The ERPD Matrix "Scorecard": Quantifying the Macro-Financial Performance of the ASEAN+3 Economies

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The ERPD Matrix "Scorecard": Quantifying the Macro-Financial Performance of the ASEAN+3 Economies[1]

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Abstract

The Economic Review and Policy Dialogue (ERPD) aims to **prevent** financial crises through the early detection of risks and vulnerabilities in ASEAN+3 economies and the swift implementation of remedial policy actions. If necessary, it serves as the foundation for providing immediate liquidity assistance to members in the event of a crisis, via the Chiang Mai Initiative Multilateralisation (CMIM). The ERPD Matrix, which is integrated into AMRO's surveillance framework, is aimed at supporting those objectives. The **ERPD Matrix Scorecard** is a tool that may be used for both surveillance and CMIM qualification purposes. It comprehensively quantifies a member's macro-financial performance—external, fiscal, monetary and financial— relative to that of its designated peer benchmark group, as well as rates the adequacy of data used. However, as with all quantitative methods, the reliability of the Scorecard results is dependent on data adequacy and methodology, and should always be analyzed in conjunction with those obtained using other tools, complemented by staff's expert judgment.

Abbreviations

AE	Advanced economy
ASEAN+3	Association of South-East Asian Nations, China, Japan and Korea
BIS	Bank for International Settlements
BRICS	Brazil, Russia, India, China, South Africa
CMIM	Chiang Mai Initiative Multilateralisation
CMIM-PL	Chiang Mai Initiative Multilateralisation Precautionary Line
eGDDS	Enhanced General Data Dissemination System
EME	Emerging market economy
ERPD	Economic Review and Policy Dialogue
EU	European Union
FCL	Flexible Credit Line
FSAP	Financial Sector Assessment Program
IFC	International financial center
IMF	International Monetary Fund
LIDC	Lower income developing country
LMIC	Lower middle income country
PLL	Precautionary and Liquidity Line
ROSCs	Reports on Standards and Codes
SDDS	Special Data Dissemination Standard

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"The combination of some data and an aching desire for an answer does not ensure that a reasonable answer can be extracted from a given body of data."

~ John W. Tukey
"Sunset Salvo"
The American Statistician 40 (1), 1986

I.   Introduction

Asset allocation by international investors, and hence capital flows, is a zero-sum game—one country's gain is another's loss. Investors make decisions on where to invest their funds and whether to under- or over-weight those investments in favor of others. In their "reach for yield" in the protracted low interest rate environment since the global financial crisis, investors have also become more discerning in sorting out the "wheat from the chaff" so as to not overlook attractive investment opportunities. As an example, this increased awareness was evident during 2013–14, when anticipation of a cut back in the U.S Federal Reserve's quantitative easing program raised concerns about a potential rout in emerging markets. Following the negative knee-jerk reaction towards emerging market economies (EMEs) in general (Figure 1), investors subsequently differentiated the countries based on their economic fundamentals, identifying a group of more fragile economies. Some of these countries addressed their vulnerabilities and investors eventually returned to their markets.

Figure 1. Emerging Market Capital Flows
(In billions of US dollars)
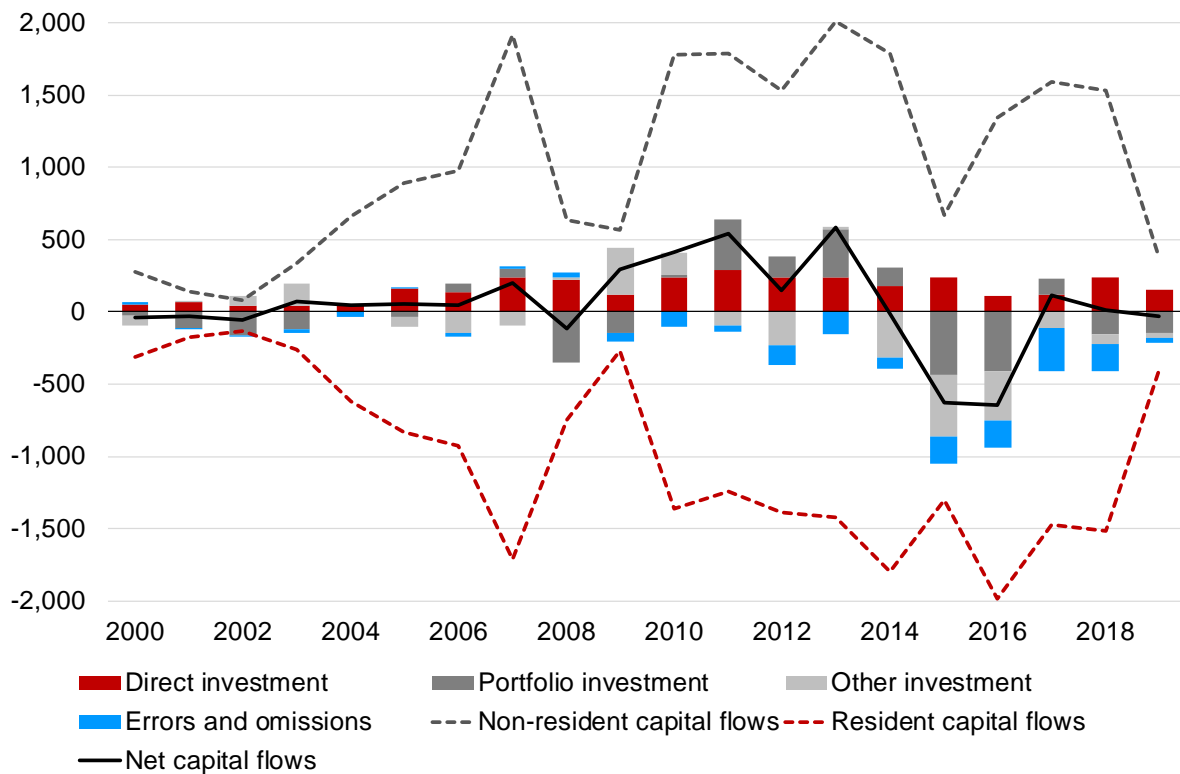
Sources: Institute for International Finance; and authors' calculations.

This emerging market stress event underscores the importance of the pragmatism of the ASEAN+3 Economic Review and Policy Dialogue (ERPD), whose objectives are to promote a solid economic foundation and sound financial system while providing a safety net against short-term volatility. The ERPD aims to **prevent** financial crises through the early detection of risks and vulnerabilities in member economies (hereafter "Members") and the swift implementation of remedial policy actions. However, Members recognize that while strong fundamentals and policies should ultimately prevail in sustaining investor confidence in a particular country, the neutralization of any short-term liquidity shock would be critical in bridging that confidence during tumultuous events that may be beyond the country's control. Hence, it is important to have a facility that provides short-term liquidity support for sound economies against volatile capital flows, given the tendency for investors to react first and reassess later. In such situations, the ERPD serves as the foundation for providing immediate liquidity assistance to Members via the Chiang Mai Initiative Multilateralisation (CMIM).

The **ERPD Matrix** is the operational manifestation of the ERPD objectives. It was initially introduced as a quantitative "scorecard" on financial stability, to be applied in determining access the crisis prevention facility, the CMIM Precautionary Line (CMIM-PL), which was established in 2012. The ERPD Matrix has since been enhanced and expanded to include both quantitative and qualitative analyses and currently consists of the following three components (Figure 2):

- a purely quantitative "scoring" of a suite of macro-financial indicators, representing pre-defined macroeconomic and financial soundness criteria for Members, relative to designated peer economies (hereafter "Scorecard");

- analyses from AMRO's regular bilateral surveillance of Members, i.e., the ongoing monitoring of risks to financial stability and the identification of vulnerabilities to those risks, which include both quantitative analytics and qualitative inputs; and

- qualitative assessments of Members' data adequacy and quality of financial supervision, which require significant expert knowledge and judgment.

The ERPD Matrix is integrated into AMRO's surveillance framework and also supports assessments for CMIM purposes. The convergence of the ERPD Matrix with AMRO's regular macro-financial surveillance of Members provides the basis for the in-depth analysis required for assessing qualification to access the CMIM-PL.[4]

This paper presents the framework and methodology for the first component of the ERPD Matrix described above—the Scorecard. In addition to its usefulness for surveillance purposes, the Scorecard "scores" the qualification Areas and Criteria for the CMIM-PL, where a Member's performance in pre-defined macro-financial indicators is measured against those of its **designated core peer group** (hereafter "Benchmark").[5] To elaborate, the Scorecard:

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[4] AMRO's role vis-à-vis the CMIM and the relevance of the ERPD Matrix to the latter may be found at https://amro-asia.org/about-amro/what-we-do/#missionandvision and https://amro-asia.org/joint-statement-of-the-22nd-asean3-finance-ministers-and-central-bank-governors-meeting/, respectively.

[5] AMRO has developed a web-based, interactive visualization tool, which is designed to generate regularly updated Scorecards for individual countries to ensure transparency and facilitate its implementation among

- represents a purely qualitative assessment of the current health of a Member's economic fundamentals and financial system;

- serves as a possible early-warning system of incipient risks to Members, identifying any trend deterioration in those economic fundamentals as well as in the soundness of the financial system, for subsequent deep-dives; and

- provides the basis for assessing a Member's qualification to access CMIM-PL support, but also the flexibility to take into account AMRO staff's analyses of characteristics and circumstances specific to Members.[6]

The use of a broad and diverse set of macro-financial indicators to gauge financial stability is not new. In the wake of the Asian Financial Crisis, Kaminsky, Lizondo, and Reinhart (1998), Kaminsky (1999), and Kaminsky and Reinhart (1999) introduced the use of univariate indicators to provide early warnings of currency and banking crises. Later studies on early-warning indicators include Alessi and Detken (2009), Rose and Spiegel (2010), Babecký and others (2011), and Frankel and Saravelos (2012).

The International Monetary Fund (IMF) has applied a wide collection of indicators in its Vulnerability Exercises for advanced economies (AEs) and EMEs. The latter serve as quantitative inputs into the confidential Early Warning Exercises with the Financial Stability Board (IMF, 2010a). Separately, IMF staff also developed the Global Financial Stability Map (Dattels and others, 2010b), which utilizes a suite of macro-financial variables to visually communicate changes in risks and conditions affecting global financial stability, which became a staple in the *Global Financial Stability Report* between 2007 and 2017. As a complement to the Global Financial Stability Map, IMF staff subsequently constructed a corresponding Country Financial Stability Map (Cervantes and others, 2014) for bilateral surveillance purposes.

