small and medium enterprises (MSMEs) are well recognized as a group that is underserved by the conventional banking sector (Wignaraja and Jinjarak 2015), and the government typically provides support to such firms through the major banks.

Table 5. ASEAN+3: BVI Factors in which D-SIBs and Large Banks are Less Resilient Benchmarked against Own Domestic Banking Sector, 2022

(Percent)

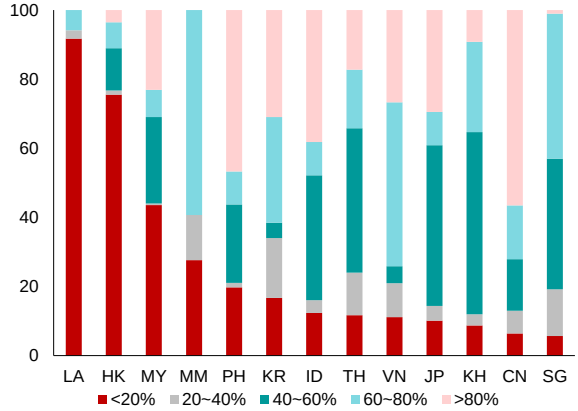
BVI Factor/ Indictor	AE		EME					IFC		LIDC				Average ASEAN+3
	KR	JP	CN	ID	MY	PH	TH	HK	SG	KH	LA	MM	VN	
Capital adequacy				✓	✓	✓		✓	✓	✓				43
Total capital ratio				✓	✓	✓	✓	✓		✓				43
Tier 1 capital ratio			✓	✓	✓	✓	✓	✓		✓				50
Dividend payout ratio					✓	✓		✓	✓					29
Asset quality			✓		✓		✓	✓					✓	36
NPL ratio net of capital				✓	✓	✓	✓	✓						36
NPL net of provisions to total gross loans							✓	✓					✓	21
Individual bank credit growth				✓		✓							✓	21
Valuation of property prices														
Management capability	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	71
Cost to Income ratio	✓	✓	✓	✓	✓	✓	✓	✓		✓			✓	71
Net interest margin to income	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	79
Earnings								✓						7
Return on avg equity (ROAE)														
Return on avg assets (ROAA)		✓						✓	✓					21
Liquidity			✓	✓	✓	✓		✓					✓	43
Non-bank loan to deposit ratio			✓	✓				✓					✓	29
Liquid asset to total liabilities ratio				✓	✓	✓	✓	✓					✓	43
Liquid asset to total asset ratio			✓	✓	✓	✓	✓	✓					✓	50
Non-bank deposits over total deposits ratio	✓	✓	✓	✓		✓		✓	✓				✓	57
Non-bank deposits over total deposits ratio	✓	✓	✓	✓		✓		✓	✓				✓	57
Leverage	✓	✓		✓	✓	✓	✓	✓	✓	✓				64
Tier 1 leverage ratio	✓	✓		✓	✓	✓	✓	✓		✓				57
Overall leverage ratio	✓	✓		✓	✓	✓	✓	✓	✓					57

Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.

Note: The latest BVIs reported are preliminary, given that some banks might only publish their 2022 annual reports towards the end of 2023. BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam. The BVIs for the economies are computed relative to their individual domestic banking sectors. A "√" means that the median BVI of D-SIBs and large banks falls below that of other banks.

In other words, the more vulnerable group of banks could indeed pose systemic concerns. In several economies, banks in the lowest BVI quintile hold a disproportionately large share (that is, greater than 20 percent) of banking sector assets and loans (Figures 8 and 9). In the event of a shock, assets that may need to go on fire sale could be sizable and have large impact on market prices (Greenwood, Landier and Thesmar 2015). Minimally, credible supervisory and crisis stress tests should be developed for these banks (Ong and Pazarbasioglu 2013), in particular those identified to be the weaker ones, to ensure adequate levels of capital and liquidity buffers well over current regulatory requirements.

Figure 8. Selected ASEAN+3: Share of Assets by BVI Percentile, 2022
(Percent)



Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
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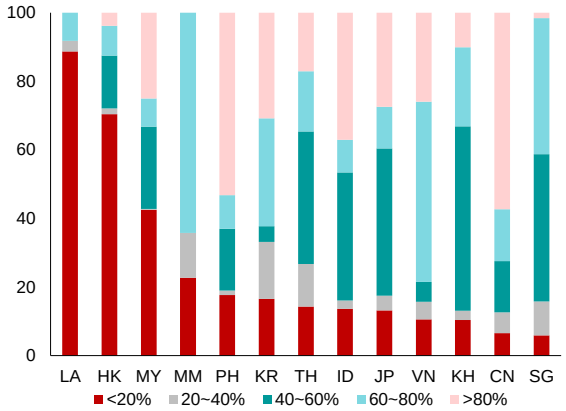
Figure 9. Selected ASEAN+3: Share of Loans by BVI Percentile, 2022
(Percent)



Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam. The BVIs for the economies are computed relative to their individual domestic banking sectors.

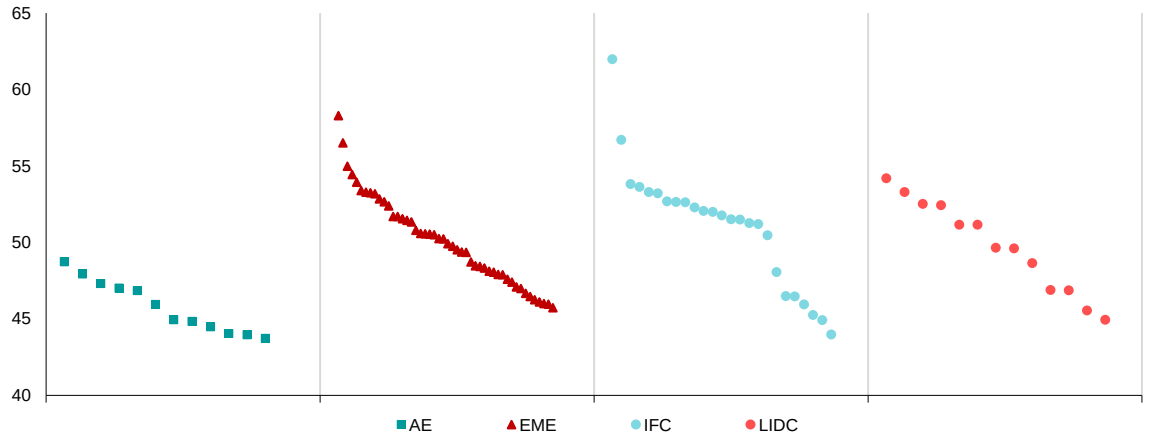
C. Individual Banks

It is important to identify the areas of improvement for D-SIBs and large banks, given the potential systemic risks that they might pose to their respective domestic banking sectors. In this instance, the identities of the major banks in each ASEAN+3 economy are anonymized to avoid implicating any particular institution for market sensitivity reasons. For illustration purposes, each bank is assessed against all its peers in the region, and grouped by development levels.