As with all quantitative methods, the Scorecard is ultimately hostage to data adequacy across countries and the robustness of the chosen methodology. Hence, it should be emphasized that the Scorecard results are not fail-safe and should always be analyzed in conjunction with other analytical tools and expert judgment within the ERPD Matrix. The Scorecard will continue to be enhanced over time as countries improve the quality and coverage of their published data as well as their reporting frequency.

The paper is organized as follows. Section II discusses the analytical framework of the Scorecard and the datasets that are required to calculate the requisite indicators. Section III explains the "scoring" methodology, followed by a discussion of the data sources. Section IV presents some sample outputs of the Scorecard and possible extensions to the Benchmarks. Section V concludes.

Members. The tool is hosted on AMRO's surveillance platform, ARTEMIS, at https://artemis.amro-asia.org/sys/login?returnUrl=%2F.

[6] The CMIM qualification requirements are not discussed in this paper.

Figure 2. ERPD Matrix Framework
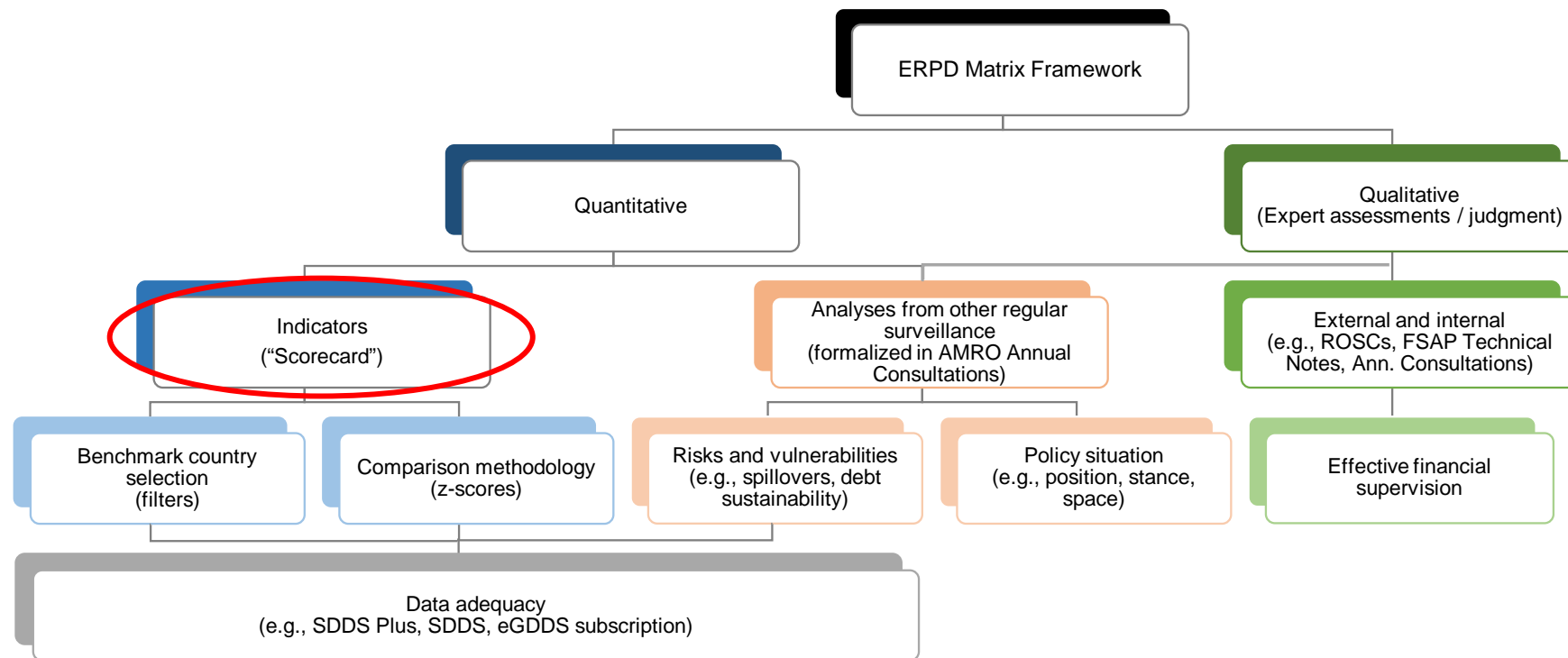
Source: AMRO.

II. Frameworks and Data

A. Assessment Framework

The ERPD Matrix **assessment framework** is based on five qualification Areas for the CMIM-PL as stated in the 2019 CMIM Agreement. These five Areas, common to general economic surveillance, comprise the external, fiscal, monetary and financial sectors, plus data adequacy. They are consistent with those covered by the IMF—the CMIM's potential co-financing partner in the swap arrangement—in determining qualification to access its own Flexible Credit Line (FCL) and the Precautionary and Liquidity Line (PLL) (IMF, 2012a, 2012b, 2014, 2015a, 2015b, 2017a, 2017b, 2018a, 2018b).[7] Borrowing from the **IMF's framework**, the five Areas are further refined into nine Criteria (Figure 3). AMRO's objective of aligning the ERPD Matrix framework with those applied to the IMF's liquidity facilities is to **minimize the risk of diverging independent assessments** between the two institutions in co-financing situations.[8]

The ERPD Matrix Scorecard methodology **differs** from the IMF's own assessment methodology. The Scorecard comprises two components:

- the "Indicator Scorecard," which explicitly quantifies a subset of these Areas and Criteria by statistically comparing selected macro-financial **Indicators** of members against those of their designated Benchmarks;[9]

- one qualitative Area and Criterion.

Specifically, the Scorecard consists of four **Levels** that are "averaged upwards" (Figure 3):

- **Level 1** quantifies **four of the Areas** defined by the IMF and the CMIM Agreement:

    I. external position and market access;

    II. fiscal position;

    III. monetary policy; and

    IV. financial sector soundness and supervision.

    plus the fifth (and qualitatively assessed) Area,

    V. data adequacy, which is characterized by whether or not a Member subscribes to the Special Data Dissemination Standard (SDDS).

    Under (IV), the quality of financial sector supervision requires qualitative expert judgment and is typically assessed by the IMF and World Bank through Reports on Standards and Codes (ROSCs), typically undertaken during Financial Sector

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[7]   See https://www.amro-asia.org/about-amro/amro-and-the-cmim/#overview.

[8]   See AMF/AMRO/EFSD/EC/ESM/FLAR (2018) and IMF (2017) on collaboration between Regional Financing Arrangements and the IMF.

[9]   The IMF does not explicitly score the indicators that are being assessed but rather, relies on its staff's expert judgment based on various analytics.

Assessment Programs (FSAPs) with member countries. It is excluded from the Scorecard but the findings could be included in any overall assessment.

- **Level 2** quantifies **seven of the nine Criteria** under the five Areas described above, namely:

  I.   External position and market access

       (i)   a sustainable external position;

       (ii)   a financial account position dominated by the private sector;

       (iii)   a track record of steady sovereign access to capital markets at favorable terms; and

       (iv)   a reserve position that remains relatively comfortable at the time of a precautionary request.

  II.   Fiscal position

       (v)   sound public finances, including a sustainable public debt position.

  III.   Monetary policy

       (vi)   low and stable inflation, in the context of sound monetary and exchange rate policies.

  IV.   Financial soundness and supervision

       (vii)   a sound financial system and the absence of solvency problems that may threaten systemic stability.

  As with Level 1, the *effective financial sector supervision* Criterion under the *financial sector soundness and supervision* Area is omitted from the Scorecard and incorporated into the overall analysis qualitatively. The *data transparency and integrity* Criterion under the *data adequacy* Area is also assessed qualitatively and determined by whether a Member subscribes to the SDDS or not.

- **Level 3** consists of one or more **Elements** under each Criterion, introduced to better categorize and score the various indicators that underpin the quantifiable aspects of the Scorecard.

- **Level 4** comprises one or more **Indicators** under each Element, which are derived from a combination of raw economic or financial variables.

The Scorecard compares each Member's economic and financial soundness performance and data adequacy against its designated **Benchmark**, to provide a **relative** overall view of financial stability. Comparator countries or jurisdictions should share similar characteristics in order to facilitate meaningful comparisons. A multi-layered framework is applied in selecting these constituents out of a possible 189 IMF and World Bank (International Bank for Reconstruction and Development) members, wherein filters are used to capture key characteristics (Figure 4):

Figure 3. ERPD Matrix Scorecard: Analytical Framework
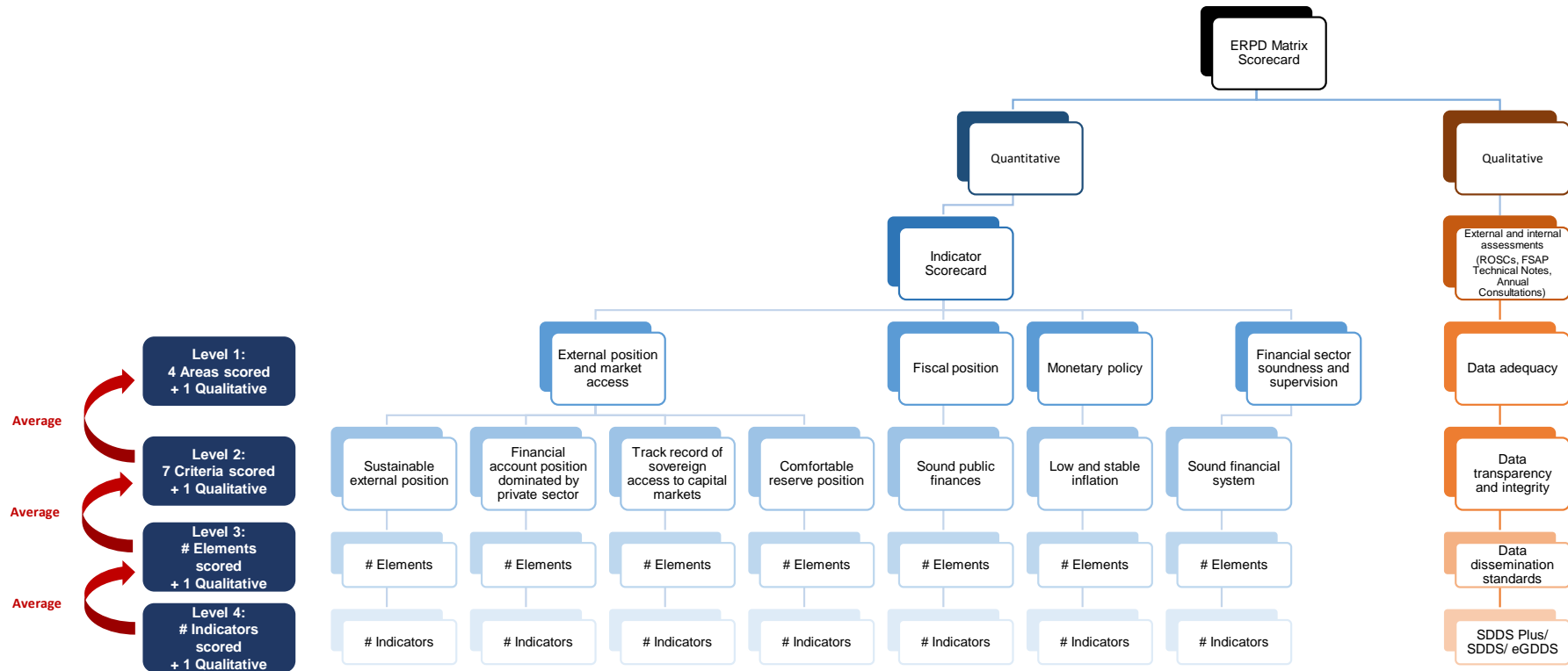
Sources: IMF; and AMRO.

Figure 4. ERPD Matrix Scorecard: Framework for Selecting Benchmark Constituents
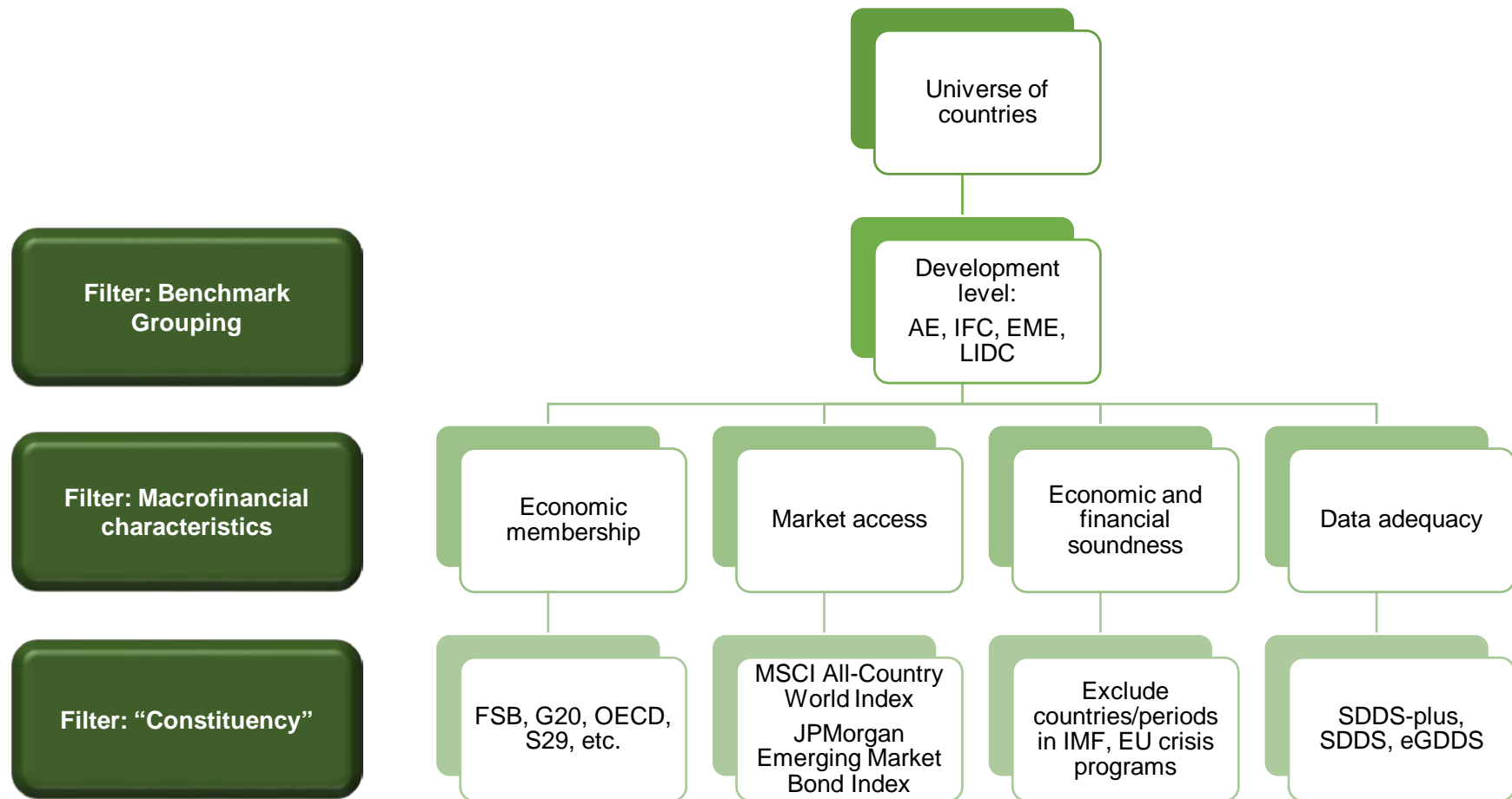
Source: AMRO.

- *Benchmark group.* The **Benchmarks** are categorized by development level, and Members are assigned to one of four core peer groups: AEs, international financial centers (IFCs), EMEs and low-income developing countries (LIDCs), as defined by the IMF (2018) and its World Economic Outlook (Table 1).

- *Macro-financial characteristics.* Features that are taken into account include the systemic importance of a country's financial sector and/or its role in global trade, its ability to access market financing, economic soundness and quality and availability of data. Where possible, cross-regional inclusion is also taken into account to ensure diversity within each benchmark group.

  o *Economic membership.* Membership(s) of major trade and/or financial stability groups or organizations underscore a country's importance in the international monetary system, and hence its relevance as a benchmark constituent.

  o *Market access.* Sovereigns or financial institutions—typically AEs and EMEs— should be able to raise financing in capital markets rather than rely on official loans. Hence, they should be constituents of investible market indices. Countries that have, or seek access to, capital markets are also typically incentivized to improve their transparency so that investors have sufficient information to access their economic situation (this would in turn contribute to the Data Adequacy requirement of the qualification criteria).[10]

  o *Economic and financial soundness.* Benchmark constituents should possess solid fundamentals in order to set high comparator standards. Very weak economies, defined as those that are in crisis programs or whose balance of payments are under stress, are automatically be excluded as Benchmark constituents. In addition to dropping these economies, the historical data of countries during their respective crisis program periods are excluded.[11] This omission ensures that the data used for benchmarking always reflect periods with strong fundamentals.

  o *Data adequacy.* The adequacy of requisite data is crucial to construction of the Scorecard. Considerations in the Benchmark constituent selection process include the prioritization of:

    ➤ countries that subscribe to the IMF's SDDS or the SDDS-Plus, while omitting those with a known history of unreliable or inaccurate data; LIDC countries, which have less developed statistical systems, typically subscribe to the enhanced General Data Dissemination Standards (eGDDS);[12]

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[10] See IMF (2013).

[11] Countries that are in crisis programs (e.g., the IMF's Stand-by Agreement, the European Stability Mechanism program) or are facing balance of payments problems (e.g., those drawing from the IMF's Extended Fund Facility, Rapid Financing Instrument and concessional facilities) are excluded (see http://www.imf.org/external/np/fin/tad/extarr1.aspx and https://www.esm.europa.eu/financial-assistance for program dates).

[12] In 2012, the IMF created the SDDS Plus as an upper tier of the IMF's Data Standards Initiatives to help address data gaps identified during the global financial crisis. The IMF established the GDDS in 1997 for member countries with less developed statistical systems as a framework for evaluating their needs for data improvement and setting priorities; the enhanced GDDS (eGDDS) replaced the GDDS in 2015 (IMF, 2017d).

> ➤ countries that report data at higher frequency, preferably at monthly and quarterly frequencies, in order to capture changes in economic and financial conditions in a more timely manner.

Reclassifications of Members or changes to benchmark groups are likely to occur over time. Countries could be affected by events such as changes to: their development status; their regulatory environment, impacting market access; or their economic situation, requiring financial support, and amendments will have to be made accordingly (Figure 5).

Table 1. ERPD Matrix Scorecard: ASEAN+3 Member Assignments to Benchmark Groups

Benchmark / Constituent	Group			
	AEs	IFCs	EMEs	LIDCs
ASEAN+3 Member	Japan Korea	Hong Kong, China Singapore	Brunei China Indonesia Malaysia Philippines Thailand	Cambodia Lao PDR Myanmar Vietnam

Sources: IMF; and AMRO.

B. Data Sources

Preference is always given to datasets that have undergone some degree of "cleaning" and standardization. Hence, internationally recognized data sources are drawn on as much as possible, notably, those of the IMF (e.g., Balance of Payments; Direction of Trade Statistics; Financial Soundness Indicators; International Financial Statistics), The World Bank (e.g., Quarterly External Debt Statistics; Quarterly Public Sector Debt; World Development Indicators; and the Bank for International Settlements (BIS) (e.g., credit).

Many countries in the Scorecard universe produce most of the requisite data for calculating the indicators, although quality and frequency differ. The AEs (and most IFCs) typically publish the most comprehensive and complete sets of data, while the LIDCs tend to have the biggest data gaps in terms of coverage and frequency, in addition to quality (Figure 6). Hence, rather than restrict the data only to those that are commonly available to all, which would reduce the set to a very small number, the pragmatic alternative is to ensure that:

●   the Benchmarks are of sufficient breadth and depth so that each indicator is adequately representative when combined across countries;

●   each Member has sufficient data coverage for a credible determination of its economic and financial soundness relative to its Benchmark.