It is encouraging that the major ASEAN+3 banks are not the weakest links in this region. Despite some of the more systemically important banks in ASEAN+3 falling within the most vulnerable set of banks within their domestic economies, they still have BVIs above the 40th percentile (Figure 10). Amongst the D-SIBs and large banks in ASEAN+3, the ones in AEs appear to be less sound in relative terms. Specifically, their BVIs are all below the 50th percentile among the region's banks, albeit still above the 43rd percentile, while the major banks in other development groups are distributed above and below the rest of the banks in the region and all are at around the 43rd percentile or higher. The performance of the major AE banks is most tightly bunched (43rd–48th percentile), while that of the major IFC banks are most dispersed (43rd–62nd percentile).

Figure 10. Selected ASEAN+3: D-SIB and Large Bank BVIs, Benchmarked against ASEAN+3 Peers, 2022

(Percent)



Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: The latest BVIs reported are preliminary, given that some banks might only publish their 2022 annual reports towards the end of 2023.

The five worst-performing D-SIBs and large banks in each peer group show clear trends and differences in their vulnerabilities. A closer look at their CAMEL ratings and contributing indicators (Table 6) reveal the following:

- ***Capital adequacy*.** While the capital adequacy BVIs of the D-SIBs and large banks in ASEAN+3 are generally above the 40th percentile, there are two major banks (one each from among EMEs and IFCs) with capital adequacy BVI scores that are below the 35th percentile. The higher dividend payout ratios appear to have weighed on their respective capital adequacy indices. That said, both total and Tier 1 capital adequacy ratios remain generally sound for the major banks in ASEAN+3.

- ***Asset quality*.** Major AE and IFC banks have particularly low BVI scores for asset quality, whereas the banks in EMEs and LIDCs show a more resilient picture. The latter group faces higher credit risks originating from a general overvaluation of their respective property sectors rather than from any deterioration in credit quality. In such circumstances, banks can mitigate risks by adopting more prudent decisions toward awarding construction and/or mortgage loans.

- ***Management capability*.** The D-SIBs and large banks in EMEs have the lowest BVI scores for management capability. They are attributable to the higher cost-to-income indicator, highlighting less efficient operations relative to their counterparts. The "less efficient" banks could potentially explore high tech solutions (e.g., FinTech), which has been found to generate cost savings for the banks and improve accessibility for the lower income groups at the same time (Jahan and others 2018).

- ***Earnings*.** Earning BVIs of major ASEAN+3 banks are mostly above the 40th percentile, with the exception of one IFC and two LIDC banks. For these banks, the returns on assets appear weak while their returns on equity seem comparable to ASEAN+3 peers, implying higher leverage take-up rates amongst the three banks. Higher funding costs, worse-off cost-to-income ratios, and higher problem loans are also several other factors that could weigh on the earnings of these banks (Xu, Hu, and Das 2019).

- ***Liquidity*.** Liquidity is one of the weakest links for the ASEAN+3 D-SIBs and large banks, particularly for the EME banks, registering an average BVI liquidity factor score below the 40th percentile. Their liquid-asset-to-total-asset indicators—which provide an indication of the liquidity available to meet expected and unexpected demands for cash—are particularly weak. The major banks in EMEs have a lower share of non-bank deposits than the others in ASEAN+3. Implicitly, most of these EME banks could be obtaining their funding from less stable sources, such as the interbank markets (Gobat, Yanase, and Maloney 2014).

- ***Leverage*.** A few major LIDC banks fall below the 40th percentile, mainly attributable to their weaker Tier 1 leverage ratios. These banks hold less Tier 1 capital (i.e., common equity, retained earnings, and reserves) compared to their consolidated exposures that include both on- and off-balance sheet exposures. As these banks' Tier 1 capital profiles also do not perform better than average, accumulation of more Tier 1 capital would improve both capital adequacy and leverage BVI scores.

IV. Green BVI

This paper also estimates a "Green BVI," which incorporates climate change risks, to monitor their impact on ASEAN+3 banks. The identification, measurement, and assessment of these risks to the banking sector have become an important priority, as evidenced by the participation of many ASEAN+3 authorities in the Network for Greening the Financial System (NGFS) and the commitment of banks in the region to the Glasgow Financial Alliance for Net Zero (GFANZ) (Wong, Gabriella, and Durrani 2022). Further, a considerable share of ASEAN+3 bank loans could face significant transition risks going forward (Urgewald 2022).

Three indicators are used to represent the extent of "greenness" among ASEAN+3 banks. The indicators are discussed in Wong, Gabriella, and Durrani (2022) and comprise:

- ***Environmental, Social and Governance (ESG) ratings.*** The ratings reflect individual banks' resilience to physical and transition risks; their risk management and mitigation strategies are also taken into consideration. The credit ratings are sourced from the Moody's Analytics CreditView database.[13]

- ***Share of climate change related loans.*** The climate change-related loans refer to the sectors that are most affected by climate change risks, as identified by the Emissions Database for Global Atmospheric Research (EDGAR), notably: (1) agriculture, forestry, and other land use (AFOLU); (2) buildings; (3) energy systems; (4) industry; and (5) transport. The bank loans statistics are obtained from the national authorities, via Haver Analytics.

- ***Emissions per loan.*** A larger carbon intensity ratio (i.e., carbon dioxide (CO2) emission per dollar of loan) represents larger transition risks for banks (Faiella and Lavecchia 2020). The figures are estimated using CO2 emission statistics from EDGAR as the numerator and identified climate change-related loans from the authorities as the denominator.

[13] The Moody's Analytics ESG ratings include banks' corporate governance practices, such as their transparency of reporting and disclosures on environmental and social risks (Moody's Analytics 2022). However, qualitative information on banks' business practices, such as sourcing and procurement, could be assessed separately to complement BVIs, which are quantitative in nature.