The number of Indicators is anticipated to change over time. As countries compile and publish additional data series to improve transparency and enhance the monitoring of macro-financial developments, or additional indices on economic or financial performance that are sufficiently robust are developed by AMRO staff or other sources, the information could be incorporated into the Scorecard. As a starting point, the Scorecard uses a set of indicators similar to the ones listed in IMF (2018).

Figure 5. ERPD Matrix Scorecard: Framework for "Cleaning" Historical Data

1. BENCHMARK COUNTRIES: CRISIS PROGRAMS

Portugal

May 2011   Troika program   May 2014

Ireland

Nov 2010   Troika program   Dec 2013

Spain

Dec 2012   Dec 2013
Troika program
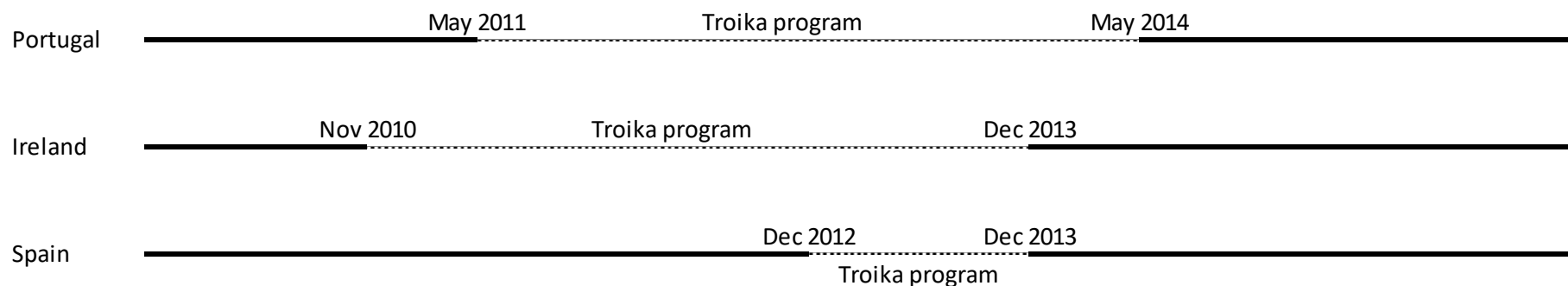
2. BENCHMARK COUNTRIES: RE-CATEGORIZATION

Pakistan

IMF program   Aug 2016   EME (graduates to MSCI Emerging Markets Index)
EME (MSCI Frontier Markets Index)
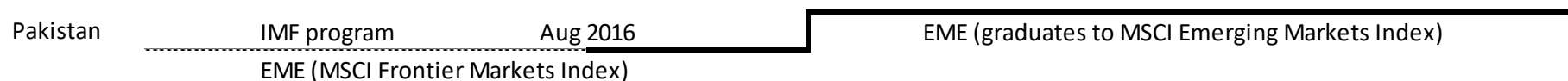
3. MEMBER COUNTRIES: RE-CATEGORIZATION (HYPOTHETICAL)

Country "X"

Graduates to EME (benchmarked to EME group)
LIDC (benchmarked to LIDC group)

Legend:

--------------------------Exclude data

————————————Include data

Source: Authors.

Figure 6. ERPD Matrix Scorecard: Typical Data Coverage and Quality

AEs IFCs	• Subscription to SDDS or SDDS-Plus • Higher frequency data for some indicators
EMEs	• Subscription to SDDS • Less comprehensive debt and external sector data for some countries
LIDCs	• Subscription to eGDDS • Less coverage • Lower frequency • Little to no market data
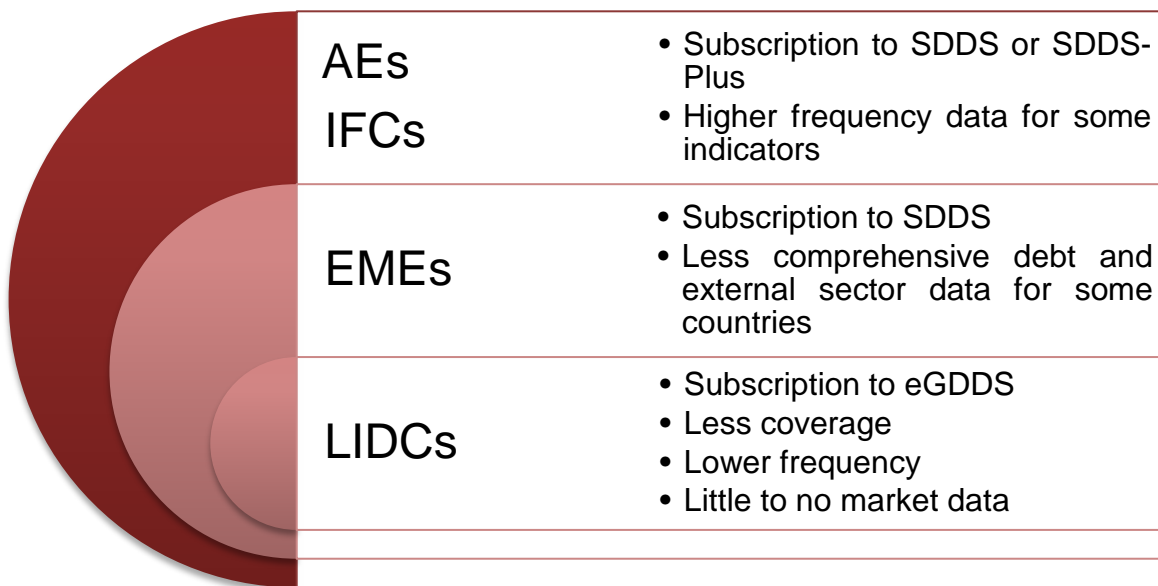
Source: Authors.

III. Methodology

A. Benchmarking and Standardization

A methodology for benchmarking and standardizing the Scorecard indicators that is both easy to implement and monitor, and which is intuitively appealing, is introduced. The selection of methodology takes into account several important considerations:

- *Data availability.* The method should be useable even for Members that have insufficient data for sophisticated econometric modelling.

- *Equity.* The same method should be applied to all Members.

- *Transparency and simplicity.* The method and results should be easy to understand and not be a "black box."

- *Versatility.* The method should allow aggregation and comparison across the wide variety of indicators over time and at a particular point in time.

- *Flexibility.* The method should enable threshold scores to be adjusted in accordance with Members' determination of what may be appropriate under different environments or situations.

The statistical **z-score** methodology constructs standardized indices for each **Indicator** to facilitate assessments of Members' performance relative to their respective Benchmarks. It is similar to that used by Dattels and others (2010) and Cervantes and others (2014) for scoring financial stability, and by Ong, Jeasakul, and Kwok (2013) for analyzing the relative health of banks. The methodology assumes that the population observations underlying each Indicator sample is normally distributed (Figure 7).

Figure 7. ERPD Matrix Scorecard: Mapping the z-scores of an Indicator to the Normal Distribution
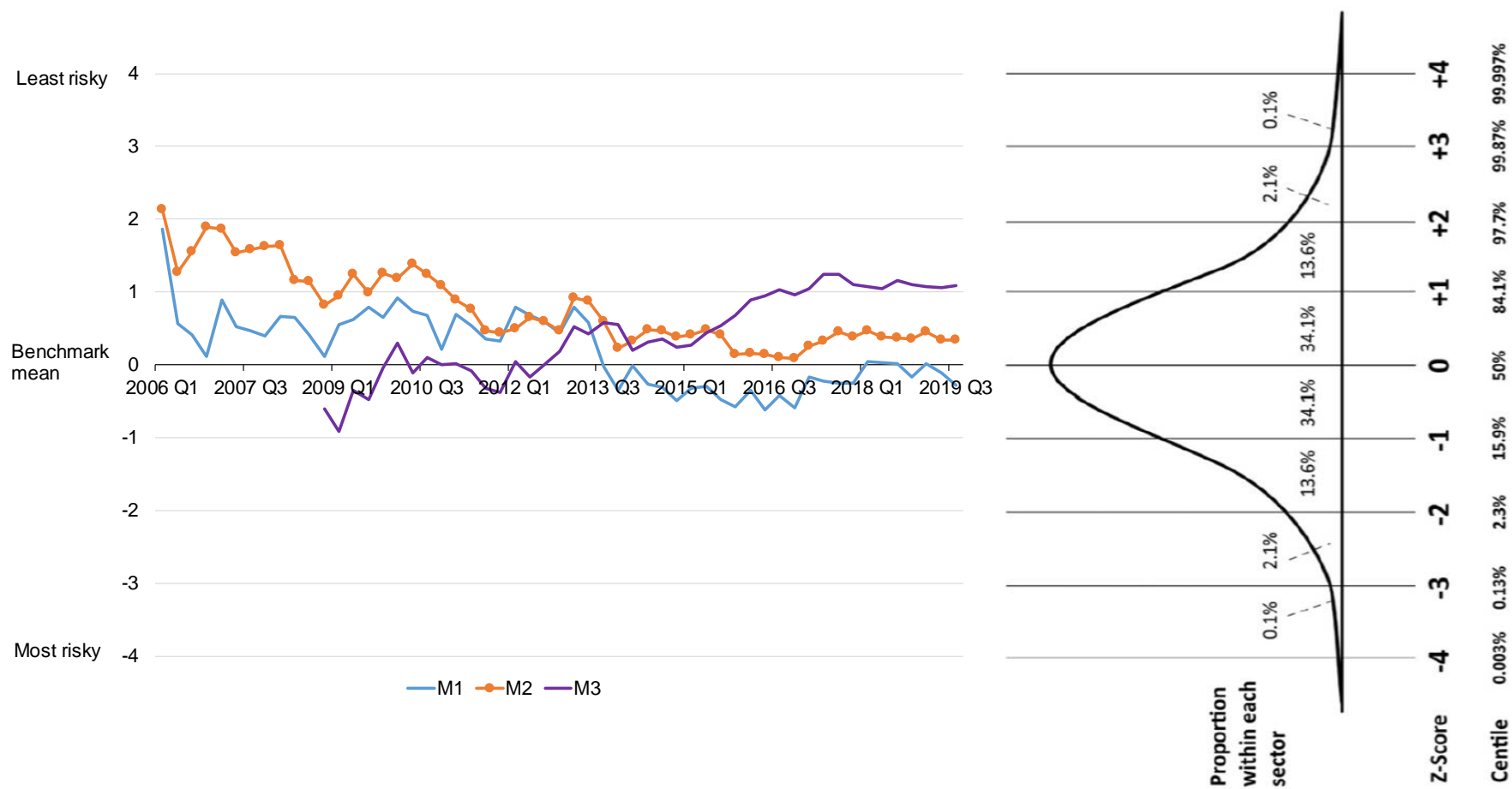
Sources: IMF Financial Soundness Indicators; and authors' estimates.

Indicators may be either "one-way," "one-way, inverted" or "two-way," depending on the nature of the indicator. The corresponding indicator z-scores would thus be interpreted as follows (Figure 8):

- "one-way" (the more negative the z-score away from the Benchmark, the greater the risk);

- "one-way, inverted" (the more positive the z-score away from the Benchmark, the greater the risk); or

- "two-way" (the more positive or negative the z-score away from the Benchmark, the greater the risk).[13]

Figure 8. ERPD Matrix Scorecard: The Normal Distribution and Interpretation of z-scores

One-way Indicator

The more negative the z-score, the greater the risk

z-score

One-way Inverted Indicator

The more positive the z-score, the greater the risk

z-score

Two-way Indicator

The further the z-score from zero, the greater the risk
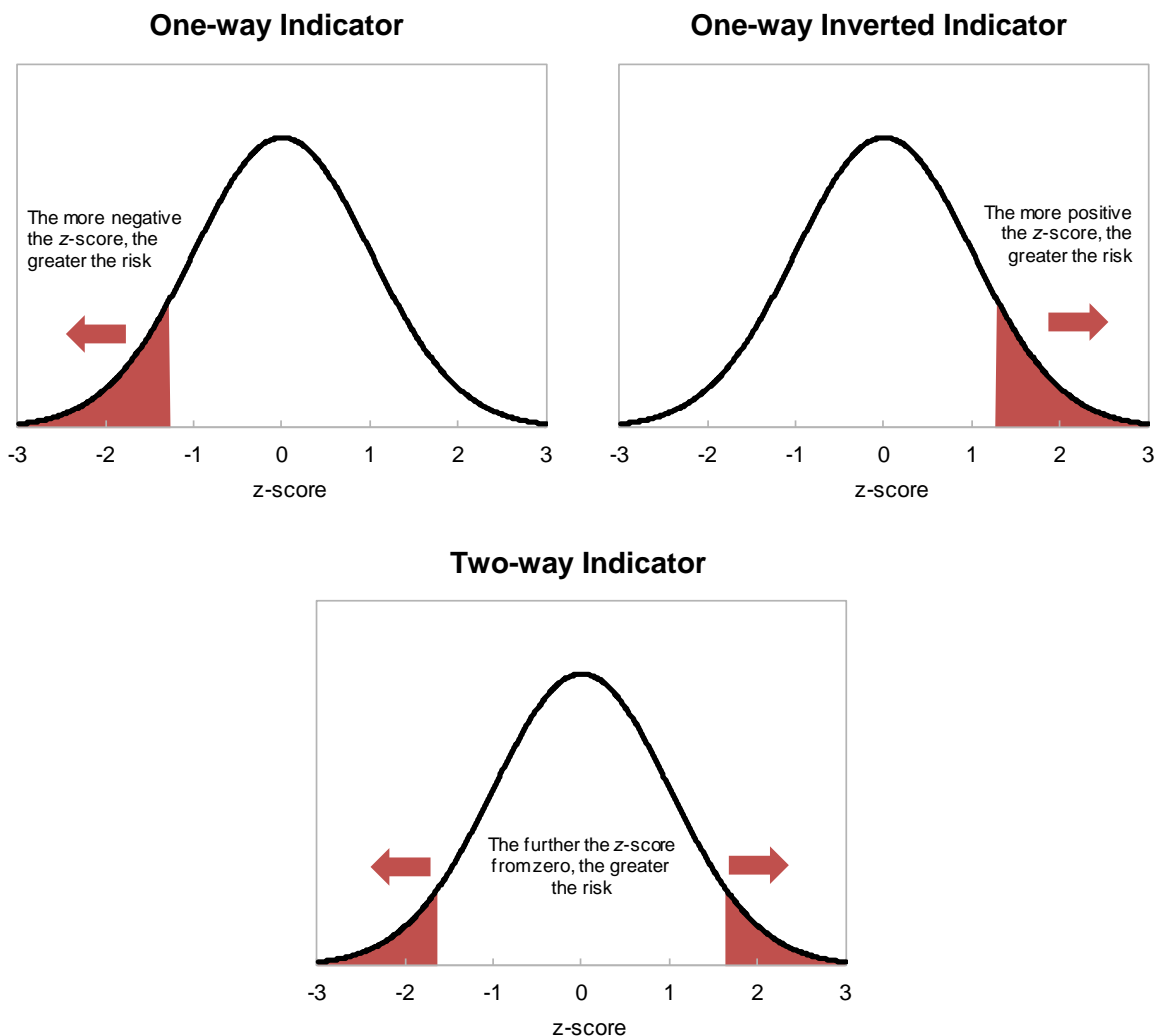
z-score

Source: Authors.

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[13] For monetary policy indicators, the Benchmark is the "ideal" and z-scores are either zero or negative only.

Some typical examples of the above are as follows:

- The fiscal-balance-to-GDP ratio is a one-way indicator—the more positive the indicator vis-à-vis the Benchmark mean, the smaller the risk to financial stability or, put another way, the more negative the indicator relative to Benchmark, the greater the risk.

- In contrast, external debt-to-GDP is a one-way inverted indicator—the more positive vis-à-vis the Benchmark average, the greater the risk to financial stability.

- Inflation is a two-way indicator—the greater the change in prices from the actual or de facto inflation target (or Benchmark mean, where neither are available) in either direction, reflecting either greater inflationary or disinflationary/deflationary pressures, the less desirable.

The scoring is implemented in several steps:

(i)   First, the framework is defined as follows:

- Each **Indicator,** S_p^l, is calculated by combining one or more variables, V_r^p, where $S_p^l = f\left(V_1^p, V_2^p, \dots, V_r^p\right)$.

- Each **Element**, E_l^k, is represented by one or more indicators, S_p^l, where $E_l^k = f\left(S_1^l, S_2^l, \dots, S_p^l\right)$.

- Each **Criterion**, C_k^j, is represented by one or more elements, E_l^k, where $C_k^j = f\left(E_1^k, E_2^k, \dots, E_l^k\right)$.

- Each **Area**, A_j^i, is represented by one or more criteria, C_k^j, where $A_j^i = f\left(C_1^j, C_2^j, \dots, C_k^j\right)$.

(ii)   Next, the ***z-scores*** for the **Indicators** are estimated:

- The **running** Benchmark mean and standard deviation for each indicator are calculated. Hence, the date of commencement of a particular data series is important for comparisons across countries and should be the same for as many countries as possible to ensure consistency in capturing information related to historical developments. A start date of January 1995 is selected, given that publication of the majority of variables used in the Scorecard commenced between 1995 and 2000 (with some commencing in the 1980s or before).

- The *z*-score for each **Indicator** for each Member, $z_{S_p^l}$, is calculated, such that:

$$z_{S_{p,t}^l} = \frac{S_{p,t}^l - \mu_{S_{p,t-k,t}^l}}{\sigma_{S_{p,t-k,t}^l}} \, ,$$

where,

$\mu_{S_{p,t-k,t}^l}$ is the running sample mean of the Benchmark for indicator S_p^l from time *t-k* to time *t*; and

$\sigma_{S_{p,t-k,t}^l}$ is the running sample standard deviation of the Benchmark for indicator S_p^l from time *t-k* to time *t*.[14]

All the signs are standardized for consistency and to reduce confusion. The z-scores of all "one-way inverted" variables are multiplied by "-1" while all "one-way" signs are maintained so that all positive numbers reflect lower risk to financial stability. The corresponding percentiles are mapped to $Pi\left(z_{S_{p,t}^l}\right)$.

- The percentile for each **Element** is subsequently calculated by averaging the percentiles of the corresponding **Indicators** (Figure 3), such that:

$$Pi\left(E_{l,t}^k\right) = \sum_{n=1}^{p} \frac{Pi\left(z_{S_{p,t}^l}\right)}{p} \,.$$

- Next, the percentile for each **Criterion** is obtained by averaging the percentiles of the corresponding elements, such that:

$$Pi\left(C_{k,t}^j\right) = \sum_{n=1}^{l} \frac{Pi(E_{l,t}^k)}{l} \,.$$

- Finally, the percentile for each **Area** is derived from averaging the percentiles of the corresponding criteria, such that:[15]

$$Pi\left(A_{j,t}^i\right) = \sum_{n=1}^{k} \frac{Pi\left(C_{k,t}^j\right)}{k} \,.$$

The latest uniformly available averaged **Area**, **Criterion** and **Element** percentiles would be calculated as of the time period in which all **Indicators**, actual or extrapolated, are available. In the example presented in Figure 9, the cut-off period would be February 2019 although the individual indicators may provide more timely information for trend analysis.

For cross-sectional "spidergrams," the z-scores are mapped to a numerical ranking. For consistency in the conversion, we map the lowest risk situation to the highest numerical ranking of 10 and the highest risk to the lowest numerical ranking of zero. The rankings are mapped differently depending on whether the variables are "one-way" (including the converted "one-way inverted") or "two-way" (Table 2).

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[14] For inflation-targeting countries, the mid-point of the target band is used as the mean instead of the Benchmark group average, scaled by the standard deviation of the Benchmark group.

[15] In the fiscal, monetary and financial soundness areas, the z-scores would be the same as those for the corresponding criteria.

Figure 9. ERPD Matrix Scorecard: Framework for Data Transformation and Standardization

Source: Authors.

Table 2. ERPD Matrix Scorecard: Assignment of Numerical Rankings to a Spidergram Mapped to a Normal Distribution

Ranking	Percentile		Risk Assessment
	One-Way 1/	Two-Way	
0	0	0 and 100th	Highest
1	10th	5th and 95th	:
2	20th	10th and 90th	:
3	30th	15th and 85th	:
4	40th	20th and 80th	:
5	50th	25th and 75th	Norm/historical average or trend
6	60th	30th and 70th	:
7	70th	35th and 65th	:
8	80th	40th and 60th	:
9	90th	45th and 55th	:
10	100th	50th	Lowest

Source: Authors.
1/ Applies to both one-way and one-way inverted indicators, given that the latter are already multiplied by "-1" to ensure consistency in all "one way" signs.