Table 6. Selected ASEAN+3: Worst-Performing D-SIB and Large Bank BVIs, Benchmarked against ASEAN+3 Peers, 2022

(Percent)

BVI factor	AE banks						EME banks						IFC banks						LIDC banks					
	1	2	3	4	5	Average	1	2	3	4	5	Average	1	2	3	4	5	Average	1	2	3	4	5	Average
BVI factor	**43.7**	**43.9**	**44.0**	**44.5**	**44.8**	**44.2**	**45.7**	**46.0**	**46.0**	**46.1**	**46.3**	**46.0**	**44.0**	**44.9**	**45.2**	**45.9**	**46.5**	**45.3**	**44.9**	**45.5**	**46.9**	**46.9**	**48.6**	**46.6**
Capital adequacy	**50.3**	**45.7**	**43.3**	**43.8**	**44.2**	**45.5**	**50.4**	**51.9**	**31.3**	**51.8**	**49.5**	**47.0**	**48.0**	**35.5**	**48.9**	**45.6**	**45.0**	**44.6**	**46.0**	**50.9**	**43.3**	**41.9**	**39.8**	**44.4**
Total capital ratio	48.4	48.9	48.8	48.5	48.6	48.6	48.2	48.2	48.4	48.3	48.2	48.3	48.7	48.7	49.4	48.8	48.7	48.8	47.5	50.9	47.2	47.4	48.0	48.2
Tier 1 capital ratio	45.8	47.4	46.7	46.2	46.7	46.5	45.1	45.1	45.4	45.2	45.1	45.2	47.3	47.6	48.5	47.1	46.5	47.4	44.4		42.3	42.7	45.2	43.7
Dividend payout ratio	56.7	40.8	34.6	36.6	37.2	41.2	58.1	62.5	0.0	61.9	55.3	47.5		10.2		41.0	40.0	30.4			40.4	35.5	26.3	34.1
Asset quality	**38.8**	**36.3**	**36.3**	**36.4**	**36.3**	**36.8**	**50.8**	**50.8**	**51.1**	**51.0**	**50.9**	**50.9**	**34.1**	**38.5**	**25.5**	**34.1**	**38.3**	**34.1**	**45.4**	**50.0**	**50.8**	**47.7**	**34.1**	**45.6**
NPL ratio net of capital	46.5					46.5	51.0	51.1	51.3	51.2	51.1	51.1		51.3			51.1	51.2	42.1	49.1		50.8	0.4	35.6
NPL net of provisions to total gross loans	51.6	51.8	51.6	51.7	51.7	51.7	51.2	51.4	51.1	52.2	51.7	51.5	51.3	51.8		51.3	51.0	51.3	43.2	51.5		41.2	51.4	46.8
Individual bank credit growth	50.8	50.9	50.9	51.0	50.8	50.9	51.0	50.8	50.8	50.8	50.8	50.9	50.8	50.8	50.8	50.7	50.7	50.8	50.8	49.4	50.8	51.1	50.5	50.5
Valuation of property prices	6.4	6.4	6.4	6.4	6.4	6.4	49.9	49.9	51.3	49.9	49.9	50.2	0.2	0.2	0.2	0.2	0.2	0.2						
Management capability	**46.9**	**49.1**	**51.9**	**49.0**	**50.9**	**49.5**	**46.4**	**45.1**	**46.1**	**44.8**	**44.2**	**45.3**	**53.7**	**49.7**	**50.6**	**47.1**	**47.4**	**49.7**	**48.2**	**50.2**	**51.0**	**48.1**	**46.6**	**48.8**
Cost to Income ratio	44.6	49.0	54.6	48.7	52.6	49.9	43.6	41.0	43.1	40.4	39.1	41.4	58.1	50.3	52.0	45.0	45.5	50.2	45.9	50.1	52.8	46.8	44.0	47.9
Net interest margin to income	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	50.5	50.4	49.2	49.3	49.2	49.7
Earnings	**49.3**	**45.3**	**46.4**	**50.5**	**50.0**	**48.3**	**44.4**	**48.3**	**55.2**	**48.2**	**52.2**	**49.6**	**37.5**	**56.5**	**49.0**	**55.8**	**53.9**	**50.5**	**34.3**	**37.9**	**52.7**	**59.5**	**80.3**	**53.0**
Return on avg equity (ROAE)	51.3	49.5	49.2	53.5	52.3	51.1	46.3	49.2	47.5	49.1	52.5	48.9	42.1	59.7	50.2	52.6	52.3	51.4	39.4	41.6	58.5	64.1	71.7	55.1
Return on avg assets (ROAA)	47.3	41.1	43.7	47.5	47.6	45.4	42.5	47.5	62.8	47.3	51.8	50.4	33.0	53.3	47.9	59.0	55.6	49.7	29.2	34.2	47.0	54.9	88.9	50.8
Liquidity	**33.4**	**45.3**	**43.2**	**45.2**	**44.7**	**42.4**	**35.8**	**33.3**	**45.2**	**34.5**	**35.5**	**36.9**	**47.5**	**47.8**	**53.5**	**49.1**	**48.9**	**49.4**	**56.7**	**36.6**	**50.7**	**46.2**	**43.6**	**46.7**
Non-bank loan to deposit ratio	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8
Liquid asset to short term liabilities ratio	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2
Liquid asset to total liabilities ratio	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.1	49.0	49.0	49.2	49.2	49.2	49.1	49.2	49.1	49.1	49.1	49.1	49.1
Liquid asset to total asset ratio	17.3	13.4	15.2	15.7	12.6	14.8	19.9	11.1	17.0	14.3	17.8	16.0	3.6	4.9	44.6	26.3	40.6	24.0	74.7	19.1	19.7	11.5	29.3	30.8
Non-bank deposits over total deposits ratio	0.6	64.3	51.6	61.4	62.0	48.0	10.1	6.4	59.9	9.4	10.8	19.3	85.0	84.9	73.9	70.2	55.0	73.8	59.6	14.7	84.5	70.4	39.8	53.8
Leverage	**43.7**	**41.9**	**43.1**	**42.0**	**42.9**	**42.7**	**46.5**	**46.3**	**47.2**	**46.2**	**45.3**	**46.3**	**43.0**	**41.4**	**43.8**	**44.0**	**45.1**	**43.5**	**39.1**	**47.5**	**32.7**	**38.0**	**47.4**	**40.9**
Tier 1 leverage ratio	38.9	35.6	37.9	35.8	37.5	37.2	44.3	43.9	45.5	43.7	42.0	43.9	37.8	34.8	39.3	39.6	41.7	38.6	30.6	46.3	32.7	28.3		34.5
Overall leverage ratio	48.4	48.2	48.3	48.2	48.3	48.3	48.7	48.7	48.9	48.7	48.6	48.7	48.2	48.0	48.4	48.4	48.5	48.3	47.7	48.7		47.6	47.4	47.8

Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: The latest BVIs reported are preliminary, given that some banks might only publish their 2022 annual reports towards the end of 2023.