B. Data Transformation

The ERPD Matrix Scorecard could be used for several purposes in addition to assessing qualification for the CMIM-PL. The tool could also potentially be applied as an early-warning distress device; for estimating the impact of stresses to economic variables in scenario analyses; and for estimating conditionality requirements. Hence, timeliness of new "marginal" information is crucial. Consequently, the following rules are adhered to in constructing the requisite indicators (Figure 7):

- As much as possible, monthly frequencies are used. However, if higher frequency data are not available for a particular variable, the latest available quarterly or annual values are used.

- Lower frequency data are interpolated to obtain monthly equivalents. Stock variables are interpolated proportionally between frequencies; flow variables are apportioned equally within one frequency.

- In calculating a particular indicator, the lower frequency variable is extrapolated in order to incorporate any subsequent information from other higher frequency variable(s). No change is assumed in the lower frequency variable, up to the period before the next release; in the meantime, more recent information from higher frequency variables are added as they become available.

- Where two or more indicators are required to estimate a particular Element, the indicator(s) that are more dated are extrapolated. They are assumed to remain stable in subsequent months while new information from more timely indicators are incorporated.

C. Caveats

Clearly, the proposed methodology is not without its weaknesses. In order to maintain simplicity, uniformity and consistency:

- Linearity is assumed in the relationship between the selected indicators and macro-financial performance, although the literature suggests that some of these relationships might be non-linear and that risks could change significantly beyond certain thresholds (Drehmann, Borio, and Tsatsaronis 2011; Dell'Ariccia and others 2012; and Arregui and others 2013).

- The underlying populations from which the sample data are drawn are assumed to approximate a standard normal distribution, even though this may not be the case for all economic variables. While other methods, such as truncated normal distribution adjustments or using non-parametric ranks, are possible alternatives, they too have their limitations.

- The Indicator percentiles are equally weighted in estimating the percentile of a particular Element, and then again for the Criterion above it and again for the Area above it, although some factors might be more important than others for a particular country. While the application of principal component analysis could help determine relative weightings, the sheer number of indicators and countries—and the evolving relationship among variables over time—render the method unwieldy.

- The same set of indicators are applied across all countries, as much as possible, even though the use of more bespoke variables could improve the detection of particular risks for each country.

With these caveats in mind, it should be emphasized that the Scorecard results are not fail-safe. They should be used as one of the (purely quantitative) inputs and be analyzed in conjunction with the other components of the ERPD Matrix, that is, complemented by the application of other tools and analytics, as well as qualitative expert judgment.

IV. Example Outputs

The Scorecard outputs may be presented in several ways. Notably, they may be viewed through a time series perspective or cross-sectionally at particular points in time, or both. The results could focus on several aspects or a particular economy or on a particular aspect across several economies. In the following examples, actual (anonymized) data for Members (M_i) are presented to show the various types of outputs that may be generated for analysis:

- **Example 1:** Time series trends of Indicators, Elements, Criteria or Areas for a Member relative to the Benchmark, which show the evolution of **relative** performance over time. Figure 10(a) shows the percentiles of selected external sector Indicators, S_p, for a Member, which are compared against the respective indicator Benchmarks. Each qualification Area percentile in Figure 10(b) is then obtained by averaging up from the corresponding Indicator percentiles under that Area, A_j, through its Element percentiles, then through its Criterion percentiles, to finally arrive at the Area percentile.

- • **Example 2:** Time series of benchmark group means and standard deviations of Indicators, which show how the average performance of these groups over time. Figure 11(a) presents the Benchmark means of the various Indicators, S_p, while Figure 11(b) shows the Benchmark standard deviations of those same Indicators. The score (and corresponding percentile) of a Member relative to its Benchmark would obviously depend on not only its own performance at a particular point in time but also that of the Benchmark over time.

- • **Example 3:** Time series cross-section of all indicators for a Member, in the form of a heatmap, which provides a comprehensive overview of economic developments at a particular point in time and over time, relative to the Benchmark. Figure 12 shows the performance of a Member across the various economic sectors relative to that of their corresponding Benchmark. However, as noted in Example 2 above, the results do not give any information as to whether the Member's own performance has improved or deteriorated over time.

- • **Example 4:** Time series trends of a particular Indicator, Element, Criterion or Area across selected Member countries relative to their respective Benchmarks over time. Figure 13(a) shows the performance of a specific Indicator, S_1, across countries from different groups in relation to those of their respective peers, juxtaposed against one other. Figure 13(b) does the same for a specific qualification Area, A_1.

- • **Example 5:** Cross-section of selected Indicators, Elements, Criteria or Areas for a Member, which highlights how several aspects of its economy have evolved between two particular points in time. Figure 14 shows the changes in ranks between 2005 and 2018, across all qualification criteria, C_k, for a selected Member. During this period the financial soundness and market access Criteria of the Member improved significantly, while its public finances and reserve position deteriorated markedly.

- • **Example 6:** Cross-section of a selected Indicator, Element, Criterion or Area across Members, which shows how a particular aspect of the economy has changed over two points in time for each Member. Figure 15 shows the change in ranks between 2005 and 2018, for qualification Area, A_2, for a group of EMEs (including Members) relative to the Core Emerging Market Benchmark. Performance has clearly varied, with some countries having improved in this Area while others weakened.

Comparisons against several key groups, of which a Member is a constituent, could also provide a more complete view of its performance. Additional benchmark groups, beyond the Core ones, would include various combinations of constituents by income, region, economic membership, the entire benchmark universe and even a Member's own historical performance (Table 3):

- • **Example 7:** *The Member is compared against several benchmark groups of which it is a constituent.* Figure 16 shows the performance over time of Indicator S_1 and qualification Area A_1 of a Member, relative to its Core, ASEAN+3 and World benchmark groups, plus its own history. It has performed best relative to its past, followed by the World, and has been weakest compared to the aggregate region, albeit still comparable to, or better than, 50 percent of its peers in recent years. Importantly, it has shown the most marked improvement relative to its own historical performance since the end of the Global Financial Crisis.

Figure 10. ERPD Matrix Scorecard Example: Time Series of Selected Indicators and All Quantifiable Qualification Areas for a Member Relative to Its Benchmark
(Percentile)

(a) Selected Indicators, S_p

— Member M1 – Indicator: Current Account Balance to GDP   — Member M1 – Indicator: Gross Short-Term External Debt to GDP
— Member M1 – Indicator: Government Bond Yield (in local currency)   — Member M1 – Indicator: Reserves to Imports

(b) All Quantifiable Qualification Areas, A_j 1/

— Member M1 – Area: External position and market access   — Member M1 – Area: Fiscal Position
— Member M1 – Area: Monetary Policy   — Member M1 – Area: Financial sector soundness

1/ For monetary policy indicators, the benchmark average is defined as the "ideal" and z-scores may be either zero or negative only. Hence, the closer to zero, the less risky.

Sources: BIS; IMF; national authorities; The World Bank; and authors' estimates via ARTEMIS.

Figure 11. ERPD Matrix Scorecard Example: Time Series of Selected Indicator Means and Standard Deviations for a Specific Benchmark
(Percent)
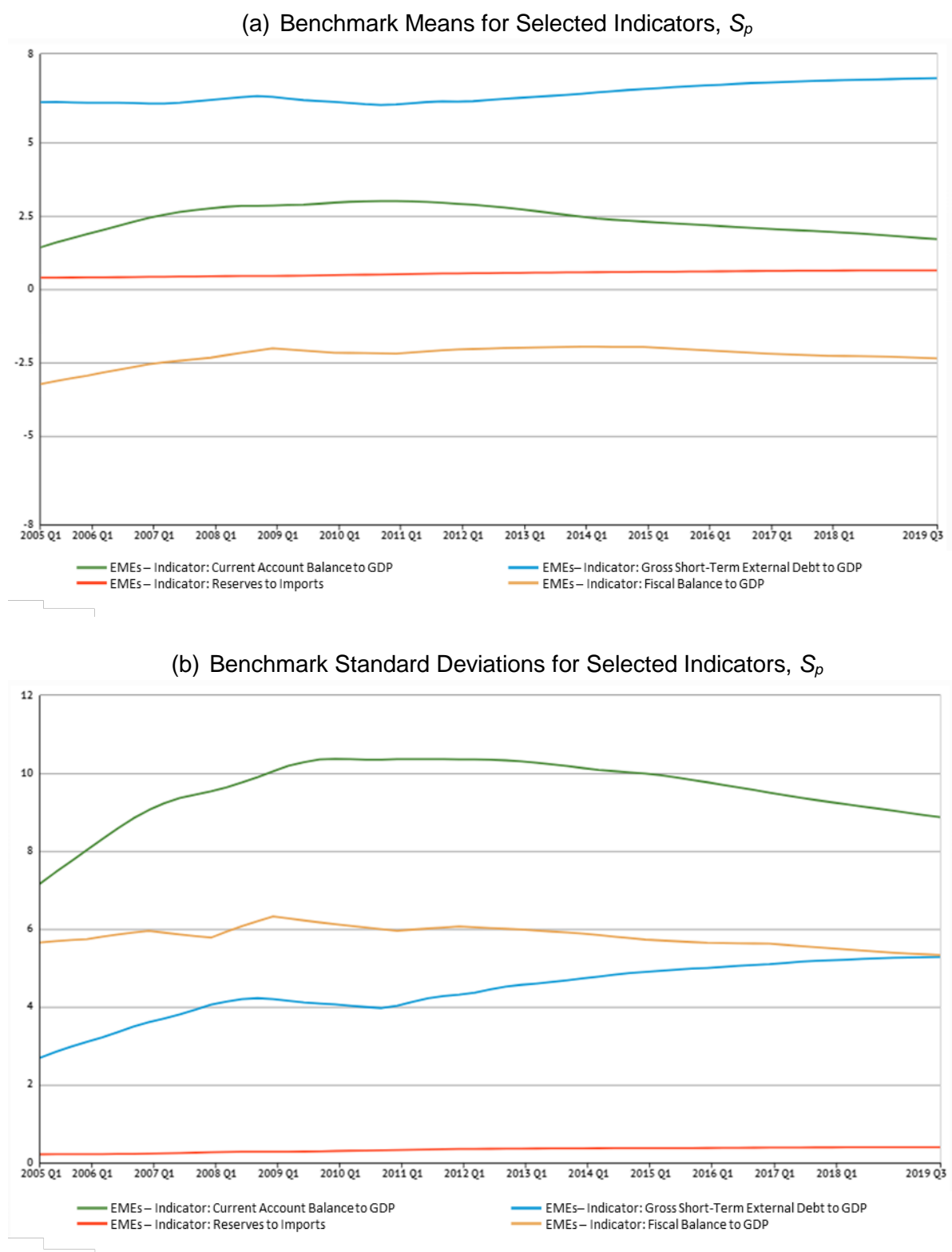
(a) Benchmark Means for Selected Indicators, S_p

(b) Benchmark Standard Deviations for Selected Indicators, S_p

Sources: BIS; IMF; national authorities; The World Bank; and authors' estimates via ARTEMIS.

Figure 12. ERPD Matrix Scorecard Example: Time Series Cross-Section Heatmap of All Indicators for a Member Relative to Its Benchmark

(z-score)

Legend: Monetary Policy* Benchmark / Least risky -0.6745 50th percentile 0 Riskiest

Legend: All other Areas Least risky 0 Benchmark Riskiest

Sources: BIS; IMF; national authorities; The World Bank; and authors' estimates.

Note: For monetary policy indicators, the Benchmark is the "ideal" and z-scores may be either zero or negative only. Hence, the closer to zero, the less risky.

Figure 13. ERPD Matrix Scorecard Example: Time Series of a Specific Indicator and Qualification Area for Selected Members Relative to Their Respective Benchmarks
(Percentile)
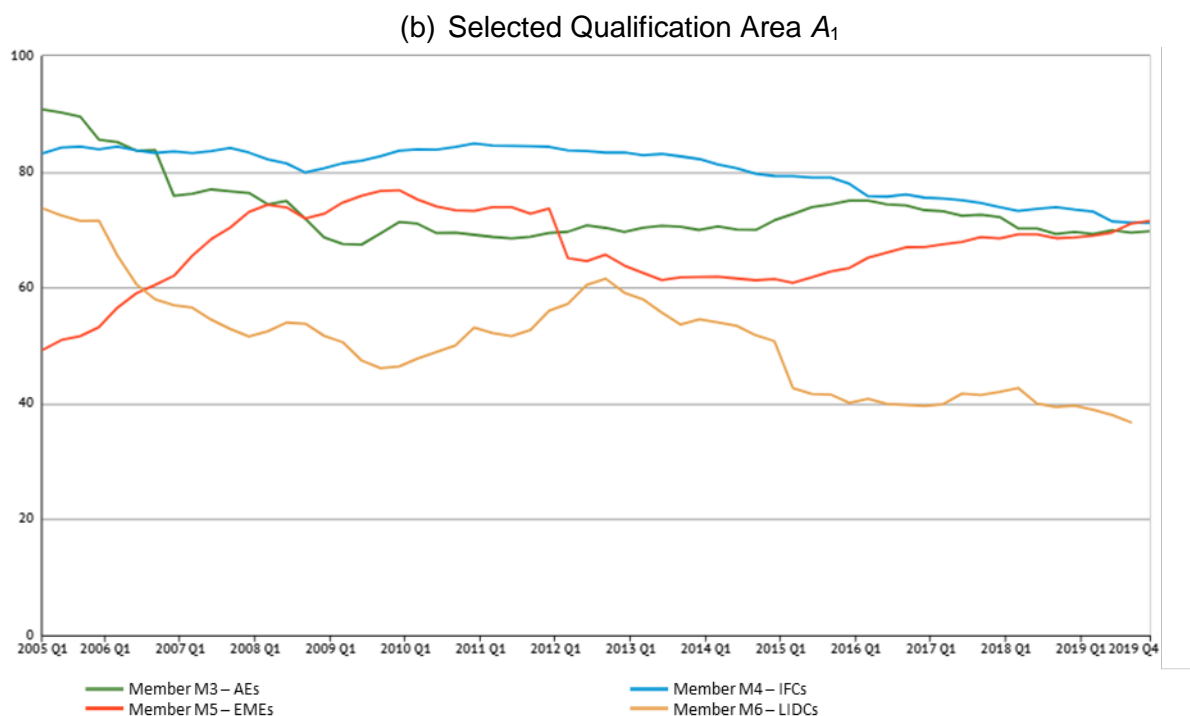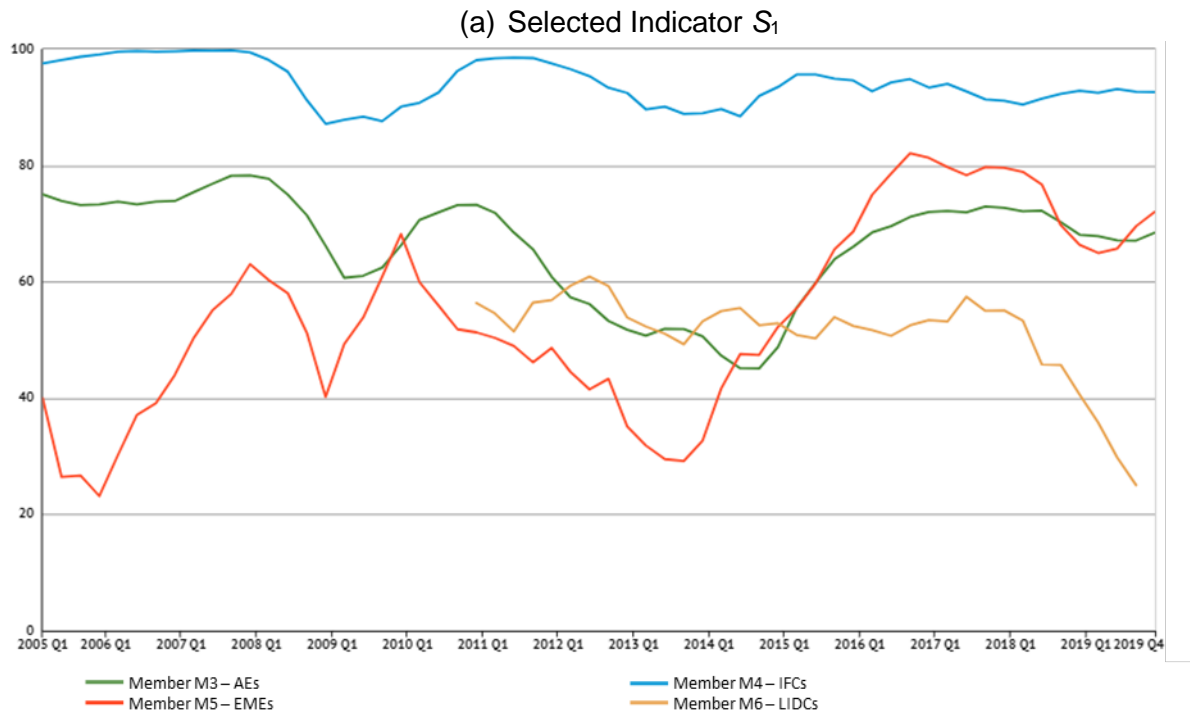
(a) Selected Indicator S_1

Member M3 – AEs
Member M5 – EMEs
Member M4 – IFCs
Member M6 – LIDCs

(b) Selected Qualification Area A_1

Member M3 – AEs
Member M5 – EMEs
Member M4 – IFCs
Member M6 – LIDCs

Sources: BIS; IMF; national authorities; The World Bank; and authors' estimates via ARTEMIS.

Figure 14. ERPD Matrix Scorecard Example: Cross-Section of All Quantifiable Qualification Criteria for a Member Relative to Its Benchmark
(Rank)

(a) All Quantifiable Qualification Criteria C_k
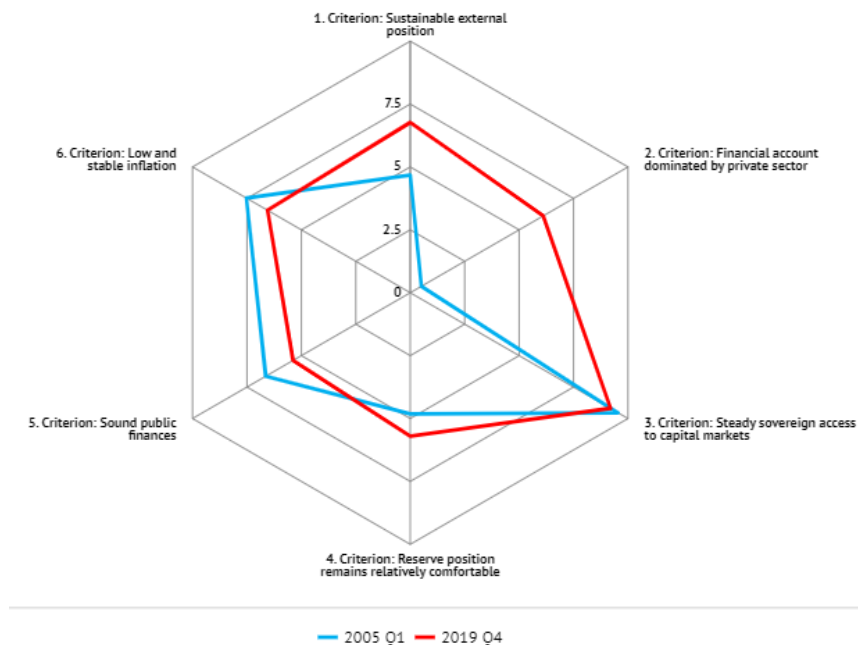
Sources: BIS; IMF; national authorities; The World Bank; and authors' estimates via ARTEMIS.
Note: The further away from zero, the less risky.