The integration of climate change risk assessments within the BVI remains an exploratory exercise at this stage. Analyses could be refined as additional indicators are included over time, alongside the availability of more granular, well-defined data that allows better estimation of climate change risks. Additionally, there are two main caveats in the interpretation of Green BVI as follows:

- First, many of the gathered datasets on climate change risks for the purpose of this paper are limited to banks in ASEAN+3 economies. Hence, the analyses are only benchmarked against banks within each economy or the ASEAN+3 region. In the future, the scope of benchmarking could be expanded to include more peers worldwide.

- Second, the definition of climate change loans is limited to the type of data collected. As of now, reliable and comparable climate-related data are not easily available, which leads to difficulties in any precise estimation of firms' exposures to climate risks (Ferreira and others 2021). "Greenwashing" poses challenges to classifying "green borrowings," and increases the difficulty in constructing a consistent index on green investments—in renewable energy projects, projects that have positive social impact, or green bonds for cross-economy comparisons. Hence, the green factor estimates are only approximate figures, to provide initial assessments of implications for banks.

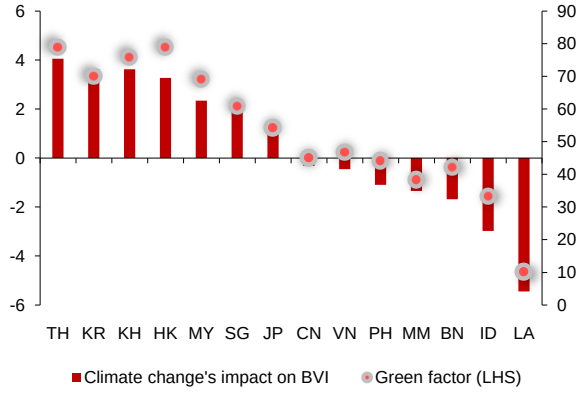
Preliminary findings are that ASEAN+3 banks address climate change issues differently. In some economies, considerable time and effort have been invested to chart a more sustainable future for the banking sector, but others are less active. The addition of a green BVI factor could increase median BVIs by up to 4 percentage points for some banking sectors, but decrease median BVIs by up to 6 percentage points for others (Figure 11). For economies with lower green BVI scores, the banking sectors could come under more pressure if additional emission taxes are introduced alongside the net-zero pledges.

Nonetheless, the efforts in reducing emissions per loan among most of the ASEAN+3 banking sectors are evident. Many economies in the region have BVI scores in relation to their emissions per loan indicator standing well above 50 percent (Figure 12). Emissions have fallen relative to loan growth, alongside national climate change strategies. For instance, Japan facilitated plans to align with its commitment to reduce greenhouse gases to zero (Japan Ministry of Economy, Trade and Industry 2020), while China pledged to achieve carbon neutrality before 2060, as part of its broader development goals (International Energy Agency 2021).

Some banks in the region have also cut back on their climate change-related loans. In particular, Thailand and Malaysia appear to have significant reduction in such loans (Figure 12). Meanwhile, the Bank of Thailand has partnered with the International Finance Corporation to encourage the financial industry to embark on more sustainable business practices (International Finance Corporation 2019). The focus on climate change issues in the region could mean more uniform efforts amongst the ASEAN+3 banks. For the benefit of the region, all the ASEAN+3 supervisors should eventually work toward integrating ESG initiatives as part of their policy frameworks, in terms of monitoring, disclosures, and

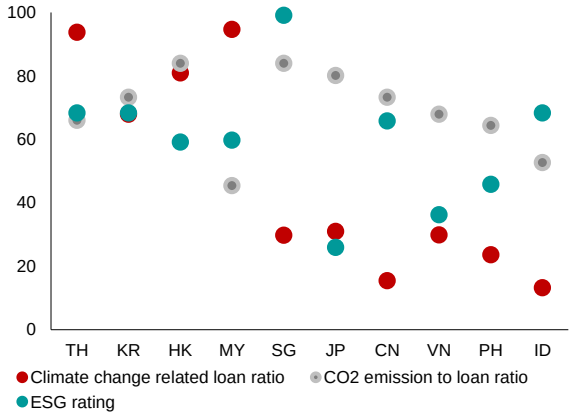
management of bank climate change risks.[14] Such regulations will lay a solid foundation to facilitate banks' climate change efforts and ensure a level playing field (BCBS 2022).

Figure 11. Selected ASEAN+3: Green BVI, Benchmarked against ASEAN+3, 2022
(Percentage points; Percent)



Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam.

Figure 12. Selected ASEAN+3: Green BVI Indicators, Benchmarked against ASEAN+3, 2022
(Percent)



Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: BN=Brunei; CN=China; HK=Hong Kong; ID=Indonesia; JP = Japan; KH=Cambodia; KR = Korea; LA=Lao PDR; MM=Myanmar; MY = Malaysia; PH = the Philippines; SG=Singapore; TH = Thailand; and VN = Vietnam.

V. Conclusion

In the last decade, banking sectors in the ASEAN+3 region have shown visible improvements in reducing their vulnerabilities. The strengthening in banks' financial soundness has been crucial, with central banks in the region currently hiking policy rates to combat intense domestic inflationary pressures, resulting in higher debt service costs for borrowers (Loh 2022). The uncertain economic outlook represents another risk to banks' asset quality. In this regard, the BVIs estimated in this paper may be a useful tool for surveillance and off-site bank supervision purposes. In the case of the latter, it could help pinpoint the nature of vulnerabilities, and inform more targeted micro-prudential measures with fewer unintended spillover effects. Such policies could also be calibrated to address the pain points, which would be more effective than a one-size-fits-all approach. From a resource allocation perspective, the BVIs can complement existing toolkits and help regulatory bodies channel their resources efficiently, by placing the emphasis on the more vulnerable segments.

The analysis in this paper reveals several trends in the region's banking sector. In particular, earnings have been lackluster for a majority of banks, possibly a function of the previously low interest rate environment and uncertainties in relation to the pandemic. However, for the larger, more systemically important banks, efforts to improve their management should be a priority, given that these banks display shortcomings in their resilience as compared to their smaller peers within the same economy. For the more vulnerable banks in the group, they should also work on enhancing their liquidity profiles. That said, the overview assessment of bank resilience provided by the BVI tool should not be taken as a standalone exercise. Rather, it should be supplemented with qualitative expert judgment and other types of

[14] For instance, authorities in Singapore and the Philippines have issued regulations or principles to integrate environmentally responsible and sustainable policies and work practices (MAS 2020b; BSP 2022).

analyses. Information on the concentration of exposures, confidence effects, differences in banks' operating models, and the banking system's crisis management framework and readiness are important considerations in determining a bank's ability to withstand shocks.

Appendix I. List of Indicators in BVIs

Appendix Table 1. BVI: List of Indicators

Factor	Risk	Indicator	Definition	Assessment	Interpretation of Indicator
Capital adequacy "C"	Measures the ability of the bank to withstand financial downturn, while largely maintaining its financial position.	Total capital ratio	Total regulatory capital (including Tier 1 and Tier 2 capital, such as revaluation reserves, subordinated term debt and undisclosed reserves) over risk-weighted assets.	• Strength of overall capital that can be used to absorb potential losses, considering the risk profile of bank's lending activities.	One-way
		Tier 1 capital ratio	Tier 1 capital (i.e., shareholders' equity and retained earnings) over risk weighted assets.	• Strength of primary source funding that can be used to absorb potential losses, considering the risk profile of bank's lending activities.	One-way
		Dividend payout ratio	Amount of dividends paid out to shareholders (both preferred and common) over net income.	• Sustainability of the bank's dividend practice, based on amount of potential increase in capital buffer set aside. • A lower cash dividend ratio means that the bank would have either (i) re-invested more of its earnings or (ii) expanded its business operations (i.e., increasing its capacity to lend) (Gambacorta, Oliviero and Shin 2020). Both of which do not equate to preserving higher capital ratio.	One-way, inverted
Asset quality "A"	Assesses the overall credit quality of the bank's assets, through the credit underwriting standards and lending/investment policies.	NPL net of provisions to capital	NPLs less the value of specific loan provisions over capital.	• Strength of the bank capital to withstand losses arising from the materialization of NPLs, considering the amount of provisions in place.	One-way, inverted
		NPL net of provisions to total gross loans	NPLs less the value of specific loan provisions over gross loans.	• Amount of loss loans on the bank's books, considering the amount of provisions in place.	One-way, inverted

Factor	Risk	Indicator	Definition	Assessment	Interpretation of Indicator
		Individual bank credit growth	Growth in total loans.	• Pace of increase in credit by the bank, where rapid credit growth suggests the take-on of greater risks. • Excessive credit growth can have a negative impact on bank soundness (Igan and Pinheiro 2011).	One-way, inverted
		Valuation of property prices*	Property price to GDP gap.	• Extent of property market momentum that is reflected in the fundamental macroeconomic expansion. • Many economies see an overvaluation of property prices as a signaling indicator for the build-up of cyclical systemic risk (BCBS 2010).	One-way, inverted
Management capability "M"	Measures the general administration's ability in making decisions to steer the bank towards growth.	Cost to income ratio	Operating expenses (e.g., staff salary, administrative expenses) over operating income.	• Efficiency of running a bank, based on how well a bank utilizes its operating resources to generate income. • A lower cost to income ratio means higher efficiency in the bank's day to day operations (Mesa, Sánchez, and Sobrino 2014).	One-way, inverted
		Net interest margin to income	Net interest margin (i.e., net interest income over average interest earning assets) over net income after taxes.	• Quality of a bank's income, based on share of revenue collected from the principal lending activities. • Higher share of bank's revenue derived from the lending activities means stability in cashflows. Should the share of non-interest income be sizable, it could be associated with volatilities in cashflows, given that such income is positively correlated with higher systemic risk for the banking sector (Brunnermeier, Dong and Palia 2020).	One-way
Earnings "E"	Measures the bank's ability to expand operations, while	Return on average equity	Net income over shareholders' equity.	• Financial performance of the bank, based on income creation per dollar of stockholders' equity.	One-way

Factor	Risk	Indicator	Definition	Assessment	Interpretation of Indicator
	remaining competitive in the market.	Return on average assets	Net income over average total assets.	• Financial performance of a bank, based on income creation per dollar of asset.	One-way
Liquidity “L”	Measures the adequacy of the bank’s liquid assets in meeting obligations as and when they come due, without the bank incurring substantial losses.	Non-bank loan to deposit ratio	Loans to non-bank customers over deposits from non-bank customers.	• Sufficiency of liquidity to cover unforeseen fund requirements arising from the default of non-bank borrowers.	One-way, inverted
		Liquid asset to short term liabilities	Liquid assets (including cash, loans to banks, reverse repos) over total deposits and short-term borrowings.	• Ability of a bank in meeting short-term withdrawal of funds without facing any liquidity problems. • A ratio of one or above means that a bank can fully pay off its current liabilities with its current assets.	One-way
		Liquid asset to total liabilities	Liquid assets (including cash, loans to banks, reverse repos) over total liabilities.	• Ability of a bank to pay off all obligations without facing any liquidity problems. • A ratio of one or above means that a bank can pay off all the liabilities with its current assets.	One-way
		Liquid asset to total assets	Liquid assets (including cash, loans to banks, reverse repos) over total assets	• Ability of a bank in meeting expected and unexpected demands for cash.	One-way
		Non-bank deposits over total deposits	Non-bank deposits (from households and corporates) over total deposits (including non-bank deposits and wholesale funding).	• Stability of funding for the bank. • A bank with larger share of deposits originating from stable sources (i.e., corporates and households) would face less market volatility than the ones obtaining more funding from the wholesale or capital markets (Roengpitya, Tarashev, and Tsatsaronis 2014).	One-way
Leverage “Ł”	Measures whether the build-up in leverage is supported by macroeconomic	Tier 1 leverage ratio	Tier 1 capital (i.e., shareholders' equity and retained earnings) over total assets.	• Ability of a bank to meet its financial obligations. • Assessment is based on the extent of the bank’s leverage relative to its total assets,	One-way

Factor	Risk	Indicator	Definition	Assessment	Interpretation of Indicator
	fundamentals or the individual bank's development.			considering only its Tier 1 assets that can be easily liquidated.	
		Overall leverage ratio	Total regulatory capital (including Tier 1 and Tier 2 capital, such as revaluation reserves, subordinated term debt and undisclosed reserves) over total assets.	• Ability of a bank to meet its financial obligations. • Assessment is based on the extent of the bank's leverage relative to its total assets, considering all of its assets that can be easily liquidated.	One-way

Sources: Ong, Jeasakul, and Kwok (2013); Ong and Gabriella (2020); and authors' compilation.
Note: * refers to indicators that are reflective of vulnerabilities only at the economy but not bank level.