Figure 15. ERPD Matrix Scorecard Example: Cross-Section of a Specific Qualification Area for Selected Members Relative to a Common Benchmark
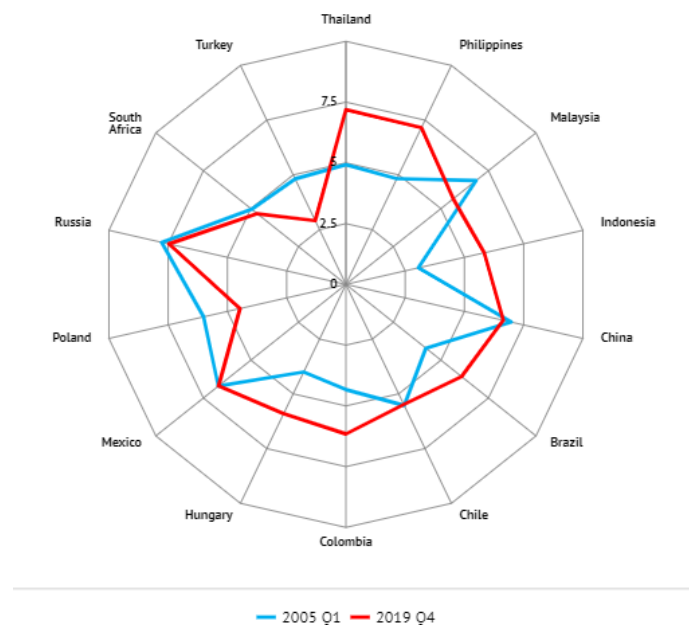(Rank)

(b) Selected Qualification Area A_2

Sources: ARTEMIS; BIS; IMF; national authorities; The World Bank; and authors' estimates via ARTEMIS.
Note: The further away from zero, the less risky.

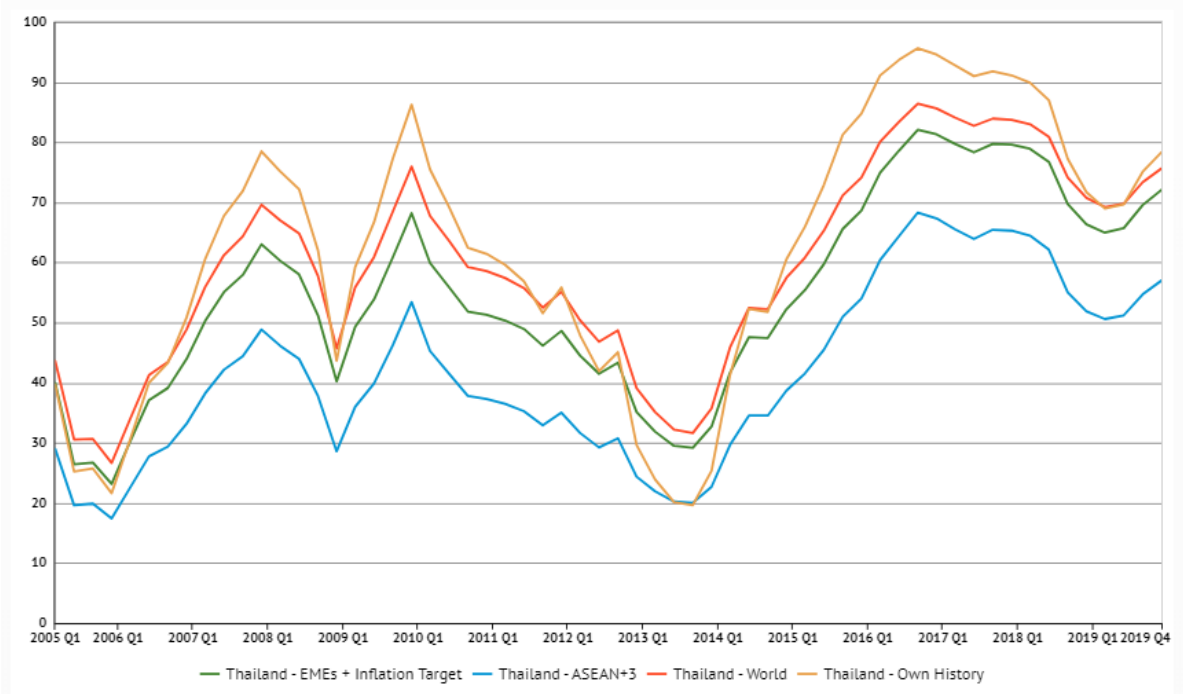# Table 3. ASEAN+3: Constituency of Core and Other Possible Benchmark Groups

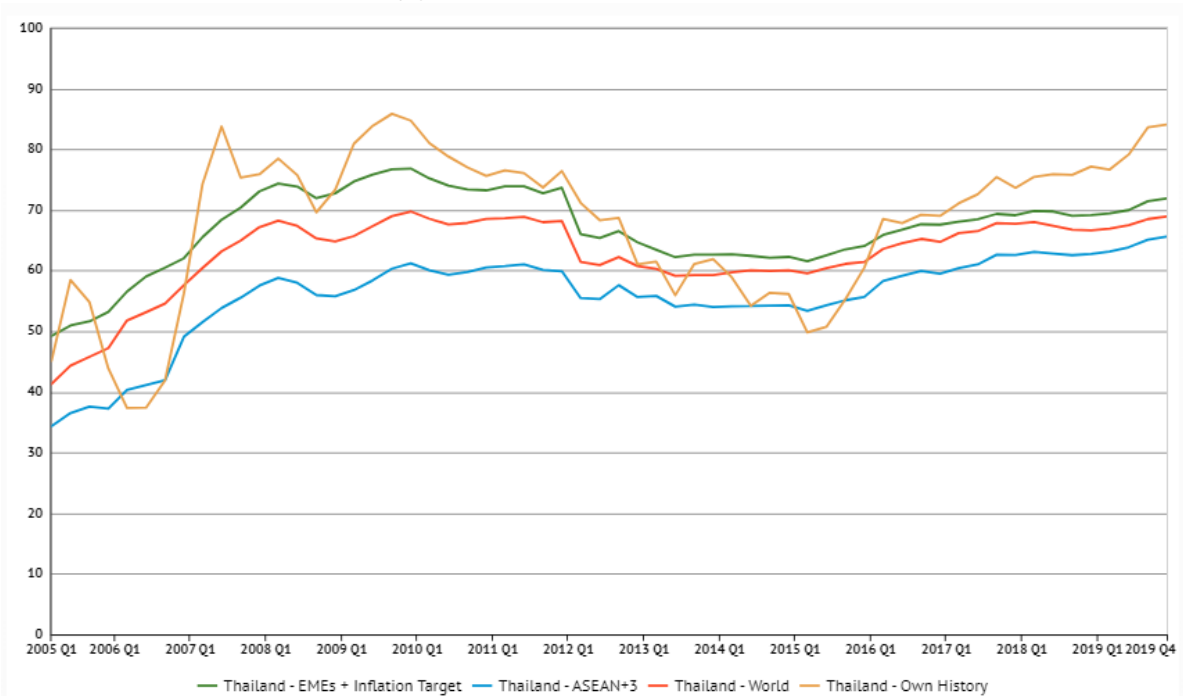| Category	Benchmark Group / Member	AE		IFC		EME						LIDC			
		JP	KR	HK	SG	BN	CN	ID	MY	PH	TH	KH	LA	MM	VN
Core*	Advanced Economies (AEs)	☑	☑												
	International Financial Centers (IFCs)			☑	☑										
	Emerging Market Economies (EMEs)					☑	☑	☑	☑	☑	☑				
	Low Income Developing Countries (LIDCs)											☑	☑	☑	☑
Alternate	AEs + Singapore + Hong Kong	☑	☑	☑	☑										
	IFCs ex-UK and -US			☑	☑										
	EMEs + CLMV					☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	EMEs + Korea		☑			☑	☑	☑	☑	☑	☑				
	EMEs + Vietnam					☑	☑	☑	☑	☑	☑				☑
	EMEs + IMF PLL Countries					☑	☑	☑	☑	☑	☑				
	Lower Middle Income Countries (LMICs)							☑		☑		☑	☑	☑	☑
Region	Asia-Pacific	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Economic Membership	ASEAN				☑	☑		☑	☑	☑	☑	☑	☑	☑	☑
	ASEAN+3	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	BRICS						☑								
	G-7	☑													
	G-20	☑	☑				☑	☑							
Other	World	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	Own History	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

Source: Authors.
* The "core" benchmark means and standard deviations are calculated from the constituent indicators except for inflation, where the inflation targets of the respective countries are used instead of the benchmark means.

Figure 16. ERPD Matrix Scorecard Example: Time Series of a Specific Indicator and Qualification Area for a Member Relative to the Core and Other Benchmark Groups
(Percentile)

(a) Selected Indicator S_2

Thailand - EMEs + Inflation Target   Thailand - ASEAN+3   Thailand - World   Thailand - Own History

(b) Selected Qualification Area A_3

Thailand - EMEs + Inflation Target   Thailand - ASEAN+3   Thailand - World   Thailand - Own History

Sources: BIS; IMF; national authorities; The World Bank; and authors' estimates via ARTEMIS.

V. Conclusion

The ERPD Matrix is AMRO's surveillance framework, which consists of both quantitative and qualitative tools. It operationalizes the ERPD objectives by providing the means for analyzing whether a Member has sound macro-financial fundamentals and policies and would thus qualify for access to short-term financial support from the CMIM during periods of external volatility beyond its control. The Scorecard is a key component of the ERPD Matrix—a purely quantitative tool that assigns scores to a Member's macro-financial performance relative to its designated peer group of countries.

The ERPD Matrix Scorecard aims to balance methodological simplicity and ease of interpretation with versatility of information and credibility of results. It offers the advantages of objectivity where the data are allowed to speak; the simplicity of design and interpretation of output; as well as the versatility of being able to analyze the information from several dimensions (time-series, cross-section and cross-country). Conversely, the Scorecard is not fail-safe, given its reliance solely on statistics. Data adequacy may be a concern in some instances, or specific country circumstances may not be obvious from the data alone. Moreover, the certain assumptions are made on the underlying population distribution in order to implement the z-score methodology. Indeed, it could arguably be seen as oversimplifying the assessment of financial stability.

Ultimately, the Scorecard enables a useful **initial** assessment of the overall economy of a Member. It needs to be complemented by other analytical tools, as well as qualitative analysis relying on expert judgment, for both surveillance and CMIM qualification purposes. Moreover, the Scorecard Indicators and benchmark countries and groups should be reviewed on a regular basis and amended or augmented as necessary, to ensure the timeliness of results and relevance of implementation.

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