Appendix II. Equivalent Peer Groups

Appendix Table 2. Mapping to Economies with Similar Economic Development

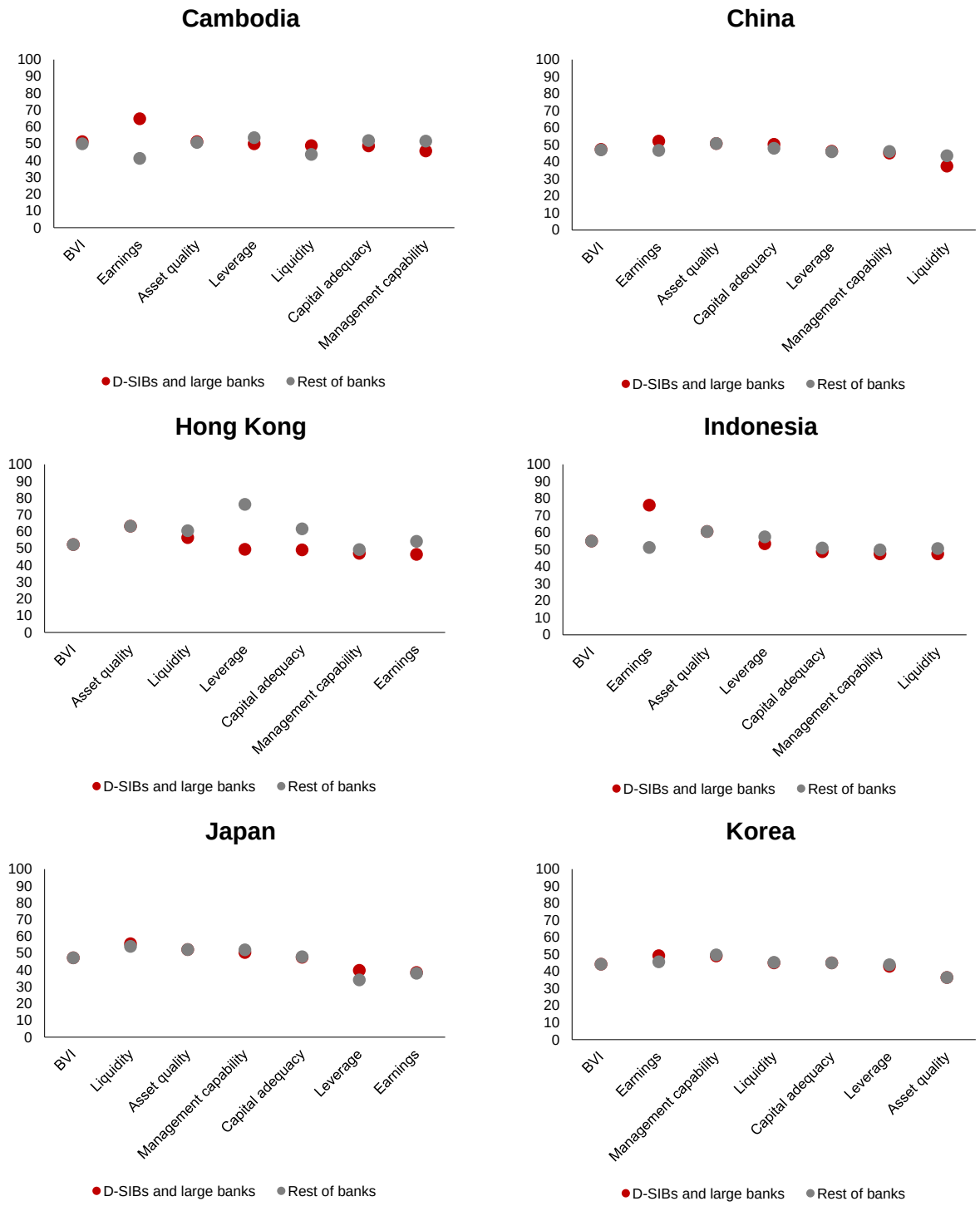
Group	AMRO Member	Economies Covered in BVI
AEs	• Japan • Korea	Andorra, Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Macao Special Administrative Region, Malta, Netherlands, New Zealand, Norway, Portugal, Puerto Rico, San Marino, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan Province of China, United Kingdom, and United States.
IFCs	• Hong Kong • Singapore	Bahrain, Barbados, Belgium, Bermuda, British Virgin Islands, Cayman Islands, Curacao, Cyprus, Gibraltar, Guernsey, Hong Kong, Ireland, Isle of man, Jersey, Lebanon, Liberia, Liechtenstein, Luxembourg, Malta, Marshall Islands, Mauritius, Nauru, Netherlands, Panama, Samoa, San Marino, Seychelles, Singapore, Switzerland, the Bahamas, United Kingdom, United States, and Vanuatu.
EMEs	• Brunei • China • Indonesia • Malaysia • The Philippines • Thailand	Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Aruba, Azerbaijan, Bahrain, Barbados, Belarus, Belize, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Cabo Verde, Chile, China, Colombia, Costa Rica, Croatia, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eswatini, Fiji, Gabon, Georgia, Grenada, Guatemala, Guyana, Hungary, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kosovo, Kuwait, Lebanon, Libya, Malaysia, Maldives, Marshall Islands, Mauritius, Mexico, Micronesia, Mongolia, Montenegro, Morocco, Namibia, Nauru, North Macedonia, Oman, Pakistan, Palau, Panama, Paraguay, Peru, Poland, Qatar, Romania, Russian Federation, Samoa, Saudi Arabia, Serbia, Seychelles, South Africa, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Syria, Thailand, the Bahamas, the Philippines, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Tuvalu, Ukraine, United Arab Emirates, Uruguay, Vanuatu, and Venezuela.
LIDCs	• Cambodia • Lao PDR • Myanmar • Vietnam	Afghanistan, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Republic of Congo, Côte d'Ivoire, Djibouti, Eritrea, Ethiopia, the Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, Honduras, Kenya, Kiribati, Kyrgyz Republic, Lao PDR, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Moldova, Mozambique, Myanmar , Nepal, Nicaragua, Niger, Nigeria, Papua New Guinea, Rwanda, São Tomé and Príncipe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Tajikistan, Tanzania, United Republic of, Timor-Leste, Togo, Uganda, Uzbekistan, Vietnam, Yemen, Zambia, and Zimbabwe.

Sources: IMF's Fiscal Monitor (IMF 2022b); Pogliani and Wooldridge (2022); and authors.

Appendix III. Comparison of D-SIBs and Large Banks with the Other Banks

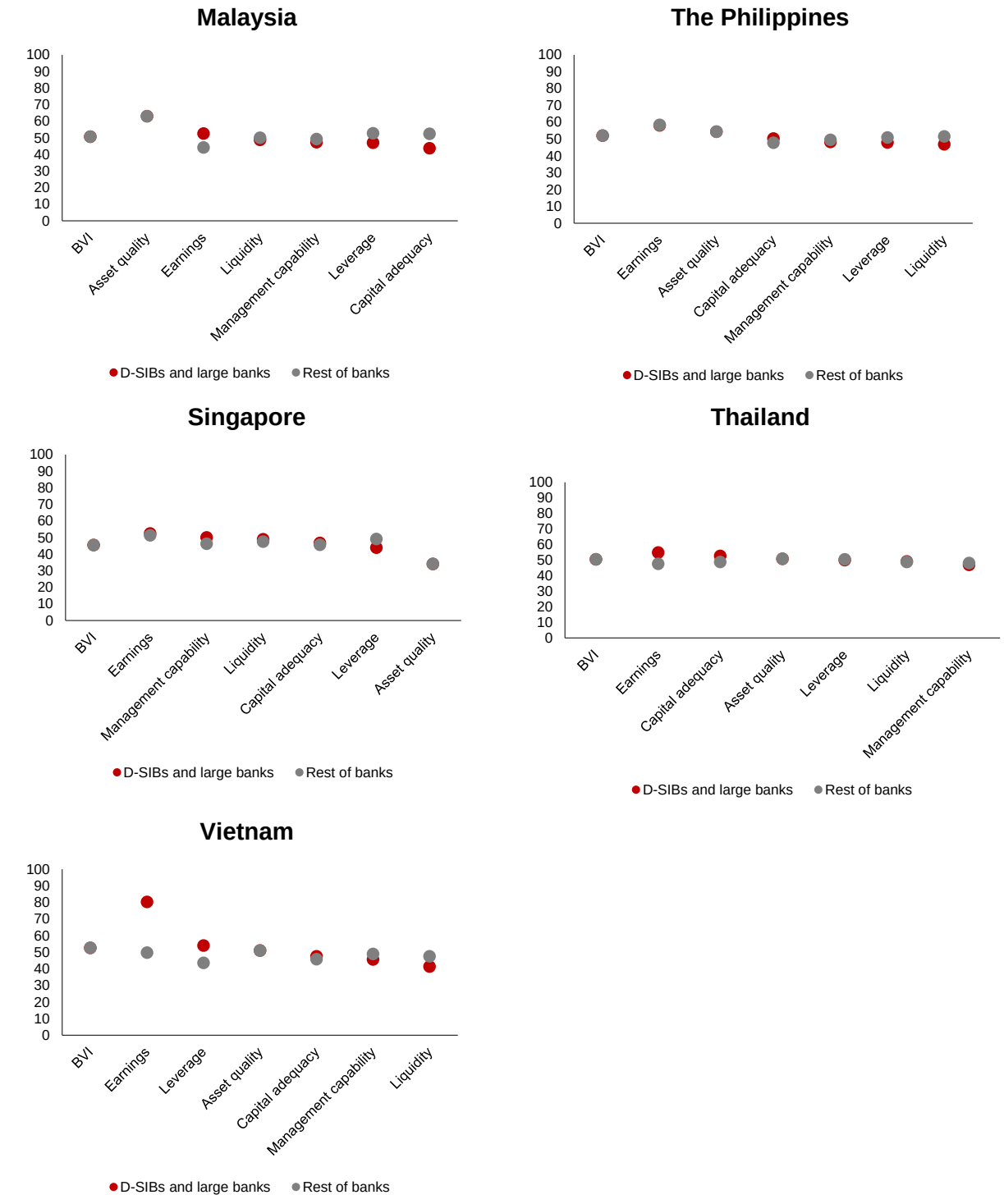
Appendix Figure 1. ASEAN+3: Median BVIs, Benchmarked against ASEAN+3 Peers, 2022

(Percent)



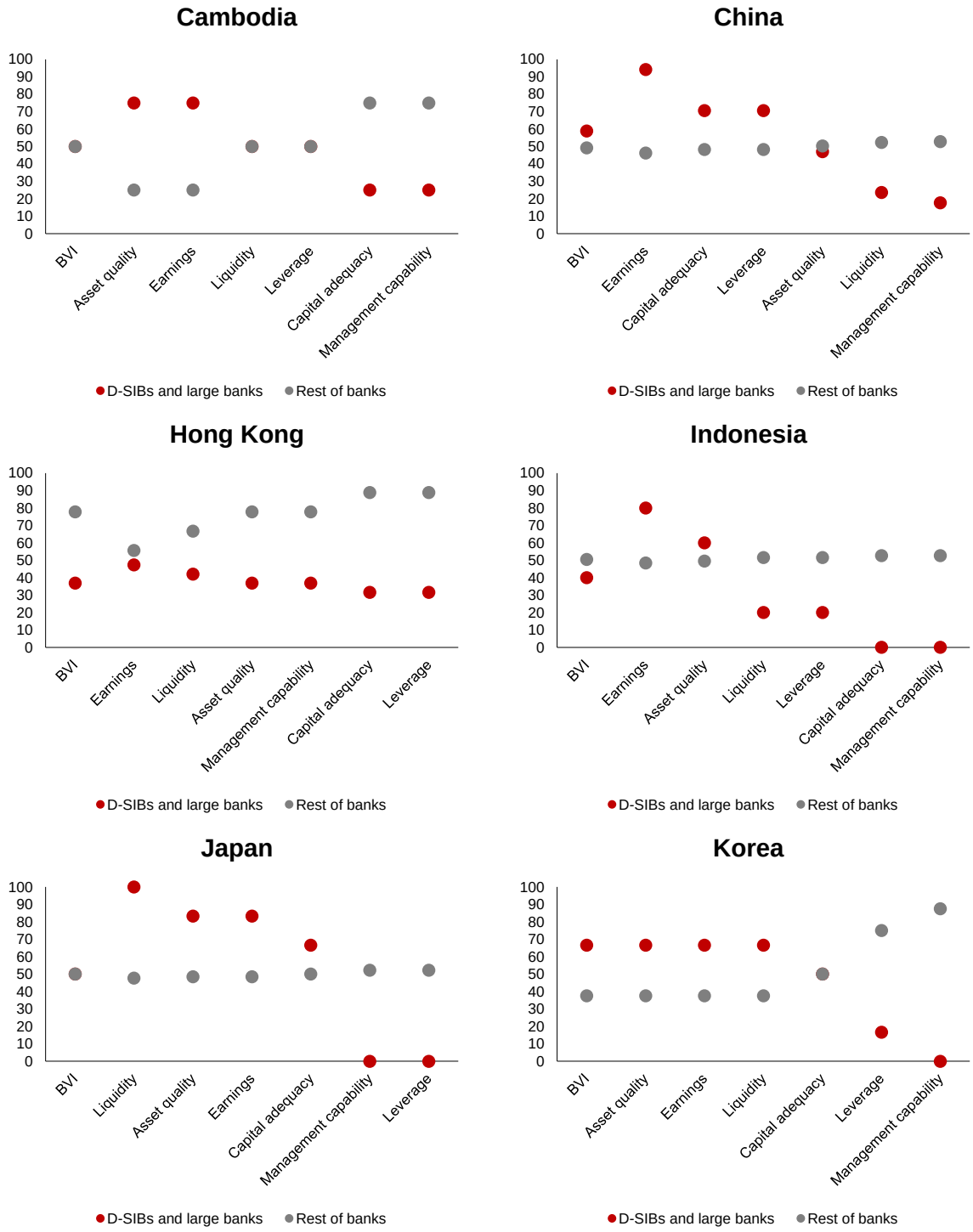
Appendix Figure 1. ASEAN+3: Median BVIs, Benchmarked against ASEAN+3 Peers, 2022

(Percent)

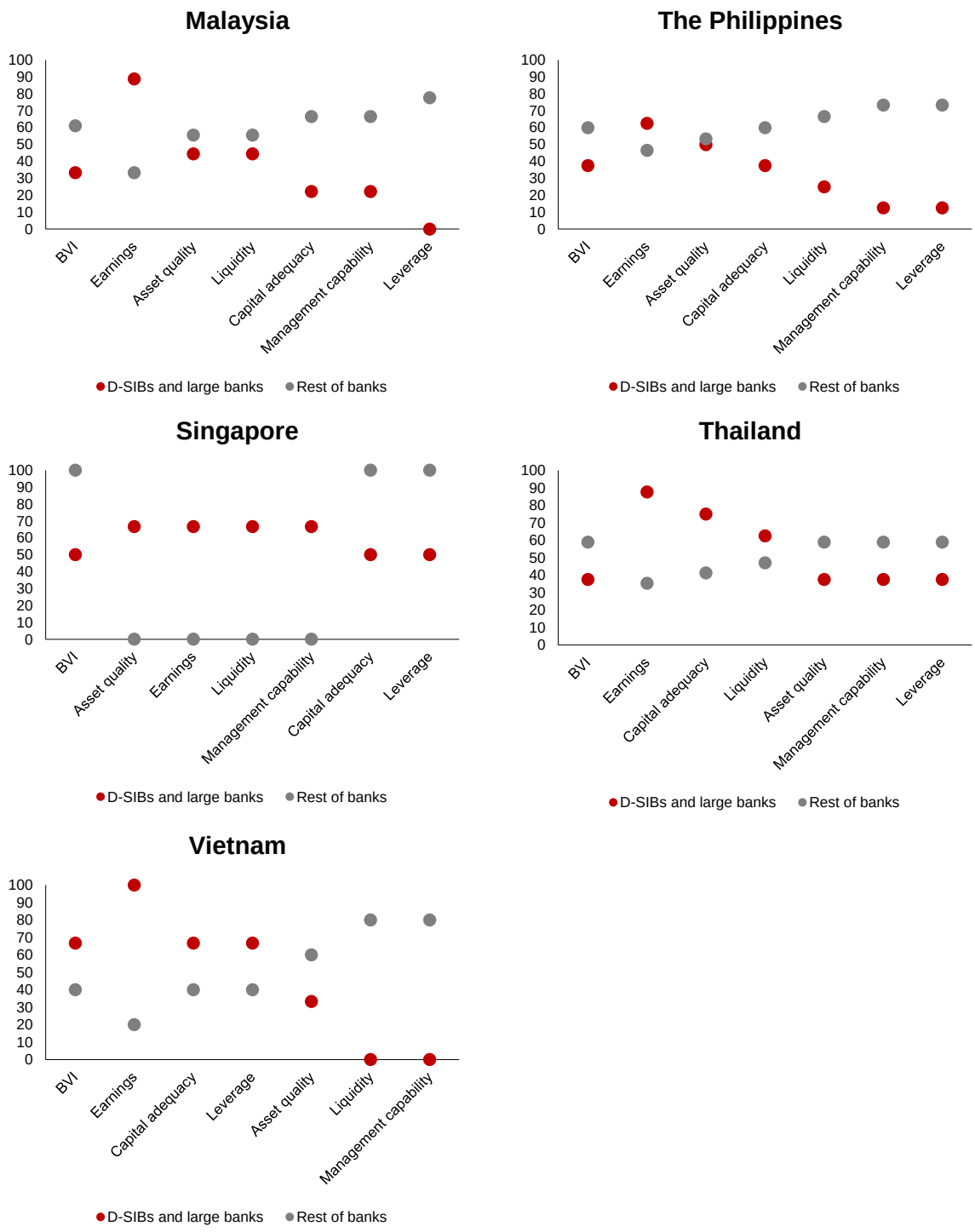


Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.

Appendix Figure 2. ASEAN+3: Share of Banks below the Median BVI, 2022 (Percent)



Appendix Figure 2. ASEAN+3: Share of Banks below the Median BVI, 2022 (Percent)



Sources: BIS; IMF; Moody's Analytics; national authorities; World Bank; and authors' estimates.
Note: The BVIs for the economies are computed relative to their individual domestic banking sectors.

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